Taxonomic Revision of the Genus *Hedychium* J. Koenig (Zingiberaceae) in India

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CONTENTS

Chapter -	**1.**	**Introduction**	Page No. 1
		Significance and Objectives of the work	5
	2.	**Area of Present Study**	7
	3.	**Materials and Methods**	16
		Presentation of Data	18
	4.	**Review of Literature - A Discussion**	20
	5.	**Genus - *Hedychium***	37
	6.	**Classification**	50
		Generic History - *Hedychium*	60
		Infrageneric Classification - *Hedychium*	62
	7.	**Systematic Treatment**	66
		Hedychium	66
		Key to the species	70
		H. aureum	75
		H. cernuum	78
		H. coccineum	81
		H. coccineum var. *angustifolium*	89
		H. coccineum var. *carneum*	94
		H. coronarium	98
		H. coronarium var. *chrysoleucum*	106
		H. coronarium var. No. 1	109
		H. deceptum	112
		H. densiflorum	116
		H. elatum	119
		H. ellipticum	123
		H. ellipticum var. *radiatum*	129
		H. flavum	132
		H. flavum var. *flavescens*	137
		H. forrestii	143
		H. forrestii var. *palaniense*	147
		H. forrestii var. No. 1	150
		H. gomezianum	152

H. gracile 154
H. gracile var. *calcaratum* 160
H. gracile var. No. 1 163
H. gratum 165
H. greenii 169
H. griffithianum 172
H. hookeri 176
H. larsenii 178
H. longipedunculatum 181
H. marginatum 183
H. maximum 188
H. robustum 191
H. speciosum 194
H. speciosum var. *gardnerianum* 198
H. spicatum 204
H. stenopetalum 215
H. thyrsiforme 220
H. urophyllum 225
H. urophyllum var. *elwesii* 228
H. villosum 231
H. villosum var. *tenuiflorum* 234
H. wardii 241
Hedychium sp. No. 1 244
Hedychium sp. No. 2 247
Hedychium sp. No. 3 249
8. Comparative Morphology 253
9. Summary 263
Enumeration - Indian *Hedychium* 266
10. References 273
11. Index to Scientific Names 296
12. Appendix 302

INTRODUCTION

The order Zingiberales includes many conspicuous taxa, like 'bananas' (Musaceae), 'bird of paradise' (Strelitziaceae), 'heliconias' (Heliconiaceae), 'gingers' (Zingiberaceae) *etc.* The flowers of the order have strongly modified androecia, and they evolved as 6→5→1→1/2. Based on the number of fertile stamen they can be broadly grouped in to 'banana families' and 'ginger families'. The former group consists of families like Musaceae, Strelitziaceae, Lowiaceae and Heliconiaceae, with large banana like leaves and five or six anthers. Later group consists of Cannaceae, Costaceae, Marantaceae and Zingiberaceae, with one or half anther. The remaining stamens are modified into elaborate staminodia that play an important role in their floral biology.

The family Zingiberaceae are the largest of the eight families in the order, with 53 genera and over 1377 species (Kong *et al*. 2010). They are mainly distributed in tropics and subtropics with the centre of distribution in the Indo-Malayan region, but extending through tropical Africa to Central and South America (Tomlinson 1969, Kress *et al.* 2002, Kong *et al.* 2010). Zingiberaceae are one among the ten largest monocotyledonous families in India, and are represented by 21 genera (excluding the genus *Costus* L.) and about 180 species (Jain & Prakash 1995). Works by Larsen (1997), Williams *et al.* (2004) Skornickova and Sabu (2005a) and Kress *et al.* (2010), the total number of genera have been reduced to 17 by transferring *Curcumorpha* A.S. Rao & D.M. Verma to *Boesenbergia* Kuntze, *Mantisia* Sims to *Globba* L.*, Paracautleya* R.M. Sm. to *Curcuma* L. and *Hitchenia careyana* Benth. to *Larsenianthus careyanus* (Benth.) W.J. Kress & Mood. However, the recent additions of *Plagiostachys* Ridl. by Sabu *et al.* (2008), *Stahlianthus* Kuntze by Sanoj *et al.* (2008) and *Larsenianthus* W.J. Kress & Mood by Kress *et al.* (2010) again raised the total Indian generic representation to 20, and are mainly concentrated in Northeastern, Peninsular and Andaman and Nicobar regions. It forms one of the most interesting natural groups of

Monocotyledons and the species are remarkable for their wide range of morphological features.

The Indian subcontinent is essentially tropical and has a rich wealth of living organisms. India is one among the 12 mega diversity countries of the world and a tremendous variety of environmental regimes from the warm, humid tracts of Kerala to the cold, dry heights of the Ladakh plateau, and the hot desert of Rajasthan to the swamps of Sundarbans. Biogeographically India is situated at the tri-junction of the three realms, namely African, European and Southeast Asian realms. Its characteristic elements are derived from each of these realms along with the elements developed independently in peninsular India from its history as a part of Southern Gondwanaland. These render India rich and unique in biological diversity.

Zingiberaceae are the important group with considerable economic value, with genera like *Aframomum* K. Schum.*, Amomum* Roxb.*, Curcuma* L.*, Elettaria* Maton*, Kaempferia* L. and *Zingiber* Boehm. As many members of the family are spice yielding, it is commonly called as the 'spice family'. Many members of the family have been used in Ayurvedic and native systems of medicine from prehistoric times. Many are much popular for their aesthetic value, and used as ornamentals in garden.

Zingiberaceous plants are perennial rhizomatous herbs in shady habitats. They are characterized by tuberous creeping rhizomes with an aerial shoot, covered by leafy sheaths. The inflorescence may be a spike or raceme. Zingiberaceae have been a taxonomically neglected group mainly because of the inaccessible nature of the habitats, the wet evergreen forests, in which they grow. The short flowering period coincides with the monsoon season, makes the collection much laborious. Moreover, huge size of vegetative part and massive underground parts makes the preparation of herbarium specimens difficult. Due to the delicate nature of flowers, loss of colour and formation of a gummy mass soon

after collection, the study of floral morphology makes much difficult unless the fresh flowers are readily available.

Kress *et al.* (2002) recognized four subfamilies under the family Zingiberaceae, *viz*., Tamijioideae W.J. Kress, Siphonochiloideae W.J. Kress, Alpinioideae Link and Zingiberoideae Hassk. Among them large subfamilies are Alpinioideae and Zingiberoideae. The most prominent vegetative feature that is universal in the subfamily Zingiberoideae is the parallel orientation of distichy of the leafy shoots with respect to the rhizome. Another vegetative trait that characterizes the subfamily is the capacity of the members to go into dormancy during dry season in monsoon climates (Kress *et al. l.c.*), unlike the Alpinioideae and Tamijioideae, in which individuals are evergreen throughout the year. However, some species in Zingiberoideae like *Hedychium* J. Koenig can also be evergreen in the wet forest habitats or under continuous supply of water. The most recognizable floral feature of the subfamily is the conspicuous and often well developed lateral staminodes (Plate 01. A, B, C, D, E & H) that are generally absent in Alpinioideae (Plate 01. F & G). These lateral staminodes are free in *Hedychium*, *Kaempferia, Boesenbergia* and *Curcuma* (Plate 01. A, B, C & D), and are fused with the labellum in *Zingiber* (Plate 01. E) and connate with the filament in *Globba* (Plate 01. H).

According to Schumann (1904), the Zingiberoideae includes the three tribes, Zingibereae, Hedychieae and Globbeae. Although strong molecular support is lacking, within Zingiberoideae, Kress *et al.* (2002) recognized two tribes, Zingibereae and Globbeae. The tribe Zingibereae possesses a trilocular ovary, which in some genera may be incompletely closed towards the apex, with axial or rarely basal placentation. Where as in Globbeae the ovary is unilocular with parietal placentation and long arching filament to which the labellum and/or lateral staminodes are fused.



Plate 01. **Inflorescence -Zingiberaceae: A.** *Hedychium coronarium* J. Koenig; **B.** *Kaempferia rotunda* L.; **C.** *Boesenbergia siphonantha* (King ex Baker) M. Sabu *et. al.*; **D.** *Curcuma mutabilis* Skornick. *et. al.*; **E.** *Zingiber neesanum* (Graham) Ramamoorthy; **F.** *Amomum pterocarpum* Thwaites; **G.** *Alpinia calcarata* Roscoe; **H.** *Globba schomburgkii* Hook. f.

Hedychium is a very natural monophytletic genus, which possesses a number of unique characters, like dense inflorescence with long exserted stamen, the development of several flowers at the same time, and the seeds embedded in the more or less merged arils. *Hedychium*, commonly called as “ginger lily” or “butterfly lily” produces one of the most beautiful and flavoured flowers in the family Zingiberaceae. Though the flowers are short lived, many flowers are produced in succession on an inflorescence for a longer period. Genus *Hedychium* was established by Koenig (1783) with *H. coronarium* J. Koenig as the type species, based on Rumphius’ (1747) illustration. It includes about 80 species with major distribution in eastern Himalaya to South China and South-east Asia. About half of the species occur in the Indochinese region (Sirirugsa & Larsen 1995). According to Jain and Prakash (1995), this is the largest genus of the family in India with about 43 taxa, mainly distributed in North-eastern states with 16 endemics, of which only 4 are represented in South India.

The flowers of the genus *Hedychium* are constructed according to the typical monocotyledonous pattern, with organs arranged in whorls of three. The perianth is differentiated in to sepals and petals. Of the three petaloid floral members interior to the petals, the labellum lies in the sagittal plane, is bilobate and is larger than others. The lateral staminodes are inserted closer to the coronal plane and are unlobed. Although the labellum is initiated in an abaxial position, the mature flowers in species like *H. coronarium* resupinate and the labellum is oriented adaxially. However in species like *H. coccineum* Buch.-Ham. ex Sm., *H. gardnerianum* Ker Gawl. (= *H. speciosum* var. *gardnerianum* (Ker Gawl.) Sanoj & M. Sabu) *etc.* flowers do not resupinate (Kirchoff 1997, Kong *et al.* 2010). The ovary is inferior, tricarpillary and trilocular with numerous ovules on axile placentae. Epigynous glands are inserted on top of the ovary, at the base of the style. The style developed from the top of the ovary passes through the furrow in the corolla tube, filament and between the two anther lobes. The style terminates in a cup-shaped stigma.

Hedychium is well known for its horticultural importance. Major species traded as garden ornamentals include *H. coronarium*, *H. densiflorum* Wall., *H. flavum* var*. flavescens* (Lodd.) Sanoj & M. Sabu, *H. speciosum* var*. gardnerianum*, *H. coccineum*, *H. spicatum* Buch.-Ham. ex Sm., *H. greenii* W.W. Sm. *etc.* A number of flowers are produced at a time, the brilliant coloured and delightfully fragrant flowers on terminal spike increase its aesthetic value. Free inter-specific hybridization and ease of cultivation and propagation makes the genus much interesting among horticulturists. Flowers are valued as a perfume by the Arabs and Persians (Sawar 1894), Hindus used it for the worship of God, for the decoration of hair and also used as a symbol of love. Commercially, *H. coronarium* is widely cultivated in Brazil for paper making (Beadle 1917). Besides its ornamental and commercial value, many species like *H. coronarium, H. spicatum etc*. are well known for Ayurvedic and folk medicines. Usually *Hedychium* not have any negative impact on natural habitats, but *H. speciosum* var. *gardnerianum* has become a dangerous invasive weed in countries like Federated States of Micronesia, Fiji, New Caledonia, Cook Islands, Australia, French Polynesia, Hawaii, New Zealand, La Reunion Island (France), South Africa and Jamaica (Sankaran 2008) and included under the list of *'100 of the World's Worst Invasive Alien Species'* (Lowe *et al.* 2000).

SIGNIFICANCE AND OBJECTIVES OF THE WORK

The genus *Hedychium* has a good historical systematic and ornamental background. Since Koenig (1783), many species have been added mainly from India, Nepal and Bangladesh. But many of them have become conspecific with other taxa. Hence the total number of the genus enlarged considerably and along with that the confusion. The taxonomic revision of the genus *Hedychium* in India is chosen for the present study because of the absence of authentic and comprehensive work on the genus in India. The descriptions provided by earlier

workers are either very brief and incomplete or mere reproduction of earlier works. The lack of properly identified and preserved herbarium specimens coupled with the brief protologues and absence of type specimens made the situation worse. The range of variation within the species is very high, which makes delimitation of the species very difficult and led to the emergence of many conspecific taxa. Lack of much work in this genus is mainly because of the short flowering period associated with monsoon, bulky nature of rhizome and inflorescence and its distribution in the inaccessible dense evergreen forests. Despite the significant importance, rich endemism and threat of extinction of many species, the genus *Hedychium* has not received adequate attention of taxonomists in the Indian region. In these circumstances intensive taxonomic revision along with the proposed objectives are badly needed on this genus.

Objectives of the work

- Taxonomic revision of the genus *Hedychium* in India.
- Study of the morphological, ecological and geographical variations of selected species of *Hedychium* in India based on live collections.
- Preparation of detailed taxonomic account of the genus in India with descriptions, illustrations, ecology, ethnobotanical notes, distribution and a dichotomous key for identification of taxa.
- Preparation of herbarium and pickled specimens of all Indian taxa for further studies.
- Updating nomenclature of all taxa and typification of those Indian species, if necessary.
- Establishment of a germplasm of all Indian taxa of the genus in the Calicut University Botanic Garden.
- Identification of endemic, endangered and potential ornamental taxa from India.

AREA OF PRESENT STUDY

The area of present study, India, covers 3,287,570 sq. km, which comprises of 28 states (which are further divided into districts), 6 Union territories and one National Capital Territory of Delhi. The Andaman and Nicobar Islands in the Bay of Bengal and Lakshadweep in the Arabian Sea are coming under the territories of India. India is bounded by the great Himalayas in the north, northeast and northwest. Arabian Sea in the southwest and Bay of Bengal in the southeast. India is bordered by Pakistan, Peoples Republic of China, Bangladesh, Myanmar, Nepal, Bhutan and Afghanistan. Sri Lanka and Maldives are the Island nations to the south of India. (*Figure 01*)

TOPOGRAPHY

India, one of the centres of mega biodiversity, isolates from any other countries due to the presence of wide range of mountains, seas, suitable special climates, physiographic conditions *etc.* They support different types of ecosystems that maintain the high range of diversity among organisms throughout the country. It includes all possible types of vegetations, such as tropical, sub-tropical, temperate and alpine, semi-deciduous and deciduous forests, mangroves, salt marshes, swamps, aquatic vegetations *etc.*

This megadiversity centre represents about 2.46% of the total world landmass, lying in the tropical belt between 6°45'–37°6' N latitudes and 68°51'–97°25' E longitudes. Now it is estimated that India comprises about 45,000 species of plants, in which 17,000 species are the flowering plants and shows high level of endemism that is the reason of evolution and speciation of several new elements and occurrence of original flora (Hajra *et al.* 1996).



Fig. 01. Map of India (Area of present study)

Many floristic surveys mention the affinities of Indian flora with that of other countries. The results of extensive floristic surveys of Botanical Survey of India provide eleven geographical zones of India (Hajra *et al. l.c.*) and their detailed explanations of vegetation types. The different phytogeographical zones of India include the following.

1. North-West Himalayas
2. Indo-Gangetic plains
3. Eastern Himalayas
4. North-Eastern India
5. Central India
6. Arid zone
7. Northern Western Ghats and Northern West Coast
8. Southern Western Ghats, Southern West Coast and Lakshadweep
9. Deccan
10. Eastern Ghats and Coromandel Coast
11. Andaman and Nicobar Islands

1. North West Himalayas

The region comprises the states of Jammu-Kashmir, Himachal Pradesh and Western Utter Pradesh. The topography is irregular and intercepted by plateaus and valleys. There is the great diversity in the floristic pattern because of the high altitudinal variations and climate. The vegetation of this region can be divided as subtropical semi-desert type, tropical forests, subtropical forests and temperate forests, sub-alpine and alpine forests, based on the climate and altitudinal variations.

2. Indo-Gangetic plains

It covers south east Punjab, plains of Haryana and Uttar Pradesh and Bihar which also extended up to Bangladesh including Sunderbans, where a warm wet season (June-September) follows a dry season. Varying rate of rainfall, humidity variation of dry-cold seasons, thunder storms of April-May and 'Loo' in May, altogether control the diversity of Indo-gangetic plains. Most of the areas of the plains have been under cultivation and due to this extensive agricultural practices and over human interferences with the environment, forests have been degraded in to scrub jungles with scattered trees, and grass lands are also common. Roughly five types of forests are recognized, sal forests, mixed forests, swamp forests, alluvial forests and mangrove forests of Sunderbans.

3. Eastern Himalayas

The zone includes both Sikkim and Arunachal Pradesh. Among this, Sikkim lies between 27°10'–28°5' N and 88°30'–89° E, and that of Arunachal Pradesh lying between 26°28'–29°30' N and 90°30'–97°30' E. The altitude of these states ranges from 244 m to over 8,598 m and 200-7,750 m respectively. Because of the climatic, edaphic, altitudinal and biotic variations, the zone show high range of biodiversity. It is also act as one of the major distribution centres of Zingiberaceae especially *Hedychium*.

Depending on the elevation and characteristics of vegetation, Sikkim can be divided in to three distinct botanic zones, *viz*., tropical, temperate and alpine. Again the vegetation can be divided as low hill forests (tropical to Sub-tropical type, up to 900 m), middle hill forest (Sub-tropical type, 750-1,500 m), upper hill forest (Warm or wet temperate type, 1,500-2,700 m), *Rhododendron*-conifer zone (Cold temperate or sub-alpine, 2,700-3,000 m) and alpine scrub and grass lands (360-4,300 m and above) on the basis of altitudes.

The vegetation of Arunachal Pradesh includes tropical vegetation (tropical evergreen and semi-evergreen plants up to 900 m.), subtropical vegetation (trees and pine forests, 900-1,800 m), temperate vegetation (temperate broad leaved and coniferous, 1,800-3,500 m), alpine vegetation (4,000-5,500 m), secondary forests (degraded Bamboo forests and grass lands), aquatic vegetation and weeds. Besides the diversity, many endemic, rare, endangered and primitive flowering plants are also common.

4. North-Eastern India

The zone embraces the states of Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura and a part of the North Bengal, Which are altogether considered as a gene pool of wild and cultivated species. The North-Eastern Indian region is characterized by high rain fall and humidity where the altitude varies from near sea land to 4,500 m. with annual rain fall above 2,000 mm. The main reasons of the rich biodiversity of the region are p^H of the soil, humidity, annual rain fall, alluvial to laterate soil *etc.* On the basis of previous works on the classification of the forest types, the forest types of the Northeast India are classified in to tropical moist and dry deciduous forest, tropical grass lands, tropical evergreen and semi-evergreen forests, sub-tropical mixed forests, subtropical pine forests, subtropical to temperate grass lands, temperate forests and subalpine forests. As a continuation of Eastern Himalaya this area also possesses high diversity of our genus of interest, *Hedychium,* with 17 endemic taxa.

5. Central India

It is a large rugged territory, consisting of low rising hills, valleys and plateaus which lies between 18°–26° N latitudes and 74°–85° E longitudes and covers an area of about 4,50,000 sq. km. Vindya hills, Satpura hills, Ramgarh hills, Malwa plateau, Chambal valley, Narmada valley and Chattisgarh plains are the major land marks in central India. The region enjoys the wide spread monsoon climate with average rainfall varies from 700-2,000 mm. It is predominantly a land

of forests – almost 32% of the region (tropical and montane subtropical forests) – agriculture (almost 43% of the land area).

6. Arid zone

The Thar Desert and The Great Indian Desert occupies the eastern extremity of the North tropical desert belt. Which is characterized by low and erratic rainfall, high solar radiation, extreme variation, seasonal temperature, low humidity, high evaporation rates, dust storms, desiccating winds, low water table and poor vegetation cover. In India, the western arid zone lies between 21°30' N and 31° N latitudes and encompasses vast areas of western Rajasthan, western Gujarat, south western Punjab and Haryana – which together covering an extensive area of over 2,85,600 sq. km. of western India. This zone has a rainfall of 25 cm or less and a mean annual diurnal temperature of 24° F or more and the semi-arid zone having a rainfall between 25 and 50 cm and annual diurnal range of 18° F or more. The relative humidity of the zone is minimum in the summer months and maximum during the monsoon months and the physiography includes Piedmont plains, Sand-dunes, Sandy plains, Ghaggar alluvial plain, Playas, Coastal marshy zone, Rann of Kutch and the little Rann Drainage.

7. Northern Western Ghats and Northern West Coast

The North-west coast is otherwise called Concan which has about 800 km long and 10-25 km wide with thick population. The north western Ghats start below Tapti river mouth and run up to Goa and have about 750 km in length which lie between 15°21' N and 73°50' to 75°50' E. The northern Western Ghats receive heavy rainfall with mean annual rainfall varies from 2,359 mm to 7,450 mm. Where humidity during monsoon months ranges between 70-90% and during dry period that is 10-30%. The mean annual temperature varies from 20-24 °C. Vegetation types of Sahyadris may be classified in to scrub, dry deciduous, moist deciduous and montane subtropical evergreen forests. Both Northern-western Ghats and north-west coast are known for endemic genera and species.

8. Southern Western Ghats, Southern West Coast and Lakshadweep

(i) Southern Western Ghats – South of Goa

From north to south, Western Ghats passes through the states of Gujarat, Maharashtra, Goa, Karnataka and Tamil Nadu. South of Goa in Karnataka, the Western Ghats rise sharply to form an unbroken rampart with an attitude of about 900 m. Beyond the Palghat gap the sahyadri continuous south wards and knowing with different names in different parts and collectively called Southern Ghats. Anamudi is a nodal point in Southern-western Ghats from which Anamudi, Palani Hills and Cardamom Hills radiate in three different directions. The climate is mainly influenced by the south west monsoon and north-west monsoon. The annual rainfall varies from 2,350 mm in the north to 7,450 mm in the south. The forests of the south-western Ghats are coming under four main types –moist tropical forest, dry tropical forests, montane forests and montane temperate forests. The southern-western Ghats, rich in endemic, rare and threatened plants, throw vistas on the biogeography of the area, centre of speciation, variance, adaptive evolution of the flora and areas of extinction. It is another major distribution centre of Zingiberaceae, especially *Hedychium* with 2 endemics.

(ii) Southern-west coast

The west coast line is long and starting from Kanyakumari in the south and ending the state of Tamil Nadu, Kerala, Karnataka, Maharashtra and Gujarat. It comprises diverse ecosystems with ecologically adapted and physiologically specialized plants. The climate, along the coast line, may be per-humid, humid, sub-humid, semi and arid. The vegetation of this zone classified by Champion and Seth (1968) as (i) Littoral and tidal swamp forests and (ii) Littoral forests, which are modified by Rao and Sastry (1972) as (i) Coastal vegetation and (ii) Strand vegetation respectively.

(iii) Lakshadweep

Lakshadweep, the union territory of India, is lying between 8°–12°3' N latitude and 71°–74° E longitude, which comprises 36 small scattered coral Islands covering an area of 32 sq. km. It shows humid tropical climate with temperature ranges between 17–18 °C and 35–38 °C. The Islands have the benefit of both the south-west and north-east monsoons, but most of the rainfalls from south west monsoon. Many cultivated plants, trees, palms *etc.* include in the vegetation of dweep. Some endemic plants were also reported from the Islands.

9. Deccan

The area south of central India comprises the part of North Deccan Plateau, part of Eastern plateau and south Deccan plateaus. The Deccan consists of three distinctive physiographic subdivisions, *viz*., north Deccan plateau, south Deccan plateau and east Deccan plateau. This dry elevated table land is interspersed with numerous isolated hills and has light rainfall and dry climate. The characteristic vegetation present in this region, are moist tropical forests, dry tropical forests, tropical dry deciduous forests, tropical moist deciduous forests, tropical dry evergreen forests and tropical thorn forests, marshy plants, hydrophytes, weeds *etc.* The region shows lesser degree of endemism of plants.

10. Eastern Ghats and Coromandel Coast

(i) Eastern Ghats

These are situated between 77°22'–85°20' E longitudes and 11°30'–20°0' N latitudes, which covering an area of about 75,000 sq. km and the assemblage of discontinuous ranges, hills, plateau, buttes, gorges, narrow basins *etc.* by the presence of Mahanadi, Godaveri, Krishna, Pennar and Kaveri. According to Champion and Seth (1968), following are the major vegetation present in the Eastern Ghats –north tropical moist deciduous forests, southern tropical moist deciduous forests, South tropical wet evergreen forests, orissa tropical semi-

evergreen forests, southern tropical dry deciduous forests, red Sanders bearing forests, tropical dry evergreen forests, dry savannah and scrub forests. There is a narrow distribution of endemic plants due to geographical, ecological, edaphic and climatic barriers.

(ii) Coromandal coast

The east coast, the coast of bay of Bengal is approximately 1,500 km long with an average of about 100-130 km, and is often called Coromandal coast, mostly covers the area between the Mahanadi river in Orissa to Kannyakumari in Tamil Nadu. It consists of bays, gulfs, straits, channels, lagoons, estuaries, salt water lakes, back waters *etc.* It covers the states of Orissa, Andhra Pradesh and Tamil Nadu. This region comprises diverse ecosystems presents very interesting aspects for ecological, physiological and phytogeographical studies, where the vegetation is broadly classified as strand vegetation and estuarine vegetation. Strand vegetation indicates habitat relationship of plants and the strand and the estuarine vegetation is characterized by dense and gregarious growth of woody plants, shrubs and succulent herbs.

11. Andaman and Nicobar Islands

The flora of Andaman and Nicobar Islands is very rich with about 3,000 taxa of angiosperms, pteridophytes, bryophytes, lichens *etc.* Among the angiosperms 10% are endemic to the Islands. Most of the endemics in these Islands are rare and many are being threatened with extinction. The climatic climax of the Islands is typically the tropical low land rain forest. Champion and Seth (1968) have treated the forests of Andaman and Nicobar Islands under 11 types, *viz*., giant evergreen forest, andaman tropical evergreen forest, southern hill top tropical evergreen forests, cane brakes, wet bamboo brakes, andaman semi-evergreen forest, andaman moist deciduous forest, andaman secondary moist deciduous type, littoral forest, tidal swamp forest and sub-montane hill valley swamp forest. But based on the proximity of the sea and salinity of the soil, Balakrishnan (1977, 1989)

placed the vegetation in to two major groups –littoral and inland types. It also harbors rich diversity in ginger flora, but only one species of *Hedychium* is represented.

CLIMATE AND RAINFALL

Due to the huge size and highly varied topography of the land, it is very difficult to generalize the climate of the country, and many regions having their own microclimates. Climate in India ranges from tropical in the south to a temperate in the north. Parts of India in the Himalayas have a polar climate. Meteorologists divided the year in to four main seasons for most of the country; summer, monsoon, withdrawal of monsoon and winter. Summer lasts between March and June in the most parts of India. It is followed by southeast monsoon rains that provide most of the India with its rainfall. The official date for the arrival of the monsoon is 1st June, when the monsoon crosses the Kerala coast. The monsoons start retreating by August from northern India and by October from Kerala. This short period after the retreat is known as the withdrawal of the monsoon. Winter starts in November in northern India and late December in southern India.

The four months namely June, July, August and September form the core of the rainy season all over the country. This duration of the rainy season, however goes on decreasing from south to north and from east to west. In the extreme northwest it is barely two months.

Annual rainfall of over 300 cm is received over parts of western coast and northeastern India. Annual rainfall of less than 50 cm is experienced in western Rajasthan and adjoining parts of Gujarat, Haryana and Punjab. Rainfall is equally low in the interior of the Deccan plateau and east of the Sahyadris. Rest of the country receives a moderate rainfall. Snowfall is restricted to the Himalayan region.

MATERIALS AND METHODS

All relevant up-to-date literature related to the topic of study were collected from libraries in India and abroad and through personal communication. Most of the rare and old references are provided by online databases like 'Botanicus' (http://www.botanicus.org), 'Biodiversity Heritage Library' (http://www.biodiversitylibrary.org) and 'Hathi Trust Digital Library' (http://www.hathitrust.org). Microfisches of herbaria of Wallich were used in this revision. Specimens including types deposited in herbaria like ARUN, ASSAM, CAL, CALI, FRC, MH, PBL, PPCH *etc.* were studied well for the familiarization of the taxa. Digital photos of these specimens were also taken for further studies. Foreign herbaria like BM, E, and K were also consulted for various studies.

Based on the literature and examination of herbarium specimens total Indian representation and their distribution areas were identified. For the collection of live specimens and to explore new ones, extensive field trips were conducted throughout India especially in Central, South and Northeast India.

During the collection trips, at least 3-5 specimens of each accession from each locality were collected for the preparation of herbaria. Several accessions from different geographical regions were collected for the study of variability within the species. Collected specimens were duly tagged from the field itself. Field observations such as habitat, association with other species, habit, floral details like colour, shape, odour, nature of bulbils, arrangement of bracts and other details which cannot be preserved in herbaria were noted down in the field book. Latitude, longitude and altitude *etc.* were accurately measured by using Garmin GPS 12 or GPSmap 76CSx and were entered in the field book. Plants were collected along with their underground parts and special care was taken to observe the rhizomes.

Herbarium specimens were prepared by following wet method (Schultes, 1947). The inflorescence and flower parts were pickled in form-acetic alcohol (FAA) from the field and are stored for further studies. Digital photographs were taken from the field, whole population, single plant, leaves, ligule, Inflorescence, single flower, floral parts *etc.,* by using Sony Cyber-shot DSC76 or Super Study-shot DSC-H2 Digital cameras. The collected rhizomes were transferred to Calicut University Botanic Garden and planted there after the pretreatments against fungal and pest attacks, to establish a live germplasm of the genus.

Photomicrographs of flower parts were taken by attaching camera with Zeiss Stemi DV4 and Leica M80 stereomicroscopes. Detailed observations were made under binocular stereomicroscopes like Labomed CMS2, Willd Herrbrugg, Zeiss Stemi DV4 and Leica M80. Necessary drawings were prepared with the help of camera-lucida attachment. From them the detailed illustrations of each species were prepared by using Rotring isograph pen on Gateway paper. For the identification of plants literature like taxonomic papers, local floras, monographs, personal communication notes *etc.* were used. The types and other authentic materials in major herbaria were also used for the identification. The identification was confirmed by comparing it with protologues and type materials. Doubtful specimens were sent to experts for valuable comments. Entire herbarium specimens used for this investigation are deposited in Calicut University Herbarium (CALI) after proper mounting and labelling.

The nomenclatural corrections were made according to latest ICBN (McNeill *et al.* 2006). For the abbreviations of author names *Authors of Plant Names* (Brummitt & Powell 1992) and for abbreviation of periodicals *Botanico-Periodicum-Huntianum (BPH)* (Lawrence *et al.* 1968) were used. Online data from International Plant name Index (http:\\www.ipni.org) were also made use in this revision. *Botanical Latin* (Stearn 1992) was used for the translation of Latin description to English. *Taxonomic literature* (TL-2) by Stafleu *et al.* (1981) is used for the literature studies and for botanical terminology *An introduction to Plant Taxonomy*

(Lawrence 1966) was followed. For translation of Latin terminologies *Cassell's new Latin-English English-Latin Dictionary* by Simpson (1966) was used.

PRESENTATION OF DATA

This revisionary work begins with introduction to the general features of the order Zingiberales and its eight families. This is followed by an overview of the family Zingiberaceae in world and India along with a short note on biogeography of India. This is followed by the latest subfamilial classification of the family based on molecular studies. The sub-families and tribes recognized by Kress *et al.* (2002) represent natural groups and worldwide in scope, and hence this classification is accepted in the present work. An outline of the genus *Hedychium* is given towards the end.

The introduction is followed by the significance of the work in the present context, proposed objectives of the work and review of literature. It is presented in chronological order and covers all available literature starting from the taxonomic history of Indian Zingiberaceae and genus *Hedychium* till date. The next chapter gives a general discussion of the genus *Hedychium,* which includes morphology and ontogeny, cytology, anatomy, pollination, phytochemistry, cultivation, uses and invasiveness of the genus and phylogeny and evolution of the order and family.

The next chapter provides a detailed discussion on classification and systematic position of the genus and above ranks starting from Linnaeus. The complex taxonomic history of the genus and a separate infrageneric classification are provided.

The systematic part provides detailed nomenclatural citation of the genus followed by type, synonyms, common names, detailed description, taxonomic notes, phenology, distribution and IUCN Red list Category. It is followed by a dichotomous key to the species of the genus *Hedychium* in India. This is followed

by alphabetical arrangement of 44 taxa of the genus, each with detailed citation, description, taxonomic notes, phenology, distribution, IUCN Red list Category and typification if any. A list of specimens examined is given at the end of the treatment of each species. The acronyms of the herbaria, as per *Index Herbariorum,* where the specimens are deposited are given in parenthesis at the end of details of each specimen. Detailed illustrations, colour plates and distribution maps are also provided.

The systematic part is followed by a comparative morphology of all taxa including their morphological variations are discussed in detail. The chapters, summary of the work, references and index to scientific names are given towards the end. The references are arranged alphabetically and then chronologically. Online references are provided towards the end with the website address and date of accession.

REVIEW OF LITERATURE – A DISCUSSION

The earliest scientific work on the Flora of India is the *Hortus Malabaricus* of van Rheede (1678-1693), then Governor of Malabar. It was published in Holland as a twelve volume work, with short description and figures of nearly seven hundred plants. Which was prepared with the help of local physicians like Itty Achuthan, artists and interpreters *etc.* In which the plants were identified by their local Malayalam names and printed in four different scripts. Ten species of Zingiberaceae, as recognized now, are described with 12 plates in the 11th volume.

The term "Scitamina" was applied by Linnaeus (1751), in his natural orders, to a group of plants distinguished by their agreeable, useful, or valuable qualities, is derived from the Latin '*Scitamentum'*, anything of a pleasant or savoury taste. It is the eighth order in his 'Fragmenta', and consists of various productions useful in food, medicine *etc.* or remarkable for their odoriferous properties.

As a pre-linnaean work, Rumphius (1747) described the genus for the first time under the name *Gandasulium* Rumph. in his *Herbarium Amboinense* and with an excellent illustration of habit and a single flower.

Linnaeus (1753) in his *Species Plantarum* described 9 genera and 18 species under 'Monandria Monogynia'. It was a sexual system of classification and based only the stamen or sexual characters. Along with the 14 Scitamenean taxa, he has also included the some unrelated taxa like *Boerhavia* L. (Nyctaginaceae) and *Salicornia* L. (Chenopodiaceae) under 'Monandria Monogynia'. Later in 6th edition of '*Genera Plantarum*' (Linnaeus 1764) he added the two genera *Thalia* L. (Marantaceae) and *Hippuris* L. (Hippuridaceae) under this group. But he never included the above said *Gandasulium* in any of his works.

Bernard de Jussieu in his *Ordines Naturales,* classified the plants on the basis of natural affinity and treated all Scitaminean plants under Cannae Juss., and

the genus *Musa* L. is under Musae Juss. along with much distant *Bromelia* L., *Galanthus* L*., Hypoxis* L. *etc* (de Jussieu 1789).

Adanson (1763) described all Scitaminean taxa under the IX family Zingiberes Adans., along with a detailed description of the family. He included the genera like *Alpinia* L., *Ananas* Mill., *Bihai* Mill., *Bromelia*, *Costus* L., *Curcuma* L., *Karatas* Mill*., Maranta* L., *Musa* and *Zingiber* Boehm., and new genera like *Caraguata* Adans., *Hoiriri* Adans., *Katubala* Adans., *Pacoseroca* Adans., *Pinguin* Adans. and *Ravenala* Adans. under the family.

Koenig (1783), pupil of Linnaeus, was the first person who made a considerable addition to the order of Monandrian plants from India. He reached India as a Danish part-time physician but chiefly for the purpose of making improvements in the natural history of the country (Roxburgh 1795). He discovered many plants of this group and communicated the full description with his friend Retzius, who published them in the third fascicle of his *Observationes Botanicae*. In which he *effectively* and *validly* described the Rumphian '*Gandasulium'* as *Hedychium coronarium* J. Koenig along with the other Monandrian genera like *Hura* L., *Kaempferia* L., *Alpinia*, *Curcuma*, *Costus*, *Amomum* L. *etc.* He also provided a diagnosis for each genus and a detailed description for the species.

Roscoe (1807) observed that Retzius' (1783) remark on the great importance of the anthers and appendages (limbs) in the delimitation of genera, and the close association of *Hedychium* with *Kaempferia*. He also remarked that, this finding has not been followed by Retzius in his earlier or later publications. He also mentioned that, Retzius made the statements without seeing the dried specimens of Koenig (*l.c.*). However, *Kaempferia* differs from *Hedychium* in having crested anther, whereas the latter having non-crested anther.

After Retzius (*l.c.*) some additions and corrections of the genera have been made by Swartz (1791) in his *Observationes Botanicae*, but without any attempt at systematic classification. And he did not included the genus *Hedychium* in his work, though it had been established in 1783. He concludes his observations with asserting that, the genera of Scitaminean plants are so nearly related, that they can scarcely be distinguished by characters.

Antoine Laurent de Jussieu freely edited and incorporated the works of his predecessor, and proposed first complete natural system of classification in his *Gernera Plantarum* (de Jussieu *l.c.*). He is the first person who included the genus *Hedychium*, under the natural orders. He treated *Hedychium* under the Monocotyledons, class 'Stamina Epigyna', and the order Cannae Juss., along with other 11 Scitaminean genera. And he separated the genus *Musa* from the unrelated genera of B. de Jussieu, and treated under the order Musae Juss. along with two new additions *Heliconia* L. and *Ravenala*. He remarked that, like the rest who attempted to categorize these plants, "the construction of the various parts of the flower has induced a variety of opinions as to their denominations and use", and "that further observations on living plants are still requisite, in order to form proper distinctive characters".

Willdenow (1797) edited the Linnaeus' *Species Plantarum* and enlarged with the addition of much more genera and species, and published as a four volume work. He also remarked that the species *H. coronarium,* is native to India.

Roscoe (1807) is one of the most notable contributors in Monandrian plants. He subdivided these plants in to two groups, Cannae and Scitamineae. He concluded that, "the true generic character of these plants consists in the situation, form, and appendages of the anthera, and its petal like or incrassated filament". He emphasized the importance of fructification in generic delimitation. While describing the genus *Hedychium*, he considered it as more nearly related to *Alpinia*, and remarked that, "is sufficiently distinguished by its long tube and interior trifid

corolla, ……. the double anthera is attached it two adjacent lobes to the front of the filament, not to the revolute margins, as in *Hedychium*".

Richard (1808, 1811, 1819) classified the plants based on the embryologic characters in to Exembryonate and Embryonate, the latter further in to Endorhizae Rich., Synorhizae Rich. and Exorhizae Rich. He used the name Zingiberaceae Rich. to denote a group of plants coming under the Endorhizae.

Another remarkable work in the history of Indian Zingiberaceae is of William Roxburgh (1810, 1814, 1795-1820, 1820, 1832). Soon after his arrival in India he began making descriptions of the native plants, and throughout his career he continued methodically describing all the plants that were available to him. At the same time he also made life-size painting of the plants by native artists. In all he described about 2,600 species and had paintings of more than 2,500 of them (Sealy 1956). He also followed Linnaean system of classification. His first monumental work on Indian Zingiberaceae is *Descriptions of several of the Monandrous Plants of India* (1810) in *Asiatic Researches*. In which he casually mentioned about the two natural divisions of Scitaminean Plants. The first is truly herbaceous, includes all the species of *Curcuma*, *Kaempferia, Zingiber*, *Globba* L. and *Hedychium*. The second is more permanent division, includes *Canna* L*., Phrynium* Willd. and *Alpinia*. He considered *Costus* as the connecting link between these two divisions. But he formally treated Monandrous taxa under two subheads *i.e.,* 'Anther simple' and 'Anther double' with *Canna* and *Phrynium* in the former group and the genus *Hedychium* with other 7 genera under the latter group. In *Hedychium,* he has described only one species, *H. coronarium*. He disagreed the view of Retzius (*l.c.*) and Jussieu (*l.c.*) and discussed in detail to consider *Hedychium* as a species of *Kaempferia,* and treated them as distinct.

Smith (1811) added 4 new species of *Hedychium* in Rees' *Cyclopedia, viz*., *H. ellipticum* Buch.-Ham. ex Sm*., H. spicatum* Buch.-Ham. ex Sm*., H. coccineum*

Buch.-Ham. ex Sm. and *H. thyrsiforme* Buch.-Ham. ex Sm. These observations were based on the collection Buchanan Hamilton from Upper Nepal.

Roxburgh (1814) in his *Hortus Bengalensis* divided the whole plants in to five classes and treated the Zingiberaceous plants under the 'Class I', and Subclass 'Monandria Monogynia'. In the genus *Hedychium* he added three more species, *viz*., *H. flavum* Roxb., *H. angustifolium* Roxb., *H. gracile* Roxb. including *H. coccineum*, based on the collections of M.R. Smith and Buchanan Hamilton from Silhet and Bengal respectively. While describing the names he has failed to provide a description or diagnosis of the species. Very rarely he has provided very short description of the species, and hence most of '*Hortus Bengalensis*' names are '*Nomen nudum'* (McNeill *et al.* 2006).

Roscoe (1816) critically remarked on Roxburgh's *Descriptions of several of the Monandrous Plants of India*, and pointed out some points of Roxburgh which require more observation. He observed that, the distinctions founded on the anther and filament is not only characteristic and permanent, but also sufficiently distinct throughout the whole order, and to assign to each genus in its proper position.

Link (1821) in *Enumeratio Plantarum Horti Regii Botanici Berolinensis (pars 1),* classified and described the Scitamineae with two groups, Cannaceae Juss. and Alpiniaceae Link. *Hedychium* is treated in latter with two species, *H. coronarium* and *H. coccineum*.

Agardh (1822) in *Aphorismi Botanici,* placed Scitamineae under the Cryptocotyledoneae and the class Gynandrae Agardh. He further divided it in to four orders which is equivalent to current families. He just mentioned *Hedychium* having six species under the order (family) Scitamineae.

Blume (1827) in *Enumeratio Plantarum Javae,* included *Hedychium* in the section Amomae Blume under Scitamineae. *Hedychium* is described with 5 species.

Which includes only one Indian species, *H. coronarium* with three new informal varieties.

Dumortier (1829) in his *Analyse des Familles des Plantes,* treated all Zingiberacean taxa (like *Globba*, *Mantisia* Sims, *Curcuma*, *Kaempferia*, *Roscoea* Sm., *Zingiber*, *Amomum* Roxb., *Costus*, *Alpinia*, *Hellenia* Retz., *Gethyra* Salib., *Elettaria* Maton and *Hedychium*) as a single family, but called as Curcumaceae Dumort under the order Cannarieae Dumort. Along with Curcumaceae, he also treated Musaceae and Cannaceae as separate families in this order.

The major works of Roxburgh on Indian flora was published in the form of *Flora Indica.* Part of Roxburgh's manuscript was edited by William Carey, and published posthumously*,* along with the additions of Wallich under the title *Flora Indica,* in two volumes (Roxburgh 1820). In which, he described four species of *Hedychium, viz., H. coronarium, H. angustifolium, H. gracile* and *H. flavum*. Wallich also added his two new species in it, *H. villosum* Wall. and *H. speciosum* Wall., from North-East Bengal. In 1832 the whole of Roxburgh's work, edited by Carey, was reprinted in three volumes (Roxburgh 1832), without any additions of Wallich.

Roemer and Schultes (1822) followed Linnaean sexual system of classification and published in *Mantissa*. Their work mainly is a compilation of former findings and they described the genus *Hedychium* with 7 species, *viz*., *H. coronarium, H. coccineum, H. angustifolium, H. gracile, H. villosum, H. speciosum,* and *H. flavum* under the class 'Monandriae Monogyniae'. They provided very detailed citation and description for each species.

A selection of three hundred of Roxburgh's drawings and descriptions were published as *Plants of the Coast of Coromandel* (Roxburgh 1795-1820), under the auspices of the Court of Directors of the East India Company, to whom Roxburgh sent copies of his MS and drawings at intervals from 1790 onwards. The publication was under the direction of Sir Joseph Banks and comprised three volumes, each

issued in four parts, the first part appeared in 1795 and the last twenty four years later. In the third volume (1820) he included 7 genera and 15 species of Zingiberaceae. In which he described only two species of *Hedychium*, *viz., H. angustifolium* and *H. gracile.*

Another monumental work dealing with many species of Scitamineae is the *Monandrian Plants of the order Scitamineae,* of Roscoe (1824–1828). Which was published in 15 parts. The specimens on which the illustrations are based were pressed and become part of Liverpool Botanic Garden Herbarium. Even though part of Roscoe's herbarium was destroyed in world war it still holds the bulk of this collection (Cullen 1973). *Monandrian Plants* was appeared as a modified form of his earlier work (*i.e*., Roscoe 1807), and he included 112 hand coloured illustrations in it and are prepared on the basis of live specimens in the Botanic Garden at Liverpool. He has designated his earlier groups (Cannae and Scitamineae) as two sections, and made some editions at generic level and added many species under each. It was the first complete review of the earlier works of Scitaminean plants. He also provided a detailed introductory account for each genus and a first synoptical key to the species. In *Hedychium*, he constructed the key, which based primarily on the relative length of stamen with labellum, and inflorescence and bract characters to separate the species. He illustrated seventeen species of *Hedychium*, of which five were new, and also quoted brief descriptions of four more species in the introductory part of the genus, based on personal correspondence with Wallich.

Wallich (1828-1849) listed many of the Indian Zingiberaceae known till then in his '*Catalogue*' (*Numerical List of dried specimens of plants in the Museum of the Hon. East India Company, which has been supplied by Dr. Wallich, Superintendent of the Botanic Garden at Calcutta*) and included 16 species of *Hedychium* (Numer. List. 6539-6554. 1832). Wallich (1829-1832), also described some Zingiberaceae members in his *Plantae Asiaticae Rariores*. The only one species of *Hedychium* described here is the *H. speciosum* Wall. (3: 1832).

One of the major floristic works in the south Indian region is by Graham (1839). He treated the entire ginger tribe under the order Scitamineae and described 8 genera and 38 species. Under *Hedychium* he included 5 species including a new species, *H. scaposum* Nimmo., from Southern Concan region. But, later it was transferred to the genus *Monolophus* Wall. (Dalzell 1850), later to *Kaempferia* L. (Bentham & Hooker 1883) and recently to *Curcuma* (Skornickova *et al.* 2007).

Endlicher (1837) in his *Genera Plantarum,* treated *Hedychium* under the section Amoma, along with *Amomum, Elettaria, Donacodes* Blume and *Diracodes* Blume, under the order Zingiberaceae.

Lestiboudois (1841) in *Annales des Sciences Naturelles; Botanique*, While dealing Scitamineae, he separated the species *H. speciosum* from *Hedychium*, on the basis of entire labellum and proposed a new genus *Gamochilus* T. Lestib., to include *G. speciosus* (Wall.) T. Lestib., which was readily rejected by the later workers.

Meisner (1843) in his *Plantarum Vascularium Genera,* treated the genus *Hedychium* as a member of the order Zingiberaceae and the tribe Amomeae. But Hasskarl (1844) in his *Catalogus Plantarum in Horto Botanico Bogoriensi Cultarum,* redesignated the above tribes as suborders, and *Hedychium* is placed under the suborder Amoma.

Wight (1838-53) in his *Icones Plantarum Indiae Orientalis,* informally divided the Scitaminean plants in to three orders, *viz*., Cannaceae, Musaceae and Zingiberaceae. He also mentioned, in Zingiberaceae the discrimination of the genera, anther is the essential character along with other floral characters. He described four species of *Hedychium*, of which two species are, *H. cernuum* Wight and *H. venustum* Wight, from South India. While describing the species he provided

a short description along with line drawings. Many of the plates in this work are reproduced from Roxburgh's drawings (Sealy 1956).

Meanwhile many species of *Hedychium* like, *H. carneum* Lodd. (Loddiges 1823a), *H. chrysoleucum* Hook. (Hooker 1850), *H. elatum* R. Br. (Brown 1821), *H. flavescens* Lodd. (Loddiges 1823b), *H. gardnerianum* Ker Gawl. (Ker Gawler 1824b), *H. heteromallum* Ker Gawl. (Ker Gawler 1824a), *H. stenopetalum* Lodd. (Loddiges 1833b) *H. urophyllum* Lodd. (Loddiges 1832a) *etc.* were added from time to time based on several collections from India, Nepal or Bangladesh. Later many of them were identified as conspecific or relegated to other taxa.

In *Bombay Flora,* Dalzell and Gibson (1861) treated 25 species in 7 genera under Zingiberaceae. He included only one species of *Hedychium, H. scaposum* Nimmo., presently treated under *Curcuma* (Skornickova *et al.* 2007).

Wallich (1853) in his publication, *Initiatory attempt to define the species of Hedychium, and settle their synonymy*, provided a detailed account of the genus *Hedychium* and described 23 species and he divided the genus in to four infrageneric groups, *i.e*., *Coronariae* Wall., *Spicatae* Wall., *Siphonium* Wall. and *Brachychilum* R. Br. ex Wall. Later this treatment has been followed by himself (Wallich 1855) and Mueller (1861).

Horaninow (1862) in his *Prodromus Monographiae Scitaminiarum,* recognized four families under the order Scitamineae, *viz*., Amomaceae J.St.-Hill., Cannaceae, Marantaceae R. Br, and Musaceae. The family Amomaceae was subdivided into four tribes, *viz*., Alpinieae, Amomeae, Costeae and Hedychieae Horan. *Hedychium* comes under the tribe Hedychieae, and the genus is further divided in to three infrageneric groups, *viz*., *Brachychilum* R. Br. ex Wall., *Gandasulium* Rumph. ex Horan., and *Macrostemium* Horan.

Bentham and Hooker (1883) in *Genera Plantarum* treated *Hedychium* along with other 21 genera under the tribe Zingibereae of the series Epigynae. Though it is a post-darwinian classification it is not based on evolutionary relationships.

Engler and Prantl (1887-1915) elevated Scitamineae to a distinct order with four families, Cannaceae, Marantaceae, Musaceae and Zingiberaceae. Petersen (1888), in Engler and Prantl's *Naturlichen Pflanzenfamilien*, divided the family in to three tribes or natural groups, *viz*., Globbeae, Hedychieae and Zingibereae. Under Hedychieae he included the genera like, *Roscoea*, *Cautleya* Hook. f., *Curcuma*, *Hitchenia* Wall., *Hedychium*, *Kaempferia* and *Gastrochilus* D. Don.

Kuntze (1891) in the second part of his *Revisio Generum Plantarum,* reduced the Scitamineae to the family level, Scitaminaceae Kuntze, and described readily under Monocotyledons. In which he attempted to validate Rumphian (*l.c.*) epithet, *Gandasulium,* for the genus and made a new combination, *Gandasulium coronarium* Rumph. ex Kuntze. Along with that he proposed much nomenclatural changes, but most of them are cannot be accepted as per the code (McNeill *et al.* 2006).

Hooker's ever known monumental work on the Indian subcontinent is the *Flora of British India* (1872-1897). But his works are mainly based on the dried specimens and the descriptions provided are too brief, are sometimes misleading and inaccurate. In which Baker (1890-1892) described 19 genera and 224 species of Zingiberaceae. Some of which are doubtful in occurrence. He treated four tribes under the order Scitamineae, *viz*., Canneae, Maranteae, Museae and Zingibereae. Among the genera described, many are further divided into subgenera and sections. Baker treated 24 species and 15 varieties under the two sections of *Hedychium*. Among them, all taxa, except two species (*H. crassifolium* Baker and *H. longicornutum* Griff. ex Baker), occur in present India.

Schumann (1900) divided the Zingiberaceae in to two subfamilies, Costoideae and Zingiberoideae, and further in to tribes. Two tribes recognized under the Zingiberoideae are, Hedychieae and Zingibereae. In the former tribe the genus *Hedychium* is described with two subgeneric groups and are designated as sections, *Gandasulium* Rumph. ex K. Schum. and *Macrostemium* Horan. ex K. Schum. Schumann's (1904) final and most important work appeared as a monograph of the family. Nearly half of the species in that volume were originally described by Schumann himself; but mainly based on the dried specimens (Holttum 1950). He recognized three tribes, Globbeae, Hedychieae and Zingibereae. Under *Hedychium* he retained the section *Gandasulium* and erected another new section *Euosmianthus* K. Schum.

Cooke (1907) in *Flora of Presidency of Bombay* enumerated 11 genera with 24 species under the order Scitamineae, including *Phrynium*, *Musa* and *Costus*, with only one species of *Hedychium*, *i.e., H. coronarium*.

Weathers (1911) in *The Bulb Book* described bulbous and tuberous plants used for Open-air, Stove and Greenhouse. In which he described these plants under the Natural order Scitamineae with 12 species of *Hedychium*. He mentioned *Hedychium* as a closely related genus of *Kaempferia* and *Curcuma*. While describing the genus he emphasized the ornamental details of the 12 species with a short description and phenology.

Turrill (1914) discussed the species *H. coronarium* and its six allied species. He proposed to treat the taxa like, *H. chrysoleucum*, *H. flavescens*, *H. flavum* Roxb., *H. maximum* Roscoe, *H. urophyllum* and *H. elwesii* Baker at specific status, which have been considered by various earlier authors as varieties of *H. coronarium.* He also proposed a new name *H. subditum* Turrill for *H. flavum* Roscoe.

Voigt (1945) in *Hortus Suburbanus Calcuttensis* published *A Catalogue of the Plants which have been cultivated in the Hon. East India Company's Botanical*

Garden, Calcutta and in the Serampore Botanical Garden. In which he catalogued 24 species of *Hedychium* and provided a small description or reference to a description of earlier publication for each species, which became a valid publication of some Wallichian (1832) species.

Haines (1924) in the fifth volume of *The Botany of Bihar and Orissa* treated nine genera of Zingiberaceae including *Costus*. The four species of *Hedychium*, *i.e*., *H. coronarium, H. thyrsiforme, H. stenopetalum* Lodd. and *H. coccineum*, are described with a detailed description and a short discussion.

Loesener (1930) in Engler and Prantl's *Die Naturlichen Pflanzenfamilien,* followed the Schumann's (*l.c.*) classification and described 42 genera under Zingiberoideae and 4 genera under Costoideae. Under *Hedychium* he also recognized two sections, *Gandasulium* and *Euosmianthus*.

Nakai (1941) proposed Costoideae and Heliconieae as families for the first time, *viz*., Costaceae Nakai and Heliconiaceae Nakai. And also recognized another six families under Zingiberales, *viz*., Musaceae, Strelitziaceae, Lowiaceae, Zingiberaceae, Marantaceae and Cannaceae.

Systematic account of Zingiberaceae of a greater portion of Kerala appeared in Rama Rao's (1914) *Flowering Plants of Travancore*. It was only an inventory of binomials and did not give any key for identification or description. Among 33 species described in his flora, not more than 25 species belong to South India and many have been considered as misidentification. In which he described three species of *Hedychium* including *H. chrysoleucum*, which is not recorded from South India so far.

Another important floristic work in South India is the Gamble's (1916-1935) *Flora of Presidency of Madras*. In the third volume, Fischer (1928) described 34 species under 9 genera of Zingiberaceae with proper keys, description and

citations. In which he described only three species of *Hedychium* from South India, *viz*., *H. coronarium, H. flavescens* and *H. venustum.*

Santapau (1945, 1951, 1952) contributed some new taxa to the Zingiberaceous Flora of India and solved many nomenclatural problems. In his *Flora of Khandala on the Western Ghats of India* (1967), under Zingiberaceae he described only 5 genera with 7 species, without the genus *Hedychium*.

In *The Zingiberaceae of the Malay Peninsula,* Holttum (1950) retained Schumann's subfamilian divisions, Zingiberoideae and Costoideae, and proposed a new subdivision for Zingiberoideae. He recognized three tribes, Alpinieae, Globbeae and Hedychieae. Among the three tribes of Zingiberoideae, *Hedychium* is treated with seven species under the tribe Hedychieae. Among them, only one species, *H. chrysoleucum,* has Indian representation.

Based on the anatomical studies, Tomlinson (1956) treated Zingiberoideae and Costoideae as separate subfamilies, but later, Tomlinson (1962) recognized eight families as per Nakai (*l.c.*) and their evolutionary relationship.

Mitra (1958) in his *Monocotyledons of Eastern India* treated the family Zingiberaceae with subfamilies Zingiberoideae and Costoideae. Under Zingiberoideae genus *Hedychium* is treated under one of the tribes, Hedychieae, with 19 species and 7 varieties. The other two tribes are Globbeae and Zingibereae.

Sealy (1956) provided the list of Roxburgh's drawings at Kew, including 4 species of *Hedychium*, *viz*., *H. angustifolium, H. coronarium, H. flavum* and *H. gracile*. Among them only *H. angustifolium* and *H. gracile* are reproduced through the plate number 251 in *Plants of the Coast of Coromandel* of Roxburgh (1820). He also mentioned that, apart from three hundred drawings of *Plants of the Coast of Coromandel*, another four hundred of the plates in Wight's *Icones Plantarum Indiae Orientalis* (1838-53) were copied from Roxburgh's drawings, and are marked as 'Roxburghianae'; a few duplicates the *Coast of Coromandel* plates,

but the majority are different. Thus less than 700 of the total of over 2,500 drawings, which Roxburgh had made, have been reproduced.

Naik and Panigrahi (1961) re-evaluated the various morphological characters of taxonomic interest in the genus *Hedychium*, and recognized 17 species from Eastern India. He casually grouped the *Hedychium* on the basis of lip into two broad categories, deeply bifid and entire or bifid. Deeply bifid type further divided in to further classes 1. Coronarium type, 2. Marginatum type, 3. Venustum type and 4. Gracile type. Similarly among entire or emarginate type further classes are, 1. Ellipticum type and 2. Gratum type. He concluded that the nature of the lip and compactness or looseness of the spike appear to be more reliable characters rather than the relative lengths of lip and stamen.

Rao and Verma (1969a) added four more species to *Hedychium* from Khasia and Jaintia Hills. In which they compared *H. griffithianum* Wall. with *H. venustum* and their geographical distribution. Rao and Verma (1972) in *Materials towards a Monocot Flora of Assam-II,* recorded 19 genera under Zingiberaceae including the genus *Costus*. They recognized 29 taxa under the genus *Hedychium.*

Burtt and Olatunji (1972) separated the genus *Zingiber* from tribe Hedychieae and restricted the tribe Zingibereae to the genus *Zingiber* alone. Burtt and Smith (1972a) proposed a new infrafamilial classification of the family Zingiberaceae and they also recognized two subfamilies under this family, Zingiberoideae and Costoideae. Under Zingiberoideae, they recognized 4 tribes, *viz*., Alpinieae, Globbeae, Hedychieae and Zingibereae. Under the tribe Alpinieae, 23 genera, such as *Alpinia, Amomum, Achasma* Griff.*, Plagiostachys* Ridl. *etc.* are included. In Globbeae, 4 genera, *viz*., *Hemiorchis* Kurz, *Gagnepainia* K. Schum., *Globba* and *Mantisia* are recognized. Hedychieae includes 15 genera, such as *Hedychium, Boesenbergia* (Wall.) Kuntze, *Curcuma, Hitchenia etc.* Zingibereae is a monotypic tribe with only one genus, *Zingiber*.

Larsen *et al.* (1998) in Kubitzki's *The Families and Genera of Vascular plants,* treated Zingiberaceae and Costaceae at family rank and retained all the four tribes, Alpinieae, Globbeae, Hedychieae and Zingibereae under Zingiberaceae and recognized 45 genera under them. As revealed by them, the positions of four genera are questionable and treated one genus under *Insertae Sedis.*

Based on the cladistic studies, Kress (1990) proposed a new classification of Zingiberales by retaining Nakai's (*l.c.*) eight families. He proposed five new Suborders, *viz*., Musineae W.J. Kress (family Musaceae only), Strelitzineae W.J. Kress (family Strelitziaceae only), Lowineae W.J. Kress (family Lowiaceae only), Heliconineae W.J. Kress (family Heliconiaceae only) and Zingiberineae W.J. Kress. The Suborder Zingiberineae is further divided into two new Superfamilies, *viz*., Zingiberariae W.J. Kress (families Zingiberaceae and Costaceae) and Cannariae W.J. Kress (families Cannaceae and Marantaceae). Smith *et al.* (1993) also recognized these families but identified a different evolutionary relationship.

Recently, Sabu and Pradeep (2005) described the spectacular Hedychiums of Northeast India. In which they included 14 species of *Hedychium* and provided an illustrated account of the expedition, with brief descriptive notes on the taxa found in NE India and under cultivation in South India. Sabu (2006) in *Zingiberaceae and Costaceae of South India* described five Hedychiums from South India. He also included the species *H. coccineum* based on a cultivated material from Kerala. Subsequently, Chaturvedi and Moaakum (2008), published the diversity of the genus *Hedychium* in the Mokokchung and Zunheboto Districts of Nagaland. In which, 14 species of *Hedychium* were dealt, of which some are misidentifications.

Meanwhile, several new taxa of *Hedychium* were published, *viz*., *H. wardii* C.E.C. Fisch. (Fischer 1936), *H. longipedunculatum* Sastry & D.M. Verma (Sastry & Verma 1968), *H. calcaratum* A.S. Rao & D.M. Verma, *H. dekianum* A.S. Rao & D.M. Verma*, H. gracillimum* A.S. Rao & D.M. Verma*, H. rubrum* A.S. Rao & D.M. Verma (Rao & Verma 1969a)*, H. radiatum* A.S. Rao & P.K. Hajra, *H. robustum* A.S. Rao &

P.K. Hajra (Rao & Hajra 1974), *H. pynursulaeanum* S.K. Jain & S.C. Srivast. (Jain & Srivastava 1986), *H. raoii* G.D. Pal & G.S. Giri (Pal & Giri 1998), *H. satyanarayanum* S.C. Srivast. (Srivastava 1999), *H. larsenii* M. Dan & Sathish*, H. sirirugsae* M. Dan & Sathish (Dan *et al.* 1999), *H. forrestii* var*. palaniense* Sanoj & M. Sabu (Sanoj *et al.* 2010). Subsequently, Mehrotra and Srivastava (1985) rediscovered *H. wardii* from a cultivated material at BSI, Shillong, and recently Sanoj *et al.* (*l.c.*), recorded the occurrence of *H. forrestii* Diels in India.

Since Hooker, some new genera such as *Parakaempferia* A.S. Rao & D.M. Verma (Rao & Verma 1969b), *Curcumorpha* A.S. Rao & D.M. Verma (Rao and Verma 1971) and *Paracautleya* R.M. Sm. (Smith 1977) have been added to Indian ginger flora. Later two of them, *Curcumorpha* and *Paracautleya,* were transferred to *Boesenbergia* and *Curcuma* respectively (Larsen 1997, Skornickova & Sabu 2005). Recently, two genera *Plagiostachys* Ridl. (Sabu *et al.* 2008) and *Stahlianthus* Kuntze (Sanoj *et al.* 2008) were reported as new records for India. Very recently another new genus *Larsenianthus* W.J. Kress & Mood (Kress *et al.* 2010) is also added to Indian ginger Flora, with three species from India, in which the solitary Indian representation of *Hitchenia* Benth., *H. careyana* Benth. & Hook. f., was transferred to this genus, *i.e., Larsenianthus careyanus* (Benth.) W.J. Kress & Mood.

Several studies like Lestiboudois (1829), Brown (1830), Payer (1857), van Tiegham (1868), Baillon (1876), Eichler (1875), Schumann (1904), Costerus (1915), Rendle (1930), Thompson (1933, 1934, 1936), Gregory (1936), Willis (1948) Rao *et al.* (1954), Kirchoff (1997, 1998) Tang *et al*. (2002), Lin *et al.* (2007), Kong *et al.* (2010), *etc.* on Zingiberaceae were published from time to time. There are many reports on cytological studies on the genus *Hedychium*, *viz*., Raghavan and Venkatasubban (1943), Sharma and Bhattacharyya (1959), Ramachandran (1968), Mahanty (1970). Phytochemical properties of the genus was studied by Sharma *et al.* (1975), Sharma *et al.* (1976), Dixit and Verma (1979), Nakatani *et al.* (1994), Xiao *et al.* (2001), Medeiros *et al.* (2003), Zhao *et al.* (2003), Gopanraj *et al.* (2005), Bisht *et al.* (2006), Dan *et al.* (2007) *etc.* There are reports on medicinal, ornamental or

commercial uses, *viz*., Smith (1811), Sawar (1894), Beadle (1917), Nagata (1971), Joy *et al.* (1998), Sirirugsa (1998), Csurhes and Hannan-Jones (2008), Gao *et al.* (2008), Bhatt *et al.* (2009), Saraswathy *et al.* (2009), Udayan and Balachandran (2009). The invasive weed behaviour of *Hedychium* is reported by Lowe *et al.* (2000), Csurhes and Hannan-Jones (2008), Sankaran (2008) *etc*.

Several new species, new records and revisionary works of Zingiberaceous taxa in India, including our genus of interest *Hedychium*, have been published from time to time by many workers such as, Smith (1911), Naik and Panigrahi (1961), Banerjee (1966), Mangaly and Swarupanadan (1981), Ansari *et al.* (1982), Rao and Srivastava (1982), Sivarajan and Balachandran (1983), Srivastava (1983, 1998), Bhat (1987), Bhat and Venugopal (1986), Mangaly and Sabu (1987), Bhat (1988), Mangaly and Sabu (1988, 1989, 1992, 1993), Sabu and Mangaly (1988a, 1988b, 1989, 1911, 1996), Velayudhan *et al.* (1990a, 1990b), Amalraj *et al.* (1999), Sabu (2000), Prasanth Kumar *et al.* (2002), Skornickova and Sabu (2002), Skornickova *et al.* (2003a, 2003b, 2004) *etc*.

The genus *Hedychium* is characterized by the peculiar nature of the inflorescence, well developed labellum and lateral staminodes and prominent and exserted stamen. As per Wood *et al.* (2000) and Kress *et al.* (2010) it is a monophyletic genus and is closely allied to the sister clade of the newly described genus *Larsenianthus* W.J. Kress & Mood. The structure and ontogeny of the family as a whole and the genus has been well studied by many predecessors (Wood *et al.* 2000, Kirchoff 1997, Kong *et al.* 2010). The floral structure of the genus is much modified and is adapted for insect pollination. The brightly coloured flowers also attract the horticulturists world over due to their aesthetic value. Even though it is commonly cultivated in home gardens as an ornamental plant there are some reports on its invasive behaviour (Lowe *et al.* 2000, Csurhes & Hannan-Jones 2008, Sankaran 2008). Apart from their ornamental value a few species are highly priced for their medicinal properties, hence widely used in traditional medicine and Ayurveda.

Morphology and Ontogeny

The inflorescence of *Hedychium* is a 'thyrse', refers to an inflorescence with a single main axis and cymose lateral branches (Kirchoff 1997). The elements of a branch system are numbered accordingly based on their position. The primary axis bears distichous foliage leaves, and terminate in a spirally arranged inflorescence bracts. The bracts born directly on this axis are known as primary bracts. The primary bracts subtend cincinni that terminate in primary flowers, the first flowers of the cincinni. Secondary bracts are born on the axes that terminate in primary flowers. Secondary bracts subtend secondary flowers, the second flower of the cincinni.

In *Hedychium*, all the flowers in a cincinnus are initiated in such a way that the true stamen backs on the main inflorescence axis, not on the axis of bract that subtends the flower. So the median plane in the odd numbered flowers bisect the anthers, like that the median planes in the even numbered flowers bisect between the staminodes and labellum. To avoid this confusion, Kirchoff (1997) used the term 'coronal' for the plane that separates the staminodes with stamen form labellum and the term 'sagittal' for the plane that bisects through the stamen and labellum (independent to the orientation of flower on its bracts).

Labellum, Lateral staminodes and Stamen

The flowers in Zingiberaceae as a whole and *Hedychium* in particular, consist of five major parts (Kirchoff 1997, Kong *et al.* 2010), three sepals, three petals, two lateral staminodes, single labellum, single fertile stamen and a single gynoecium. The origin and evolution of six androecial members in the Zingiberaceae have been a matter of controversy since long. Lestiboudois (1829) first proposed the interpretation about the origin and evolution of six androecial members of the genus. But the widely accepted interpretation of the origin of labellum is that of Eichler (1875). Based on this interpretation, two inner antero-lateral androecial members are united to form a labellum, the posterior one form a fertile stamen, two outer postero-lateral androecial members form the two petaloid lateral staminodes. This interpretation of the labellum development is supported by Baillon (1876), Kirchoff (1998), Payer (1857), Rao *et al.* (1954), Rendle (1930), Tiegham (1868) and Willis (1948).

Brown (1830) regarded the anterior labellum and two postero-lateral lateral staminodes are to be of outer androecial whorl and the two antero-lateral epigynous glands and the single posterior fertile stamen to be of the inner whorl. Schumann (1904) proposed that the distinctly bilobed labellum of the genera (*e.g., Hedychium, Kaempferia*) consists of two inner androecial members, and the

lobeless labellum of the genera (*e.g., Alpinia, Amomum*) consists of one outer androecial member.

Recently, Kirchoff (1997) and Kong *et al.* (2010) described the most acceptable ontogeny in some species of *Hedychium*. According to them, the two inner antero-lateral androecial members are joined by intercalary growth and fuse to produce the two-lobed labellum, while the outer whorl anterior androecial member ceases growth soon after initiation. The one inner and two outer androecial members are initiated on the posterior side of the flower. The one inner posterior androecial member forms the functional stamen. The two outer potero-lateral androecial members form the lateral, petaloid staminodes. This view supports the interpretation of Eichler (1875).

Epigynous glands

Brown (1830) regarded the two epigynous glands and the posterior stamen as belonging to the inner whorl, and the antero-lateral segments are reduced to the two epigynous glands. Rao (1963) proposed most acceptable interpretation of epigynous glands of Zingiberaceae based on the ontological studies. As per him, the epigynous glands belong to the gynoecium and not to the androecial whorls at all. The two glandular outgrowths clearly develop near the top of the ovary from the antero-lateral septa, and are continued upwards above the ovary level as the epigynous glands. And the third one is always suppressed on the posterior side.

Inflorescence development

Inflorescence is terminal and developed spirally from bottom to top. With the transmission to inflorescence the phyllotaxy begin to change from distichous to spiral. Primary bracts of the inflorescence are initiated on the flanks of the apical dome in a spiral phyllotactic pattern. Soon after initiation the bract primordia become crescent-shaped, the concave side of the crescent opening upward. Cincinnus primordia are initiated in the axils of the primary bracts. As the

inflorescence ages, the inflorescence apex decreases in size relative to the surrounding bracts and finally ceases growth. Near the time of its abortion, the apex bears fewer bracts, and the primary bracts and cincinnus buds begin maturation closer to the apical dome than when the apex is most actively producing bracts (Kirchoff 1997, Kong *et al.* 2010).

Cincinnus development

In the axils of primary bracts, the ellipsoid cincinnus primordia are initiated on the flanks of inflorescence apex. On aging, the young cincinnus widens and produces a transversely elongated primordium. Soon, the primordium becomes more pointed on one side. This point is the secondary bract; and the first floral primordium is initiated on the other side. Later, the secondary bract extends and completely surrounds the cincinnus. In the axil of the secondary bract, the primordia continue the growth of the cincinnus, while the apex of the secondary axis produces a flower. Growth of the cincinnus proceeds in the same pattern. The bract is always initiated away from the flower but in the same transverse plane (Kirchoff 1997, Kong *et al.* 2010).

Flower development

Flower development begins after the initiation of the secondary bract with the transformation of the cincinnus apex into a floral primordium. This primordium enlarges, begins to flatten, and assumes a rounded, obdeltoid appearance in polar view. As growth continues, the floral primordium becomes flatten and the corners of the deltoid become more distinct.

The obdeltoid corners of the floral primordium are the sites of sepal initiation and are initiated clockwise. Following initiation, the sepals extend around the periphery of the floral primordium until the margins of the adjacent sepals become confluent. From this stage, intercalary growth of the sepals produces the majority of the synsepalous calyx.

Along with the sepal initiation, the whole flower primordium continues to enlarge. The periphery of the flower, interior to the sepals, produce a raised ring of tissue that surrounds a central depression. This ring primordium is composed of three common primordia united below into a cylinder of tissue surrounding a central cavity. The cylinder with its enclosed central cavity forms the floral cup, the site of gynoecial initiation.

The common primordia become increasingly distinct as the floral primordium enlarges. First of all, the adaxial common primordium separates from the ring primordium. Then, the two abaxial common primordia begin to separate. The adaxial common primordium is larger than the two abaxial common primordia. Each common primordium then produces a petal to the exterior and an androecial member to the interior. Separation of the three common primordia begins with the fertile stamen and its associated petal, and then the abaxial inner androecial members begin to separate. The adaxial inner androecial member develops into the fertile stamen. During the separation of the common primordia, the thecae of the stamen are visible. The two abaxial inner androecial members are sterile, they unites and constitute the petaloid labellum. The abaxial outer androecial member ceases growth soon after initiation, while the two adaxial members continue to grow and eventually produce two petaloid lateral staminodes.

During the enlargement and separation of the common primordia, the hollow space at the center of the floral cup enlarges and becomes a rounded-triangular apex. The three vertices of this triangle are the sites of outer androecial initiation.

The three primordia of the style and stigma are initiated opposite the petals, below the insertion of androecium. The adaxial primordium is slightly larger than the two abaxial primordia at an early stage of development, suggesting that the adaxial primordium is initiated first. Soon, the primordia extents longitudinally and occupies the full depth of the floral cup. With continued growth of the

gynoecial primordia, the three carpellary primordia grow upward and fuse along their lateral margins to produce a cylindrical style capped by a trilobed stigma primordium (Kirchoff 1997, Kong *et al.* 2010).

The epigynous glands are typically two in number, and are antero-lateral in position. In some, they are basally connate on the anterior side, and there is no gland on the posterior side. Of the three carpels of the ovary, one is anterior and the other two postero-lateral. Hence, one septum is posterior and the others antero-lateral. Where the loculi of the ovary end at the top of the ovary, the septa separating them thicken proportionately, and each group of processes comprising a gland arises from a broad base correspond to the broadened septum portion. A little higher, two of these glandular areas-those two that are in antero-lateral positions, become separated from the tissue lying to its outside. These two become free, short, somewhat cylindrical epigynous glands. The third gland, which is on the posterior side, does not become free and it disappears a short distance beneath the point of separation of the two other glands (Rao 1963).

Cytology

Raghavan and Venkatasubban (1943) observed a wide range of variation in chromosome number and stated the chromosome number of *H. flavescens* (2n = 34), *H. greenii* (2n = 36), *H. flavum* (2n = 52), *H. coronarium* (2n = 54), *H. gardnerianum* (2n = 54) and *H. gracile* (2n = 66). Sharma and Bhattacharyya (1959) studied ten taxa of this genus, of these one is characterized by 2n = 24 (*H. thyrsiforme*), seven by 2n = 34 (*H. villosum, H. coronarium, H. coronarium* var. *maximum, H. coronarium* var. *angustifolium, H. flavum, H. aurantiacum* and *H. gardnerianum*), and others by 2n = 51 (*H. greenii*) and 2n = 52 (*H. flavescens*). They studied the earlier reports of the genus in detail and suggested that, n = 17 can be considered as the haploid set of the ancestral forms of most of the species and which was derived from those with n = 12 at a certain stage in evolution. Mahanty (1970) based upon the meiotic behaviour of pollen mother cells of

H. thyrsiforme, stated that, 17 bivalents are found at the first metaphase and the pairing seems to be regular. Ramachandran (1968) determined the chromosome number of two clones of *H. coronarium* and confirmed the basic number as n = 17.

Anatomy

Jayasree (2007) studied the anatomy of South Indian Zingiberaceae, including three species of *Hedychium*, *viz.*, *H. coronarium, H. flavescens* and *H. spicatum*, and separated them based on the anatomical characters. She identified the intercostal cells of the adaxial epidermis are polygonal with longer axis perpendicular to the longitudinal veins in all species studied. Among the South Indian species, epidermal cells are larger in *H. coronarium*. Costal cells of the abaxial epidermis are broader in all species, and has maximum width in *H. spicatum* with oil cells. Trichomes are present on the abaxial epidermis of all species. Lengths of guard cells are almost same in all the three species. Abaxial surface of the sheath are hairy in *H. flavescens*, whereas in other two species it is glabrous. Calcium oxalate crystals are present in the chlorenchymatous and guard parenchyma cells of *H. flavescens* and *H. spicatum*. Starch grains are present in the chlorenchyma cells of *H. spicatum*. In all the three species studied, there is a continuous hypodermis both abaxially and adaxially. Adaxially it is two layered in *H. coronarium* and *H. flavescens*, but it is not consistent in *H. spicatum*. In all species two layers of palisade cells are present. She concluded that, because of the close resemblances, the anatomical differentiation between *H. coronarium* and *H. flavescens* is difficult.

Pollination

As like most of the monocots, *Hedychium* is also adapted to pollination by animals, mostly insects. Large brightly coloured flowers act as the primary means of attraction. The perianth, especially labellum and lateral staminodes, serves as a landing platform, a guide leading animals to feeding positions appropriate for

pollination. The nectar is present at the base of the long slender corolla tube to favour relatively long proboscised insects (Box & Rudall 2006). Production of floral scents as a means of secondary attraction is widespread in *Hedychium* with few exceptions (Larsen *et al.* 1998). The presence of downwardly directed hairs inside the tube restricts the entry of small insects like ants. In general Zingiberaceae have avian, hymenopteran and lepidopteran pollinators such as hummingbirds and euglossine bees (Box & Rudall *l.c.*). A fail-safe attachment of pollen upon the visitor's body is crucial in this monantherous *Hedychium* flower. The mucilage produced by the connective serves to attach pollen masses firmly on the visitor (Vogel 1998).

Phytochemistry

Many chemical constituents of Zingiberaceae, especially *Hedychium* were investigated. From the rhizomes of many species of *Hedychium* several monoterpenes, diterpenes and sesquiterpenes were isolated. Zhao *et al.* (2003) isolated two new diterpenoids, *viz*., Hedyforrestin-B and Hedyforrestin-C, from *H. forrestii*, which is having cytotoxic properties. Nakatani *et al.* (1994) isolated three new diterpenoids from *H. coronarium*, *viz*., Coronarin-B, Coronarin-D, and Isocoronarin-D. The rhizome extracts of *H. spicatum* were tested by Bisht *et al.* (2006) for their antibacterial and antifungal activities. Dixit and Verma (1979) studied the effect of essential oil of *H. coronarium* and *H. spicatum* on central nervous system on rats, and found that, oils possess mild transquilling action. The peak action of the essential oils was recorded 30 minutes after their administration. The essential oil also potentiated pentobarbitone induced hypnosis and marked analgesia.

Gopanraj *et al.* (2005) studied the composition of essential oil from the rhizomes of *Hedychium larsenii* M. Dan & Sathish by GC-FID and GC-MS techniques and identified 99% of the oil consisted of Monoterpenoids and Sesquiterpenoids were present only in negligible quantities. Linalool and 1,8-cineole were identified

as the major components of the essential oil. The oil showed moderate antibacterial activity against Gram-positive and Gram-negative bacteria. Dan *et al.* (2007) studied the rhizome oils of four *Hedychium* species, *viz*., *H. coronarium, H. flavescens, H. spicatum* var. *acuminatum* and *H. venustum*, of South India by GC-FID and GC-MS. They identified the oil yield is highest in *H. venustum* (0.16%) with fifty-seven constituents and lowest in *H. flavescens* (0.05%) with twenty five constituents. In *H. spicatum* var*. acuminatum* and *H. coronarium* oil yield is 0.13% with twenty five and twenty three constituents respectively. The major constituent in these species were the monoterpenes 1,8-cineole, β-pinene and linalool, constituting 70-75% of these oils.

There are many reports for the antibacterial and antifungal activities of rhizome extracts of *Hedychium*. Medeiros *et al.* (2003) tested the antimicrobial activity of essential oil from the species *H. gardnerianum,* and found that it is having a good activity against *Staphylococcus aureus* and *S. epidermis.* Xiao *et al.* (2001) isolated one new diterpene, 'Villosin', from *H. villosum*, and its structure has been elucidated by spectroscopic methods including mono and bi-dimentional NMR. Sharma *et al.* (1976) isolated a new Furanoditerpene, '7-Hydroxyhedychenone', from the rhizomes of *H. spicatum*. It is substantiated by spectroscopic data using NMR spectrum. Sharma *et al.* (1975) isolated one Furanoid Diterpene, 'Hedychenone', from *H. spicatum* rhizomes, deduced on the basis of spectroscopic and chemical evidences.

Cultivation

The *Hedychium* has more popular among the horticulturists mainly because of their easy mode of propagation and relatively disease and pest free nature. Paxton (1838) provided a detailed account on cultivation of some species of *Hedychium*. In the tropical climate of India, this can be easily propagated using rhizome cuttings, seeds or rarely by bulbils. Many species produce massive rhizomes, which can be used a propagule. A portion of rhizome with at least one

old and young aerial shoot constitutes a planting unit. Large rhizomes can be split into small pieces of convenient size and can be planted in pots containing potting mixture with the composition of 1:1:1 sand, soil and farm yard manure and allow to grow in shades. The best season for planting in India is from May onwards, *i.e.,* just after pre-monsoon showers. Deep planting of rhizomes should be avoided as many species are subterranean in nature. It may also result in the suppression of the growth of new shoots and cause death of plants due to decaying of underground rhizomes. Irrigation at regular intervals is required for proper growth and development of plants. A regular schedule of cultural practices consisting of weeding, mulching, trashing, shade regulation, manuring and irrigation is to be taken up.

Uses

Hedychium is the genus with much horticultural importance. At present, over 100 horticultural varieties have been bred world-wide (Gao *et al.* 2008). At least seven species are widely traded as garden ornamentals around the world, namely: *H. densiflorum* (ornamental cultivars include 'Assam orange' and 'Stephen'), *H. coronarium* (ornamental cultivars include 'Gold spot'), *H. flavescens*, *H. gardnerianum* (ornamental cultivars include 'Tara', 'Extendum' and 'Compactum'), *H. coccineum*, *H. spicatum* and *H. greenii* (Csurhes & Hannan-Jones 2008). A number of flowers are produced at a time, the brilliant coloured and delightfully fragrant flowers on terminal spike make the plant much attractive. Free inter-specific hybridization and ease of cultivation and propagation makes it much interesting genus for horticulturists. Flowers are valued as a perfume by the Arabs and Persians and also Hindus used it for the worship of God (Sawar 1894), and for the decoration of hair. It is also used as a symbol of love, when belles sent flowers of this plant as a present to a young man, is meant to reproach him with inconstancy in love (Smith 1811). *H. coronarium* is widely cultivated in Brazil for paper making (Beadle 1917). In Hawaii, flowers and roots of *H. coronarium* are

used as a remedy for fetid nostrils (Nagata 1971), also used for making leis and also as a source of perfume, rhizomes are stimulant and carminative. The flower of *H. coronarium* is eaten as vegetable. It is also a source of perfume (Sirirugsa 1998). In Thailand the rhizome of *H. coronarium* is used as a stimulant and carminative and a decoction of the stem is gargled for tonsillitis. The roots of *H. longicornutum* Griff. ex Baker, is used for the treatment of earache, and the pounded root or the whole plant is a remedy for intestinal worms (Sirirugsa *l.c.*). In India, rhizomes of *H. coronarium* are used as a febrifuge, anti-rheumatic, tonic and gargle in Folk system of medicine (Udayan & Balachandran 2009). *Hedychium spicatum* rhizomes are one of the ingredients of Ayurvedic preparations. It is used for the treatment of cardiac failure, splenic disease, asthma, hiccup, cough, digestive impairment, constipation, anaemia and pain in urinary bladder, sacral region, anus and female genital tract (Saraswathy *et al.* 2009). The therapeutic activity of the rhizome is due to its essential oil. The rhizome in powder form is sprinkled as an antiseptic agent and also used as a poultice for various aches and pains. It is a carminative and bronchodialator. The drug is an ingredient of some Ayurvedic preparations but rarely used in Unani system (Joy *et al.* 1998). Besides the medicinal properties the fruits are cooked and eaten in savoury dishes with lentils and also used for essential oil and incense (Bhatt *et al.* 2009).

Invasiveness

Without knowing the negative impact on indigenous flora, *H. gardnerianum* was introduced around the world through horticultural trade. It has become a dangerous invasive weed and later included under the list of *'100 of the World's Worst Invasive Alien Species'* (Lowe *et al.* 2000). It is now distributed throughout the tropics by invading natural forest ecosystems and causing threat to the indigenous species. The affected countries include Federated States of Micronesia, Fiji, New Caledonia, Cook Islands, Australia, French Polynesia, Hawaii, New Zealand, La Reunion Island (France), South Africa and Jamaica (Sankaran 2008).

H. coronarium is naturalised in south-east Queensland and in North Queensland, though it shows slow growth, it may develop into a troublesome weed like *H. gardnerianum* in future. *H. flavescens* is another popular garden plant that has become a major threat in New Zealand and Hawaii (Csurhes & Hannan-Jones 2008).

Phylogeny and Evolution

Kress (1990) derived a new classification of the order Zingiberales based on the cladistic studies. Among the eight families only ginger group is monophyletic, but the banana group is paraphyletic. Musaceae at the base of the phylogenetic tree. Lowiaceae and Strelitziaceae form a clade, paraphyletic to Heliconiaceae. Later, cladistic analysis of the *rbc*L sequence data (Smith *et al.* 1993) also recognized eight families under Zingiberales. But they identified, except Musaceae, all seven families are monophyletic, but Musaceae is paraphyletic with the Cannaceae.

Phylogenetic studies based on the ITS sequence well supported the monophyly of the genus *Hedychium* (Wood *et al.* 2000) with a bootstrap value of 100%, and resulted in the four moderately supported clades. But its affinity with *Cautleya, Pommereschea* Wittm.*, Rhynchanthus* and *Roscoea* is weekly supported, as expected on the morphology. They concluded that, the genus *Hedychium* is monophyletic and includes the genus *Brachychilum*. They also proposed four clades, *viz*., Clade I, Clade II, Clade III, Clade IV. Of which Clade IV (three to five flowers per bract) and Clade II (one flower per bract), have a natural circum-himalayan distribution; where as Clade I (one or two flowers per bract) occur only in the Malay Peninsula, Philippines, Borneo, Sumatra, Java, Sulawesi, and the Moluccas. The position of Clade III (*H*. *acuminatum*) is uncertain but probably includes *H. venustum* on the basis of morphology. The molecular phylogenetic classification (Wood *et al.* 2000) is contrary to Schuman's (1904) classification based on morphology in many cases. This analysis emphasised that the most important factor in the evolution of this genus is geographic and ecological

isolation. They also suggested that tribal concepts need to be re-evaluated in the *Zingiberaceae.*

Phenetic studies on this genus by Wood (1996) suggested that there is a significant genetic distance between the circumhimalayan terrestrial species and the Southeast Asian and Indonesian lowland epiphytic species. Based on this he hoped to establish two subgenera *Himalayanum* T. Wood and *Malesianum* T. Wood. He himself did not follow this classification in his future works.

Evolutionary studies by Kress *et al.* (2005) indicate that the Zingiberales originated in the Jurrassic, 158 Ma, with an ancestral distribution in the Americas, Africa and Southeast Asia (*i.e.*, tropical Gondwanaland). It suggests that this specialized group of plants had an early origin in angiosperm history with a broad tropical distribution. The three main lineages of the banana-families originated about 97 Ma in the early Cretaceous although the split between the Lowiaceae and the Strelitziaceae did not occur until 49 Ma in the middle Eocene. The ginger-families began to diversify 88 Ma with the Costaceae diverging from the Zingiberaceae and Marantaceae from the Cannaceae 83 Ma and 80 Ma respectively. There for by the end of the Cretaceous six of the eight currently recognized families had become independent lineages with the final two families (Strelitziaceae and Lowiaceae) diverging in the early Tertiary. In the ginger families within-family lineages began to diverge in the late Cretaceous and Tertiary at 65 Ma in the Zingiberaceae.

CLASSIFICATION

Linnaeus outlined the classification of Plants, Animals, Stones and Minerals in his *Systema Naturae* (1735), and later the Plant Kingdom in *Species Plantarum* (1753). He divided the plant kingdom in to 24 classes and further to subclasses on the basis of sexual characters, based on the number, arrangement and fusion of sexual parts. Linnaeus included 4 genera and 9 species of Zingiberaceous taxa under 'Monandria Monogynia'. These include *Amomum zingiber* L.*, A. zerumbet* L.*, A. cardamom* L.*, A. granparad* L.*, Alpinia racemosa* L.*, Curcuma rotunda* L.*, C. longa* L.*, Kaempferia galanga* L. and *K. rotunda* L. He also included other genera like *Canna* L., *Costus* L. and *Maranta* L., and the unrelated *Boerhavia* L. (Nyctaginaceae) and *Salicornia* L. (Chenopodiaceae) under 'Monandria Monogynia'. Subsequently some of them have been transferred to other genera, *viz*., *Amomum zingiber* to *Zingiber officinale*, *A. zerumbet* to *Z. zerumbet*, *A. cardamom* to *Elettaria cardamom* and *Curcuma rotunda* to *Boesenbergia rotunda*.

Bernard de Jussieu classified the plants on the basis of their natural affinity (de Jussieu 1789). Among Monocotyledons he treated about all Scitaminean plants under two natural orders *viz.*, Cannae and Musae. The Cannae includes genera like *Canna* L.*, Amomum* L.*, Costus* L.*, Alpinia* L.*, Maranta* L.*, Curcuma* L.*, Kaempferia* L. and *Thalia* L., and the genus *Musa* L. under 'Musae' along with *Bromelia* L., *Galanthus* L., *Leuconium* L. *etc.* Antoine Laurent de Jussieu (*l.c.*) freely edited and incorporated the works of his predecessor, and proposed first complete natural system of classification in his *Genera Plantarum*. He divided the Monocotyledons in to three classes, *viz*., Stamina hypogyna, Stamina perigyna and Stamina epigyna. He further divided the last class in to four orders, *viz*., Musae Juss., Cannae Juss., Orchides Juss. and *Hydrocharides* Juss. As like his predecessors, under the order Cannae, he included the genera, like *Catimbium* L.*, Canna, Globba* L.*, Myrosma* L.*, Amomum, Costus, Alpinia, Maranta, Thalia, Curcuma, Kaempferia* and *Hedychium* J. Koenig (under the appendix p. 448). He rearranged the constituent taxa of the

order Musae of B. de Jussieu (*l.c.*), and separated all other unrelated genera and treated the genus *Musa* along with two new additions, *Heliconia* L. and *Ravenala* L.

Adanson (1763) treated all the scitaminean taxa as a single family, Zingiberes Adans. He included 16 genera under this family, *viz*., *Alpinia* L., *Ananas* Mill., *Bihai* Mill., *Bromelia* L., *Caraguata* Adans., *Costus* L., *Curcuma* L., *Hoiriri* Adans., *Karatas* Mill*., Katubala* Adans., *Maranta* L., *Musa* L., *Pacoseroca* Adans., *Pinguin* Adans., *Ravenala* Adans. and *Zingiber* Boehm. Later many of them were transferred to other families.

Roscoe (1807) provided a detailed account of Monandria Monogynia and divided into two classes, *viz*., Cannae and Scitamineae L. And he naturally divided the Monandrian plants in to two tribes, Cannae, a name applied by Jussieu (1789) to the whole tribe, (includes *Canna, Maranta, Thalia, Phrynium* Willd. and *Myrosma*) and Scitamineae to include the "true Scitaminean" plants (includes *Phylidrum* Willd*., Hedychium, Alpinia, Zingiber, Costus, Kaempferia, Amomum, Curcuma* and *Globba*). Later in the modified form of his earlier work, *i.e., Monandrian Plants of the order Scitamineae* (Roscoe 1824-1828), he designated his former tribes (Cannae and Scitamineae) as the sections, and provided synoptic keys to the genera and species.

Richard (1808, 1811, 1819) used the name Zingiberaceae Adans. in his *Demonstrations Botaniques, ou Analyse Du Fruit*. In which he proposed a new system of classification on the basis of embryologic characters, and primary divided the plants in to 'Exembryonatae' and 'Embryonatae' and the classified into 'Anarhizae' and the latter into 'Endorhizae, Synorhizae and Exorhizae'. He used the name Zingiberaceae to denote a group of plants coming under the Endorhizae.

Roxburgh (1810) treated Monandrous plants under two subheads *i.e.,* 'Anther simple' and 'Anther double' with *Canna* and *Phrynium* in the former group and 8 genera under the latter group, *viz*., *Hedychium, Kaempferia, Curcuma,*

Amomum, Zingiber, Costus, Alpinia and *Globba*. He further divided the two genera, *Curcuma* and *Zingiber*, in to two sections based on the position of inflorescence.

Roxburgh (1814) followed the Linnaean system of classification and divided the whole plants in to five classes on the basis of sexual characters. He treated the whole Scitaminean plants under the 'Class I' and Subclass 'Monandria Monogynia' along with the unrelated taxa like *Lopezia* Cav., (Onagraceae) *Boerhavia* (Nyctaginaceae) and *Mithridatea* Comm. ex Schreb. (Monimiaceae). This classification was followed in his later works, *Flora Indica* (Roxburgh 1820, 1832).

Link (1821) divided the 'Monandria Monogynia' in to six subgroups. Of which Scitamineae was further divided in to Cannaceae Juss. and Alpiniaceae Link. He separated the true Scitaminean plants from Cannaceae and treated under Alpiniaceae. The genera like *Canna*, *Maranta* and *Thalia* were retained under Cannaceae and the genera like *Hedychium*, *Kaempferia, Curcuma, Amomum* Roxb.*, Zingiber, Costus, Alpinia* and *Globba* under Alpiniaceae. The genera like *Heliconia* and *Strelitzia* Banks were treated under Musaceae Juss. under 'Pentandria Monogyna'.

Agardh (1822) recognized the class 'Gynandrae' under the 'Cryptocotyledoneae'. Which further divided in to four orders (equivalent to current families), *viz*., Cannaceae, Musaceae, Scitamineae and Orchideae Juss. Eleven Scitaminean genera, like *Hedychium*, *Kaempferia*, *Curcuma*, *Amomum*, *Zingiber*, *Costus*, *Hellenia* Willd., *Alpinia*, *Globba*, *Roscoea* Sm. and *Hornstedtia* Retz., were placed under Scitamineae, without any further divisions.

The first major attempt to subdivide the family was made by Blume (1827). He divided Scitamineae it into five sections (equivalent to tribes), *viz*., Sect. 1. Zingibera Blume includes the genera like *Zingiber*, *Curcuma*, and *Kaempferia*. Sect. 2. Amomae Blume includes *Amomum*, *Elettaria* Maton, *Donacodes* Blume, *Diracodes* Blume and *Hedychium*. Sect. 3. Alpiniae Blume includes *Alpinia*, *Hellenia*

and *Cenolophon* Blume. Sect. 4. Costi Blume includes *Costus* only. Sect. 5. Globbae Blume includes *Globba* only. The genera like *Canna*, *Maranta* and *Phrynium* were treated under Canneae. These ranks are, of course, not acceptable for subdivisions of a family under the International Code (Burtt 1972, Burtt & Smith 1972b).

Dumortier (1829) recognized two orders, Cannarieae Dumort. and Orchidarieae Dumort., under the class Gynotepalae. The former is further divided into three families, Curcumaceae Dumort., Cannaceae and Musaceae. The genera like *Globba*, *Mantisia* Sims, *Curcuma*, *Kaempferia*, *Roscoea*, *Zingiber*, *Amomum*, *Costus*, *Alpinia*, *Hellenia*, *Gethyra* Salib., *Elettaria* and *Hedychium* were under the family Curcumaceae.

Wight (1834) by retaining Jussieu's (*l.c.*) division classified Monocotyledons in to three classes, *viz*., Monohypogyneae (stamens hypogynous), Monoperigyneae (stamens perigynous) and Monoepigyneae (stamens epigynous). Later Wight (1853) in *Icones Plantarum Indiae Orientalis* also treated Scitamineae as inclusive of three natural orders Cannaceae, Musaceae and Zingiberaceae. And without any further division Zingiberaceae is treated with 10 genera and 26 species.

Likewise, Endlicher (1837) treated Scitamineae as the Class, and is further subdivided in to three orders, *viz*., Cannaceae Musaceae and Zingiberaceae. By following Blume (*l.c.*) Zingiberaceae is further classified and treated 18 genera under the five sections, Alpiniae, Amoma, Costi, Globbae and Zingibera. He treated the genus *Hedychium* under the section Amomae along with the genera *Amomum, Elettaria, Donacodes* and *Diracodes*.

Lestiboudois (1841) formulated a new classification and divided the Scitaminean plants ("Scitaminees") in to six classes, *viz*., Kaempferiees Lestib., Hedychiees Lestib., Curcumees Lestib., Alpiniees Lestib., Costoidees Lestib. and Mantisees Lasib. In order to include the *Hedychium speciosum* Wall*.,* with entire

labellum, he erected a new genus, *Gamochilus.* Under Hedychiees he included *Hedychium, Gamochilus* T. Lestib. and *Roscoea*.

Meisner (1843) followed Wight's (*l.c.,*) and Endlicher's (*l.c.*) classification, *i.e.,* class Scitamineae with three natural orders Cannaceae, Musaceae, Zingiberaceae. But he re-designated the Blumes' former sections, *i.e*., Alpiniae, Amoma, Costi, Globbae and Zingibera, as tribes. He included the tribe Alpinieae with *Renealmia* L., *Alpinia*, *Hellenia*, *Kolowratia* Presl., *Cenolophon*, *Leptosolena* Presl., *Gastrochilus* Wall. and *Monolophus* Wall., the tribe Amomeae with *Hedychium*, *Elattaria*, *Donacodes*, *Diracodes* and *Amomum*, the tribe Costeae with *Costus* only, the tribe Globbeae with *Globba* and *Monocystis* Lindl., and the tribe Zingibereae with *Zingiber*, *Roscoea*, *Curcuma*, *Hitchenia* Wall. and *Kaempferia*.

Hasskarl (1844) also divided the Class Scitamineae in to three orders, Cannaceae, Musaceae and Zingiberaceae. But the five subdivisions of the order Zingiberaceae is redesignated as suborders, *viz*., Alpiniae (with *Alpinia* and *Hellenia*), Amoma (with *Amomum, Elettaria, Donacodes* and *Hedychium*), Costi (with *Costus* only), Globbeae (*Globba* only), and Zingibera (*Zingiber, Curcuma* and *Kaempferia*).

Horaninow (1862) recognized Scitamineae in the ordinal status and subdivided it in to four families, *viz*., Amomaceae J.St.-Hill., Cannaceae, Marantaceae R. Br. and Musaceae. Following Meisner (*l.c.*) the family Amomaceae is subdivided in to four groups and are re-designated as tribes. He exchanged the genus *Hedychium* from Amomeae to Zingibereae and the genus *Zingiber* from Zingibereae to Amomeae. The tribe Zingibereae was renamed as Hedychieae Horan. and retained the name Amomeae. He also combined the tribe Globbeae with his Hedychieae. Thus, he recognized four tribes under the family Amomaceae, *viz*., Alpinieae, Amomeae, Costeae and Hedychieae. The genus *Hedychium* is further divided in to three infrageneric groups, *viz*., *Brachychilum* R. Br. ex Wall., *Gandasulium* Rumph. ex Horan. and *Macrostemium* Horan.

Bentham and Hooker (1883) divided the Monocoatyledons into 7 series. Among them, the Series Epigynae is further divided into 7 orders including Scitamineae. They identified four tribes, Canneae, Maranteae R. Br., and Museae, Zingibereae under Scitaminae, and grouped the entire Zingiberaceaen taxa as a single tribe Zingibereae. Under Zingibereae they treated 21 genera including the genus *Hedychium*. Later authors recognized these tribes as separate families and gave ordinal status to Scitamineae of Bentham and Hooker.

Engler and Prantl (1887-1915) treated Scitamineae as a distinct order with four families, Cannaceae, Marantaceae, Musaceae and Zingiberaceae. Petersen (1888) readily divided the family Zingiberaceae in to three natural groups or tribes, *viz*., Globbeae, Hedychieae and Zingibereae. Here the tribe Globbeae is reinstated by separating *Globba* and *Mantisia,* along with *Guillainia* Vieill. and *Hemiorchis* Kurz, from Hedychieae, and they combined the tribes Amomeae, Alpinieae and Costeae to form the Zingibereae. Under Hedychieae seven genera, *Roscoea*, *Cautleya* Royle, *Curcuma*, *Hitchenia*, *Hedychium*, *Kaempferia* and *Gastrochilus* were included.

Kuntze (1891) reduced the order Scitamineae to the family level, Scitaminaceae Kuntze, and described readily under Monocotyledons.

Baker (1890-1892) followed Bentham and Hooker (*l.c.*) and identified four tribes*,* under the order Scitamineae, *viz*., Canneae (includes *Canna* only), Maranteae (includes *Clinogyne* Salisb. and *Phrynium*), Museae (includes *Musa* and *Lowia* Scort.) and Zingibereae (includes *Mantisia, Globba, Hemiorchis, Roscoea, Cautleya, Curcuma, Gastrochilus, Kaempferia, Hitchenia, Hedychium, Amomum, Zingiber, Costus, Cyphostigma* Benth.*, Elettaria, Elettariopsis* Baker*, Scaphochlamys* Baker*, Alpinia* and *Rhynchanthus* Hook. f.).

Schumann (1900) divided the family Zingiberaceae in to two subfamilies, Costoideae, Zingiberoideae and further in to tribes. He merged the former tribes

(Peterson's *l.c.*) Globbeae with Hedychieae and recognized only two tribes under the Subfamily Zingiberoideae, *viz*., Hedychieae and Zingibereae. The former subfamily includes the genera like *Globba, Haplochorema* K. Schum.*, Curcuma, Kaempferia, Hedychium, Nanochilus* K. Schum. and *Brachychilus* Petersen, the latter subfamily includes the genera like *Zingiber, Alpinia, Amomum, Riedelia* Meisn. and *Hellwigia* Warb. By following Peterson (*l.c.*) he also maintained a separate genus *Brachychilus* Peterson, for *Hedychium horsfieldii.* He recognized two subgeneric groups of *Hedychium* and designated them as sections, Sect.: *Gandasulium* Rumph. ex K. Schum. and Sect.: *Macrostemium* Horan. ex K. Schum. Later Schumann (1904), reinstated the tribe Globbeae with the genera *Globba*, *Hemiorchis, Gagnepainia* K. Schum. and *Mantisia.* Thus he recognized three tribes, Globbeae*,* Hedychieae and Zingibereae (Peterson *l.c.*). Based on the inflorescence and bract characters, he identified two sections under *Hedychium.* He retained the section *Gandasulium* and erected another new section *Euosmianthus* K. Schum, to include the entire *Macrostemium* and some species of earlier *Gandasulium*.

Loesener (1930) followed Schumann's (1904) familian and subfamilian classification and distinguished three tribes under the subfamily Zingiberoideae, *i.e*., Globbeae*,* Hedychieae and Zingibereae. Under *Hedychium,* he also recognized two sections, *Gandasulium* and *Euosmianthus*.

Nakai (1941) recognized eight families under the order Zingiberales, *viz*., Musaceae, Strelitziaceae, Lowiaceae, Heliconiaceae, Zingiberaceae, Costaceae, Marantaceae and Cannaceae. Dahlgren and Rasmussen (1983) followed Nakai's view in their phylogenetic classification also.

Holttum (1950) followed Schumann's familian divisions, Zingiberoideae and Costoideae, and proposed a new subdivision for Zingiberoideae. He made some realignments in the tribes of Schumann. He transferred the genus *Zingiber* from the *Alpinia* group (tribe Zingibereae) and renamed it as Alpinieae, and placed the genus *Zingiber* under the tribe Hedychieae. Thus he recognized three tribes, Alpinieae,

Globbeae and Hedychieae (includes *Zingiber, Curcuma, Hedychium, Camptandra* Ridl.*, Scaphochlamys, Boesenbergia* Kuntze*, Kaempferia* and *Haniffia* Holttum).

In the *Systematic Anatomy of Zingiberaceae*, Tomlinson (1956) followed Schumann (1900) in the subfamilial classification of the family and treated Zingiberoideae and Costoideae as separate subfamilies. He remarked that, "they differ considerably in morphological, cytological and palynological features, as well as in their anatomy". Later, Tomlinson (1962) followed Nakai (*l.c.*) in the classification of the order and combined both morphological and anatomical characters for the analysis of evolutionary relationship of eight families.

Mitra (1958) followed Holttum (*l.c.*) and treated the family Zingiberaceae with subfamilies Zingiberoideae and Costoideae. Under Zingiberoideae three tribes are treated, *viz*., Hedychieae (includes *Hedychium, Kaempferia, Boesenbergia, Hitchenia, Curcuma, Roscoea* and *Cautleya*), Globbeae (includes *Hemiorchis, Globba* and *Mantisia*) and Zingibereae (includes *Zingiber, Amomum* and *Alpinia*). In which *Hedychium* consists of 19 species, and 7 varieties.

Naik and Panigrahi (1961) recognized 17 species of *Hedychium* from Eastern India. He casually grouped the *Hedychium,* on the basis of lip, into two broad categories, deeply bifid and entire or bifid. Deeply bifid type further divided in to further classes 1. Coronarium type, 2. Marginatum type, 3. Venustum type and 4. Gracile type. The entire or emarginate type further classified as 1. Ellipticum type and 2. Gratum type.

Burtt and Olatunji (1972) separated *Zingiber* from tribe Hedychieae and restricted the tribe Zingibereae to the genus *Zingiber* alone. They distinguished the *Zingiber* from Hedychieae in having well exerted style and well developed anther crest, which is wrapped around the style as a beak. In Hedychieae the stigma is exerted just beyond the anther-thecae, and if an anther crest is present it is flat and may overtop the stigma. They also identified the lateral staminodes in

Hedychieae are free from labellum and are conspicuous, whereas in *Zingiber* it is attached with the labellum, seen as two lobes at the base, and are described as adnate staminodes. In vegetative feature also *Zingiber* is distinct from Hedychieae, in having a pulvinus below the lamina. Later Burtt and Smith (1972a) proposed a new infrafamilian classification of Zingiberaceae. Following Schumann (*l.c.*) they also recognized two subfamilies under this family, Zingiberoideae and Costoideae, but classified the Zingiberoideae in to 4 tribes, *viz*., Alpinieae, Globbeae, Hedychieae and Zingibereae (only one genus: *Zingiber*).

Larsen *et al.* (1998) in Kubitzki's *The Families and Genera of Vascular plants,* treated Zingiberaceae and Costaceae at family rank and retained all the four tribes, Alpinieae, Globbeae, Hedychieae and Zingibereae under the family Zingiberaceae.

Kress (1990) derived a new classification of the order Zingiberales based on the cladistic studies. He proposed five new Suborders under the order Zingiberales, *viz*., Musineae W.J. Kress (includes family Musaceae only), Strelitzineae W.J. Kress (includes family Strelitziaceae only), Lowineae W.J. Kress (includes family Lowiaceae only), Heliconineae W.J. Kress (includes family Heliconiaceae only) and Zingiberineae W.J. Kress. The Suborder Zingiberineae further divide into two new Superfamilies, *viz*., Zingiberariae W.J. Kress and Cannariae W.J. Kress. These two superfamilies are accommodated with two families each, Zingiberaceae and Costaceae in the former and Cannaceae and Marantaceae in the latter. The classification is as follows.

Order : Zingiberales Nakai

1. Suborder : Musineae W.J. Kress
   Family : Musaceae Juss.
2. Suborder : Strelitzineae W.J. Kress
   Family : Strelitziaceae Hutch.
3. Suborder : Lowineae W.J. Kress
   Family : Lowiaceae Ridl.

4. Suborder : Heliconineae W.J. Kress
Family : Heliconiaceae Nakai
5. Suborder : Zingiberineae W.J. Kress
Super family : Zingiberariae W.J. Kress
Family : Zingiberaceae Lindl.
Family : Costaceae Nakai
Super family : Cannariae W.J. Kress
Family : Cannaceae Juss.
Family : Marantaceae Petersen

According to Kress (1990), among the eight families only ginger group is monophyletic, but the banana group is paraphyletic. Musaceae at the base of the phylogenetic tree, Lowiaceae and Strelitziaceae form a clade, paraphyletic to Heliconiaceae. Later, cladistic analysis of the *rbc*L sequence data (Smith *et al.* 1993) produced a single parsimonious tree for the families of the Zingiberales, but that differs from any previous phylogenetic analysis of morphological data. They also recognized eight families under Zingiberales, with a different inter-relationship. Among them, except Musaceae, all families are monophyletic, and Musaceae is paraphyletic with the Cannaceae.

Recently, Kress *et al.* (2002) proposed a new infrafamilial classification of Zingiberaceae, based on the evidences from molecular data, are later followed by Larsen (2005). In which they proposed a realignment of the genera of the family Zingiberaceae into four subfamilies, *i.e.,* Siphonochiloideae W.J. Kress (includes the tribe Siphonochileae W.J. Kress and genus *Siphonochilus* J.N. Wood & Franks), Tamijioideae W.J. Kress (includes the tribe Tamijieae W.J. Kress and genus *Tamijia* S. Sakai & Nagam.), Alpinioideae (includes most of the members of the former tribe Alpinieae) and Zingiberoideae (includes most of the members of the former tribes Hedychieae, Zingibereae and Globbeae). Within the Alpinioideae they recognized two tribes Alpinieae and Ridelieae W.J. Kress. Within Zingiberoideae two tribes

were also recognized to distinguish most of the old Hedychieae (current Zingibereae) from Globbeae. The subfamilies and tribes recognized by Kress *et al.* (2002), represent natural groups and are worldwide in scope and hence this classification is accepted in the present treatment.

Family: Zingiberaceae

I. Subfamily : Tamijioideae W.J. Kress
Tribe : Tamijieae W.J. Kress
2. Subfamily : Siphonochiloideae W.J. Kress
Tribe : Siphonochileae W.J. Kress
3. Subfamily : Alpinioideae Link
Tribe : Ridelieae W.J. Kress
Tribe : Alpinieae A. Rich.
4. Subfamily : Zingiberoideae Hassk.
Tribe : Zingibereae Meisn.
Tribe : Globbeae Meisn.

GENERIC HISTORY – HEDYCHIUM

The first mention of the genus *Hedychium* was in *Herbarium Amboinense* of George Eberland Rumphius (1747), and edited by Johannes Burman. He described and published under the name *Gandasulium* Rumph. (5: 69. fig. 3), with an excellent illustration of habit and a single flower. He mentioned the use of flower as ornamental and rhizomes to treat sore throat. The term '*Gandasulium*' was derived from two Malaya words ('*Ganda*'=smell or odour and '*Suli*'=Queen), which means Queen's perfume of Queen of perfume (Wallich 1853). As it has been published as a pre-linnaean work and a monomial, it cannot be considered or accepted (McNeill *et al.* 2006).

Linnaeus (1753) did not include the Rumphian monomial, in his *Species Plantarum*. Later, one of his students Olaf Stickman produced a *Dissertation on the Rumphius' Herbarium Amboinense*, and it was published in journal *Amoenitatus Academicae* (1759), edited by Linnaeus. In which they listed the Rumphian names in the left-hand column and Linnaean equivalents or equivalents from *Hortus Malabaricus* of van Rheede (1682) in the right-hand column. Here, the Rumphian name *Gandasulium* is mentioned but without any Linnaean equivalent, description or diagnosis.

On the basis of a proposal by Fosberg (1981), 13th botanical congress at Sydney (1981) rejected the Rumphian names in the Stickman's thesis. "*The designations listed in the left-hand column of the Linnaean thesis Herbarium Amboinense defended by Stickman (1754) were not names accepted by Linnaeus upon publication and are not validly published*" (ICBN, Art. 34.1 Ex. 2, Voss *et al.* 1983).

Koenig, a botanist employed by the East India Company in Madras, validly described the Rumphian species as *Hedychium coronarium* J. Koenig, in Retzius' third fascicle of *Observations Botanicae* (1783). The brief description of the genus provided by Retzius, *"Limbus uterque tripartitus. Anthera nuda basi hastata",* can be translated as: Both limbs in three parts, anther naked with hastate base. No type specimen of Koenig is extant as all of them were lost in a shipwreck (Burtt & Smith 1972b). As he mentioned Rumphius' figure in the protologue, it was established as the type for the genus (ICBN, Sec. 7.7 Ex. 4, McNeill *et al.* 2006). The generic epithet has been derived from two Greek words: '*Hedys'*, means sweet, and '*Chion'*, means snow, referring to the highly fragrant and pure white flowers of *H. coronarium*.

Linnaeus (1753) hardly made less than 20 references of the *Herbarium Amboinense* in his *Species Plantarum*. He was, himself, aware of some shortcoming as he explained that the *Herbarium Amboinense* arrived too late to be thoroughly

studied (de Wit, 1952). But Kuntze (1891) contended in his *Revisio Generum Plantarum* that, Linnaeus neglected the work of Rumphius intentionally and for base motives. He attempted to reduce, *Hedychium* as the synonym of *Gandasulium.* In which he proposed some new taxa and new combinations, including *Gandasulium coronarium* Kuntze, by transferring all the species known yet. As the *Gandasulium* is an illegitimate name it also cannot be accepted as per code (McNeill *et al.* 2006).

Since Koenig (*l.c.*), the later workers like Smith (1811), Roxburgh (1810, 1814, 1820), Roscoe (1807, 1824-1828) Wallich (1853, 1855), Wight (1853), Horaninow (1862), Baker (1890-1892), Schumann (1900, 1904) *etc.* described this delightful genus as *Hedychium* and also added many species.

INFRAGENERIC CLASSIFICATION - HEDYCHIUM

The genus *Hedychium* J. Koenig, was first divided by Lestiboudois (1841) in to two genera. On the basis of labellum character he erected a new genus *Gamochilus* T. Lestib. to include only one species *H. speciosum* Wall. with entire labellum, and the other to include all the remaining Hedychiums with bifid Labellum.

Wallich (1853), for the first time provided the infrageneric classification, mainly based on the inflorescence characters, into four groups.

1. *Coronariae* Wall.: more or less lightly imbricate spike. It includes the species like *H. coronarium* J. Koenig (type species), *H. flavescens* Lodd., *H. urophyllum* Lodd., *H. maximum* Roscoe, *H. flavum* Roxb., *H. ellipticum* Buch.-Ham. ex Sm., *H. thyrsiforme* Buch.-Ham. ex Sm. *etc.*

2. *Spicatae* Wall.: elongated spike with distant spreading bracts. It includes the species like *H*. *spicatum* Buch.-Ham. ex Sm. (type species), *H. venustum* Wight*, H. villosum* Wall.*, H. gracile* Roxb.*, H. densiflorum* Wall.*, H. gomezianum* Wall.*, H. griffithianum* Wall.*, H. gardnerianum* Ker Gwal.*, H. angustifolium* Roxb.*, H. coccineum* Buch.-Ham. ex Sm. *etc.*

3. *Siphonium* Wall.: a slightly crested anther and stemless habit. It includes only one species*, H. scaposum,* currently treating under the genus *Curcuma*.

4. *Brachychilum* R. Br. ex Wall.: labellum almost lacking with two wide lateral staminodes. It includes only one cleistogamous species, *H. horsfieldii* R. Br. ex Wall.

This was followed by Wallich in his later works (1855) and Mueller (1861). While describing these infrageneric groups Wallich fail to give any particular rank and thus not valid (ICBN, Art. 35.2, McNeill *et al.* 2006).

Horaninow (1862) broadly classified the genus mainly based on the comparative length of labellum and stamen. He divided the genus in to three groups by retaining the *Brachychilum* with only one species. The other two new groups include

1. *Gandasulium* Rumph. ex Horan. (stamen shorter than or equal to the length of labellum) including the species like *H. coronarium*, *H. maximum, H. urophyllum, H. flavum, H. spicatum, H. acuminatum* Roscoe*, H. venustum, H. densiflorum etc.*

2. *Macrostemium* Horan. (stamen much longer than labellum) including the species like *H. ellipticum, H. thyrsiforme, H. gardnerianum, H. gomezianum, H. griffithianum, H. villosum, H. gracile, H. angustifolium, H. coccineum, H. elatum* R. Br. *etc.* He also placed four Indonesian species as '*Incertae Sedis'*. Here also, Horaninow (*l.c.*) did not mention any rank for these groups.

Baker (1892) followed Horaninow's (*l.c.*) classification, but designated them as 'Sections' and recognized only two sections, Sect. *Gandasulium* Rumph. ex Baker and Sect. *Macrostemium* Horan. ex Baker.

Schumann (1904) redefined the *Gandasulium* as 'Subgenus' and to include those taxa with short and wide, ellipsoid, ovoid, rarely long cylindrical inflorescence; with bracts flat, densely imbricate, rarely arched; and with rachis always hidden. He erected another subgenus *Euosmianthus* K. Schum. to include *Macrostemium* and part of earlier *Gandasulium.* It includes taxa with less dense, with longer than wide inflorescence, bracts never densely imbricate, commonly patent or divergent, or distant from each other, clasping flowers; and with rachis not hidden. He separated the genus *Brachychilus* Petersen from *Hedychium* to include *H. horsfieldii*. with a new Molukken species, *H. tanellum* K. Schum.

Preliminary phenetic analysis of Wood (1996), with 15 species of *Hedychium* by using 11 inflorescence characters showed some support for grouping of this species in to two groups based on imbricate and tubular bracts.

Later, phylogenic analysis of 29 taxa based on ITS sequence data (Wood *et al.* 2000) highly supported the monophyly of *Hedychium*. It also identified four moderately supported clades and illustrated poor resolution within these clades due to low sequence divergence. The four clades form an unresolved polytomy in the bootstrap analysis. These clades are mainly distinguished on the basis of number of flowers per bract and are differently distributed. Clade I plants occur only in southern Vietnam, the Malay Peninsula, and Oceania. They are short, generally epiphytes or calciphiles, with a short day or day neutral photoperiod, slender inflorescences, one or two flowers per bract, and flowers much exserted from the bracts. Clade II is sister to Clade I and Clade III is sister to clades II and I. Clade III and Clade II are high altitude Himalayan species that have only one flower per bract and a strict dormancy requirement. Clade IV species have a wider circum-himalayan distribution at lower altitudes than Clades II and III. A comparison of

collection information from 23 herbarium specimens from Clade II and 43 specimens from Clade IV showed a mean altitude for Clade II of 1783 m and 1260 m for Clade IV. These tall plants do not normally go dormant in the winter and have three or more flowers per bract.

But our experience on the morphology of some species of Clade III and IV are not well supported by this phylogenetic classification. Based on the morphological characters we have synonymized *H. acuminatum* under *H. spicatum* Where as they are placed under different clades*. H. spicatum* is placed under Clade IV, characterized by tall plants, which do not go normally dormant in the winter and have three or more flower per bract. But we observed, not even a single plant of *H. spicatum* with more than one flower. *H. coccineum* is another species placed under Clade IV, but the number of flowers vary from 1-6 per bract. *H. urophyllum* and *H. elwesii* are three-flowered and *H*. *greenii* is 1-2 -flowered. It revealed that the phylogenic analysis using sequence data ITS 1 and 2 and 5.8 S nuclear ribosomal DNA are not supported by the morphology. Further molecular studies incorporating more taxa are essential for the phylogenetic classification of the genus. Furthermore, the characters like imbricate bracts and convolute bracts are good characters for grouping of the species. The number of flowers per bract can be considered as a solid character only when the bracts are invariably single-flowered, but in multi-flowered bracts the number of flowers may varies from 1 to many. Hence in this treatment we followed the classification of Schumann (1904), which is found to be more feasible and natural. The classification is as follows.

Subgenus I. *Gandasulium* Horan. ex K. Schum. — Inflorescence dense, short and wide, ellipsoid, ovoid, rarely long cylindrical; with bracts flat, densely imbricate, rarely arched; and with rachis always hidden.

Subgenus II. *Euosmianthus* K. Schum. — Inflorescence less dense and longer than wide; bracts never densely imbricate, commonly patent, or divergent, or distant from each other, clasping the flowers; and with rachis not hidden.

Hedychium

Hedychium J. Koenig in A.J. Retzius, Observ. Bot. 3: 73. 1783; Roxb., Asiat. Res. 11: 325. 1810, Fl. Ind. ed. Carey 1: 9. 1820; Sm. in A. Rees, Cyclop. 17. 1811; Roem. & Schult., Mant. Syst. Veg. 14. 1822; Spreng., Syst. Veg. 1: 9. 1825; Roscoe, Monandr. Pl. Scitam. 1828; A. Dietr., Sp. Pl. 1: 31. 1831; D. Dietr., Syn. Pl. 1: 9. 1839; Wall. in W.J. Hooker, Hooker's J. Bot. Kew Gard. Misc. 5: 325. 1853, J. Hort. Soc. London 9: 15. 1855; C. Muell., Ann. Bot. Syst. 6: 22. 1861; Horan., Prodr. Monogr. Scitam. 24. 1862; Baker in J.D. Hooker, Fl. Brit. India 6: 225. 1892; Trimen, Handb. Fl. Ceylon 4: 244. 1898; K. Schum. in A. Engler, Bot. Jahrb. Syst. 27: 339. 1899, in A. Engler, Pflanzenr. IV. 46(heft 20): 40. 1904; T. Cooke, Fl. Bombay 2: 234. 1907; Weathers, Bulb Book 268. 1911; C.E.C. Fisch., Rec. Bot. Surv. India 9: 178. 1921, in J.S. Gamble, Fl. Madras 3: 1484. 1928; Haines, Bot. Bihar Orissa 5: 1138. 1924; J.N. Mitra, Monocot. E. India 1: 241. 1958; Duthie, Fl. Gangetic Plain 2: 307. 1960; Backer & Bakh. f., Fl. Java 3: 64. 1968; Lourteig, Adansonia Ser. 2. 12(1): 122. 1972; A.S. Rao & D.M. Verma, Bull. Bot. Surv. India 14: 127. 1972; Ramamoorthy in Saldanha & Nicolson, Fl. Hassan Dist. 768. 1976; Rao & Razi, Fl. Mysore Dist. 581. 1981; J. Joseph, Fl. Nongpoh 305. 1982; Manilal & Sivar., Fl. Calicut 288. 1982; B.L. Burtt & R.M. Sm. in M.D. Dassanyake & F.R. Fosberg, Revis. Handb. Fl. Ceylon 4: 505. 1983; Deb, Fl. Tripura 2: 376. 1983; K.M. Matthew & Britto in K.M. Matthew, Fl. Tamil Nadu Carnatic 3: 1617. 1983; N.P. Balakr., Fl. Jowai 2: 526. 1983; Manilal, Fl. Silent Valley 313. 1988; Karthik. et al., Fl. Ind. Enum. Monocot. 294. 1989; R.M. Sm. in A.J.C. Grierson & D.G. Long, Fl. Bhutan 2: 199. 1991; K.G. Bhat, High. Pl. Ind. Subcont. 4: 87. 1993, Fl. Udupi, 631. 2003; M. Mohanan & A.N. Henry, Fl. Thruvananthapuram 3: 474. 1994; H.O. Saxena & Brahmam, Fl. Orissa 3:

1904. 1995; S.K. Jain & V. Prakash., Rheedea 5(2): 160. 1995; S.K. Srivast., Higher Pl. Ind. Subcont. 8(1-33): 21. 1998 (Ind. J. Forest. Addit. Ser. 10); T.L. Wu & K. Larsen in Z. Wu & P.H. Raven, Fl. China 24: 370. 2000; S. Kumar, Zingber. Sikkim 44. 2001; M. Sabu, Zingiber. Costac. S. India 191. 2006.

Type species: Hedychium coronarium J. Koenig

Gandasulium Rumph., Herb. Amboin. 5: 175. t. 69. fig. 3. 1747, *nom. illeg*.

Gandasulium Rumph. ex Kuntze, Rev. Gen. Pl. 2: 690. 1891.

Type: Gandasulium Rumph., Herb. Amboin. 5: 175. t. 69. fig. 3. 1747.

Gamochilus T. Lestib., Ann. Sci. Nat., Bot. 2(15): 341. 1841.

Type species: *Gamochilus speciosus* (Wall.) T. Lestib. (= *Hedychium speciosum* Wall.).

Common Name: Ginger Lily, Butterfly Lily.

Epiphytic, lithophytic terrestrial perennial rhizomatous herbs. *Rhizome* 1.3–5 cm wide, coloured internally, slightly aromatic or non-aromatic, fleshy; growth monopodial. *Leafy shoot* 25–300 cm high, slanting or erect with erect inflorescence, robust or slender. *Leaves* 4–24 in number, alternate, spreading, sessile or sub-sessile; sheath unilaterally split upto the base, margins coloured, membranous, translucent; ligule ovate-oblong, single-lobed or notched at tip, pubescent or glabrous externally, membranous, translucent, papery, closely appressed to the stem; lamina 13–68 x 4–18 cm, elliptic-oblong, dark green above, pale green below; margin undulate, membranous, hyaline, non-ciliate; tip twisted. *Inflorescence* 2.5–60 cm, a terminal spike, cylindrical or elliptic, dense or lax, erect or pendulous. *Bracts* 0.8–7 x 0.4–4.3 cm, convolute or imbricate; margin non-ciliate, translucent, membranous, cincinnus 1–many -flowered. *Bracteoles* 0.6–5.1 x 0.2–3.8 cm, tubular or non-tubular, outer one encircles the entire cincinnus. *Flower*

2.8–15.6 cm, showy, ascending or descending, fragrant or non-fragrant. *Calyx* 1–5.7 cm, tubular, membranous, translucent, upper portion inflated or non-inflated, lower portion closely appressed to corolla tube, unilaterally split, 2 or 3-toothed at tip. *Corolla tube* 0.8–9.6 cm, slender, hairy internally, erect or bend to one side at centre. *Corolla lobes* 1–6.2 x 0.15–1.3 cm, oblong or oblanceolate, white, coloured, membranous, drooping from flower, glabrous; dorsal lobe beaked at tip; lateral lobes non-beaked or minutely beaked at tip. *Lateral staminodes* petaloid, 0.8–6 x 0.3–3.4 cm, white or coloured, showy, usually as long as corolla lobes, elliptic, spatulate, oblanceolate, linear, gradually clawed towards base, spreading on flower, reflexed back. *Labellum* petaloid, 0.8–6.7 x 0.35–6.7 cm, showy, white or coloured, elliptic, spatulate, ovate, orbicular, oblanceolate, lanceolate, usually blotched at centre, spreading on flower, reflexed back on upper half, abruptly or gradually clawed at base, entire or emarginate at tip. *Stamen* 0.9–7.8 cm long, white or coloured, straight or arching (L-shaped), sub-sessile or filamentous. *Filament* 0.1–6.8 cm, slender. *Anther* 0.1–1.9 cm, elliptic or oblong (ovate), ciliate along thecae margins, split opens from top to bottom, attached with the filament at 1–6 mm above from base, thecae axis parallel or at an angle with the filament; connective glabrous, non-crested or minutely crested, tip slightly notched or truncate. *Ovary* 1.5–7 x 1.5–5 mm, inferior, oblong or barrel-shaped, glabrous or pubescent externally, trilocular, ovules many, placentation axile. *Style* filiform, white, glabrous, pubescent towards tip, broadens and green or yellow tinged towards stigma. *Stigma* green or yellow, cup-shaped, slanting with a depression at center, ciliate, exserted from the anther. *Epigynous glands* two, 1–6 cm, free or fused at base, oblong or finger-shaped, yellow. *Fruits* 0.8–6 x 0.8–3 cm, a loculicidal capsule, globose or ovate, three-angled, glabrous pubescent, trilocular; fruit wall green externally, orange or red internally, completely splitted and refexed back on dehiscence. *Seeds* red or black, compactly arranged on column or as globose mass. *Aril* red or black, lacerate, basal.

Notes: The genus was first described by Rumphius (1747) under the name *Gandasulium* in his *Herbarium Amboinense* appeared in part 5 (No. 69) as a pre-linnaean work. Koenig (1783) validly described this taxon as *Hedychium* with *H. coronarium* as the type species. The species was described in detail on the basis of Ramphius' plate.

Lestiboudois (1841) in *Annales des Sciences Naturelles; Botanique*, divided the genus *Hedychium* on the basis of labellum in to two genera. One is the nominal genus (labellum bifid) and another is *Gamochilus* T. Lestib., to include the species of *Hedychium* with entire labellum, with a single species *H. speciosum* Wall.

Subsequently, O. Kuntze contended in his *Revisio Generum Plantarum* (1891) that Linnaeus neglected the work of Rumphius intentionally and for base motives. He reduced *Hedychium* J. Koenig with *Gandasulium* Rumph., and proposed a new combination *G. coronarium* Rumph. ex Kuntze. Along with that he also proposed 6 new species and about 23 new combinations by transferring all taxa so far described under *Gandasulium*.

The detailed studies on the above said and other relevant literature, we recognized *Hedychium* is the earliest legitimate name for the genus as per code (McNeill *et al.* 2006). Which has been followed by Koenig (*l.c.*) and other workers, except O. Kuntze (*l.c.*). Later workers like Smith (1811), Roxburgh (1810, 1814, 1820), Roscoe (1807, 1824-1828) Wallich (1853, 1855), Wight (1853), Horaninow (1862), Baker (1890-1892), Schumann (1900, 1904) *etc.* dealt the genus and added many species. Many species have much complex nomenclatural history and are discussed in detail under each taxon.

Flowering & Fruiting: Many garden varieties flower throughout the year. In India, generally bud initiation begins from May, with flowering peaks in July–September, immature fruits in September–October, and ripe fruit and seed is present from October–December.

Distribution: About 80 species with major distribution in eastern Himalaya to South China and South-east Asia. About half of the species occur in the Indochinese region (Sirirugsa & Larsen 1995). As per the current work, in India it is represented by 44 taxa, including 31 species and 13 varieties and are mainly distributed in North-eastern states. In South India it is represented by only 5 taxa with two endemics, *viz*., *H. cernuum* and *H. forrestii* var*. palaniense*.

IUCN Red list Category: Even though it is wide spread as an ornamental genus and massively cultivated as a source material for paper industry (Beadle 1917, Turrill 1914), most of the wild species are under threat category. The habitat destruction by anthropogenic activities and natural hazards facilitated the threatness. Over collection from wild for ornamental use is another reason for the fadeout of some species. As per IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010) we recognized six taxa under Least Concern (LC), two taxa under Near Threatened (NT), four taxa under Vulnerable (VU), eight taxa under Endangered (EN) and twenty four taxa under Critically Endangered (CR) categories. As most of the Indian species are under CR category, urgent conservation strategies should be developed and implemented to rescue many of the species from the verge of extinction.

Key to the species of *Hedychium* in India.

1a. Bracts non-imbricate and convolute…….. 2

1b. Bracts imbricate…… 21

2a. Anther sagittate……. (27) ***H. villosum***

2b. Anther elliptic or oblong…… 3

3a. Flower 2.7-3.3 cm long; stamen 1.2-2.2 cm long…… 4

3b. Flower 5-15.2 cm long; stamen 3-7.8 cm long…… 7

4a. Leafy shoot 90-130 cm high; flower orange-red; labellum very widely obovate. …… (6) ***H. densiflorum***

4b. Leafy shoot 25-55 cm high; flower golden yellow, sulphur yellow or creamy yellow; labellum elliptic, lanceolate or spatulate…… 5

5a. Corolla tube 1.8-1.9 cm long; cincinnus 2-flowered…… (1) ***H. aureum***

5b. Corolla tube 0.8-1.1 cm long; cincinnus 1-flowered…… 6

6a. Calyx slightly shorter than bracts (0.8-0.9 vs 1.2-1.3 cm); fruit wall red internally; aril black…… (16) ***H. hookeri***

6b. Calyx equal with bracts (*c.* 1.1 vs *c.* 1.1 cm); fruit wall orange internally; aril red. …… (18) ***H. longipedunculatum***

7a. Stamen longer than double length of labellum (0.4-2.3 cm longer)…….. 8

7b. Stamen shorter than double length of labellum..…… 12

8a. Flower coloured with red or pale pink stamen…….. 9

8b. Flower uniform white with white stamen..…… 10

9a. Labellum oblanceolate or obovate; leaf sheath, ligule, lower leaf surface, inflorescence rachis and bracts glaucous……. (22) ***H. speciosum***

9b. Labellum orbicular; leaf sheath, ligule, lower leaf surface, inflorescence rachis and bracts non-glaucous…… (3) ***H. coccineum***

10a. Calyx 1-1.3 cm or more shorter than corolla tube; flower 10-10.2 cm long; dorsal corolla lobe *c.* 1.5 mm long beaked at tip……. (25) ***H. thyrsiforme***

10b. Calyx upto 4 mm shorter or equal with corolla tube; flower 11.2-12.8 cm long; dorsal corolla lobe 5-9 mm long beaked at tip…….. 11

11a. Inflorescence conical; anther right angles to the filament; labellum orbicular…….. (17) ***H. larsenii***

11b. Inflorescence cylindrical, anther parallel to the filament; labellum obovate…….. (24) ***H. stenopetalum***

12a. Labellum entire at tip (obtuse or rounded)..…… (21) ***H. robustum***

12b. Labellum 0.8–2.1 cm deeply emarginate at tip…… 13

13a. Stamen 1.4-1.5 cm shorter than labellum; filament L-shaped.. (23) ***H. spicatum***

13b. Stamen 0.2-0.5 cm shorter, equal or longer than labellum; filament straight or arching…….. 14

14a. Anther divided at tip upto halfway; labellum 5.7-5.8 cm long….. (2) ***H. cernuum***

14b. Anther *c.* 1 mm long crested, truncate or slightly notched at tip; labellum 1.7-4.6 cm long…… 15

15a. Lateral staminodes and labellum uniform deep red……. (5) ***H. deceptum***

15b. Lateral staminodes and labellum white or creamy yellow with a dark blotch at base..…… 16

16a. Labellum 0.3-1.7 cm wide; lateral staminodes 0.2-0.5 cm wide…… 17

16b. Labellum 2.6-4.2 cm wide; lateral staminodes 0.8-2 cm wide…….. 20

17a. Cincinnus 5-8 -flowered..…… (29) ***Hedychium* sp. No. 1**

17b. Cincinnus single-flowered..…… 18

18a. Flower 5-7.4 cm long; corolla tube 1.3-3.4 cm long…… (12) ***H. gracile***

18b. Flower 8.2-9.8 cm long; corolla tube 4-4.8 cm long…… 19

19a. Dorsal corolla lobe 4.3-4.5 cm long; labellum 2.6-2.7 cm long, creamy yellow; lateral staminodes 3.1-3.2 cm long, creamy yellow; filament 3.7-3.8 cm long (exceeds labellum)…… (11) ***H. gomezianum***

19b. Dorsal corolla lobe 3.4-3.5 cm long; labellum 3.2-3.3 cm long, white; lateral staminodes 3.4-3.6 cm long, white; filament 3.1-3.2 cm long (equal to labellum…… (15) ***H. griffithianum***

20a. Filament reddish-pink; labellum reddish-pink blotched at centre; lateral staminodes reddish-pink at base…… (7) ***H. elatum***

20b. Filament white or yellowish-brown; labellum pale yellow or yellowish-brown blotched at centre; lateral staminodes white or brown tinged at base…….. (10) ***H. forrestii***

21a. Labellum 0.7-1.7 cm wide…….. 22

21b. Labellum 2.5-6.7 cm wide…….. 23

22a. Filament equal to labellum; filament, labellum and lateral staminodes lemon yellow…… (19) ***H. marginatum***

22b. Filament 1.7-3.4 cm longer than labellum; filament red; labellum and lateral staminodes white..…… (8) ***H. ellipticum***

23a. Corolla tube 3.9-5.3 cm long…… 24

23b. Corolla tube 6-10.3 cm long..…… 25

24a. Labellum and lateral staminodes crumpled, brick-red, obscurely clawed, base cuneate; bulbils present…… (14) ***H. greenii***

24b. Labellum and lateral staminodes non-crumpled, orange, distinctly clawed, base obtuse, bulbils absent……. (30) ***Hedychium* sp. No. 2**

25a. Stamen subsessile; filament 1-1.5 mm long……. (28) ***H. wardii***

25b. Stamen long filamentous; filament 2-4.8 cm long.…….…… 26

26a. Flowers deep or sulphur yellow.…….... 27

26b. Flowers white or creamy yellow.…….... 28

27a. Stamen 3.3-3.6 cm long; flowers deep yellow. ……..… (26) ***H. urophyllum***

27b. Stamen 4.3-5.8 cm long; flowers sulphur-yellow…..…… (9) ***H. flavum***

28a. Flower 10-11.3 cm long; corolla tube 6-7 cm long…..…… 29

28b. Flower 13.8-15.7 cm long; corolla tube 8.2-10.3 cm long.…… 30

29a. Stamen 5-5.1 cm long, white, 1-1.1 cm longer than labellum (labellum 4-4.2 x 3.8-3.9 cm)..……. (13) ***H. gratum***

29b. Stamen 3.1-3.2 cm long, yellow, equal to labellum (labellum 3-3.2 x 3-3.2 cm). ……. (31) ***Hedychium* sp. No. 3**

30a. Filament white, golden-yellow or creamy-yellow; corolla tube white or creamy-white; labellum 4.2-5.4 cm long; lateral staminodes 4.2-5.6 cm long.…… (4) ***H. coronarium***

30b. Filament and corolla tube pink or plae pink; labellum 6.5-6.7 cm long; lateral staminodes 5.7-6 cm long.…….…… (20) ***H. maximum***

H. aureum C.B. Clarke & G. Mann. ex Baker in J.D. Hooker, Fl. Brit. India 6: 229. 1892, *non* K. Schum. 1900; K. Schum. in A. Engler, Pflanzenr. IV. 46(heft 20): 49. 1904; J.N. Mitra, Monocot. E. India 1: 242. 1958; Naik & Panigrahi, Bull. Bot. Surv. India 3(1): 71. 1961; A.S. Rao & D.M. Verma, Bull. Bot. Surv. India 14(1-4): 131. 1972; S.C. Srivast. in S.K. Jain & R.R. Rao, Threat. Pl. India 236. 1983; Karthik. et al., Fl. Ind. Enum. Monocot. 294. 1989.

(Figure 02; Plate 02. A & B)

Lectotype & Epitype (designated here): INDIA. Meghalaya, Khasia, Mairang, 5800 ft., 22 Aug 1885, *C.B. Clarke 39995* (lecto K!); Khasia, Soyung, 5000 ft., 11 Sep 1886, *C.B. Clarke 44717* (epi CAL!).

Epiphytic or terrestrial, perennial rhizomatous herbs. *Rhizome* 1.4–2 cm wide, creamy white internally, slightly aromatic, covered by brown scales. *Leafy shoot* 50–55 cm high, slanting with erect inflorescence. *Leaves* 10–12 in number, 2.6–4.7 cm apart, spreading, petiolate; petiole 8–10 mm long, green, glabrous; sheath 5–5.5 cm wide, margins green, membranous, translucent, glabrous; ligule 2.5–3 x *c.* 1.4 cm, ovate, single-lobed, obtuse at tip, red, glabrous, membranous, translucent, papery, closely appressed to the stem; lamina 19–22 x 3–3.7 cm, elliptic, dark green above, pale green below, glabrous; margin undulate, membranous, translucent, white tinged, non-ciliate; tip long caudate, twisted; base cuneate. *Inflorescence* 6–7 cm long, cylindrical, lax, erect; rachis green, glabrous. *Bracts* 1.5–1.7 x 0.45–0.5 cm, lanceolate, green, glabrous, moderately coriaceous, convolute; margin non-ciliate, translucent, membranous, white, tip slightly notched, cincinnus 2-flowered. *Bracteoles c.* 7 x 2 mm, tubular, membranous, translucent, obtuse at tip, greenish white, white towards base, glabrous, closely appressed to the calyx, unilaterally split upto 3 mm; margin non-ciliate. *Flowers* 3–3.2 cm long, golden yellow, 6–8 flowers open at a time, ascending. *Calyx* 9–9.5 mm

long, *c.* 1.5 mm wide at mouth, pale yellow, glabrous, membranous, translucent, upper 2/3rd portion inflated, lower portion closely appressed to the corolla tube, unilaterally split upto 2.5–3 mm, 3-toothed at tip. *Corolla tube* 1.8–1.9 cm long, *c.* 2 mm wide at mouth, golden yellow, white towards base, glabrous externally, hairy internally, slightly arched. *Corolla lobes* oblanceolate, golden yellow, membranous, moderately translucent, erect on flower; dorsal lobe 10–15 x *c.* 3 mm, very minutely beaked at tip; lateral lobes 9.5–10 x *c.* 3 mm, non-beaked at tip. *Lateral staminodes* 9–9.5 x 2–2.5 mm, elliptic, golden yellow, reflexed back, margins undulate, obtuse at tip. *Labellum* 9–9.5 x 4–4.5 mm, elliptic-lanceolate, golden yellow, spreading on flower, reflexed back on upper half, base cuneate, gradually clawed towards base; claw *c.* 1.5 mm wide; sinus 5–5.5 cm deep; margin undulate; lobes overlapping, acute at tip. *Stamen* 1.2–1.3 cm long, erect, golden yellow. *Filament* 9–9.5 mm long, *c.* 1 mm wide at base, golden yellow, erect. *Anther* 5–5.5 x *c.* 1.5 mm, elliptic, golden yellow, hairy in the margins of mouth openings, split opens from top to bottom, attached with the filament at 1–1.5 mm above from base, thecae parallel with the filament axis; connective golden yellow, glabrous, non-crested, tip slightly emarginate (*c.* 1 mm). *Ovary c.* 1.5 x 1.5 mm, oblong, pale green, sparsely pubescent externally. *Style* filiform, white, glabrous, yellow tinged towards stigma. *Stigma c.* 1 mm wide, yellow, cup-shaped, margin ciliate, stigmatic head hairy, hairs hook-like, comes out at half way of anther, *c.* 1.5 mm exserted from the anther. *Epigynous glands* two, *c.* 1 mm long, oblong, yellow.

Notes: Terrestrial or epiphytic plants. Often overlooked by its smaller size of plants and flowers. We have a single live collection from the premises of Botanical Survey of India, Shillong. It can be easily identified based on the characters like shorter inflorescence, smaller and golden yellow coloured flowers.

H. aureum C.B. Clarke & G. Mann. ex Baker was described by Baker in Hooker's *Flora of British India* (229. 1892) on the basis of several collections of Clarke and Mann from North Khasia Hills at an altitude of 5,000–6,000 ft. Baker, in

the protologue mentioned about a MSS of Clarke and Mann, but this could not be traceable.

Later Schumann (1900) described another taxon under the name *H. aureum* K. Schum., from Nord-Celebes. As Schuman's name become a later homonym, later he proposed another name *H. erythrostemon* K. Schum. (Schumann 1904) for this species. Along with that he also described *H. aureum* C.B. Clarke & G. Mann. ex Baker as an entirely different species.

Typification: While examining the specimens at K and CAL, we could locate several collections of Clarke and Mann from Khasia. Among them we identified one collection of C.B. Clarke (*C.B. Clarke 39995,* K!) from Mairang, Meghalaya as the material used by Baker (*l.c.*) for describing the species and hence designated as lectotype. Another material with fruiting (*C.B. Clarke 44717,* CAL!) is also selected and designated as the epitype of the species.

Flowering & Fruiting: June–October.

Distribution: Endemic to Khasia Hills of Meghalaya in India at an altitude of 1,200–1,800 m. *(Figure 04. A)*

IUCN Red list Category: As *H. aureum* is having very limited and sparse distribution with narrow endemism, it is placed under Critically Endangered (CR B1b(i,ii,iv)+2b(ii,iv); E) category as per IUCN Guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA**. *s.loc., s.coll. 1272* (CAL). **MEGHALAYA**. Khasia, 4000 ft., Oct 1878, *G. Mann. s.n.* (CAL). EAST KHASI HILLS Dt.: E. Shillong, Kheti to Tinchha, 22 Aug 1958, *G. Panigrahi 14545* (ASSAM); Shillong, 5000 ft., Aug 1886, *G. Mann s.n.* (CAL), 12 Aug 1888, *G. Mann s.n.* (K), 15 Oct 1960, *V.N. Naik 21491* (ASSAM); Lower new Colony, 12 Aug 2007, 1470 m., *E. Sanoj & T. Rajesh Kumar 95167* (CALI). WEST KHASI HILLS Dt.: Mairang, 5500 ft., 29 Aug 1885, *C.B. Clarke*

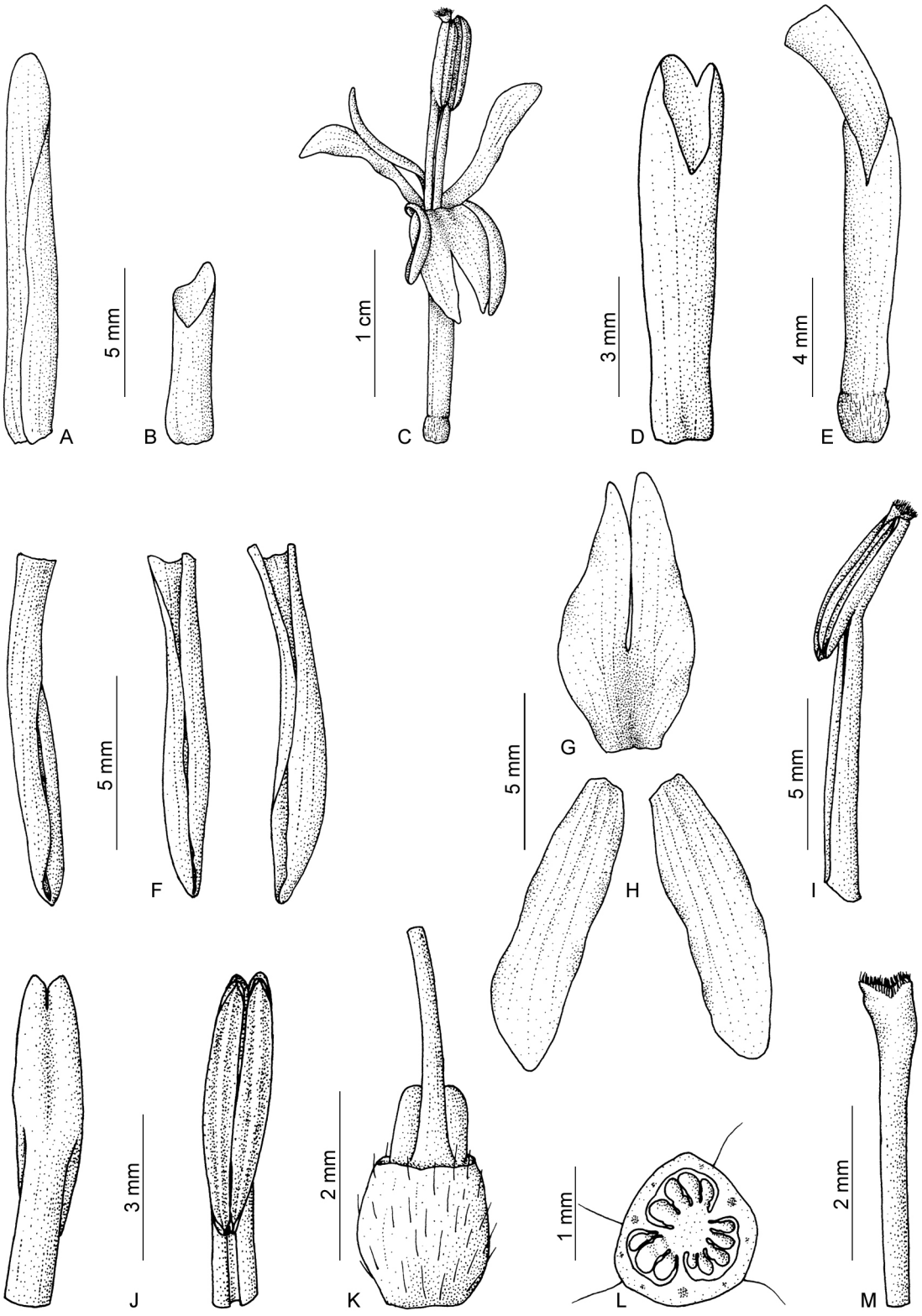

Figure 02. ***H. aureum***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, back view (left) and front view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

40289 (K). **NAGALAND**. Naga Hills, Jun 1935, *N.L. Bor 21874* (ASSAM); Sarpung, 5-6000 ft., Dec 1907, *A. Meebold 7200* (K); Fekwera, 5500 ft., 31 Aug 1935, *N.L. Bor 6205* (K), 5-6000 ft., Dec 1907, *A. Meebold 7200* (CAL).

2 Hedychium cernuum

H. cernuum Wight, Icon. Pl. Ind. Orient. 6: 17. t. 2011. 1853.

Lectotype (designated here): INDIA. Neilgherry Hills, Aug 1845, *R. Wight 2803* (lecto K!; isolecto CAL!). *(Figure 03; Plate 02. C–F)*

H. venustum Wight, Icon. Pl. Ind. Orient. 6: 17. t. 2012. 1853; Horan., Prodr. Monogr. Scitam. 25. 1862; Baker in J.D. Hooker, Fl. Brit. India 6: 226. 1892; K. Schum. in A. Engler, Pflanzenr. IV. 46(heft 20): 50. 1904; C.E.C. Fisch. in J.S. Gamble, Fl. Madras 3: 1485. 1928; M. Mohanan & A.N. Henry, Fl. Thruvananthapuram 3: 474. 1994; S.K. Jain & V. Prakash, Rheedea 5(2): 161. 1995.

Lectoype (designated here): INDIA. Courtallum, Sep 1835, *R. Wight 2802* (lecto K!; isolecto E!, CAL!).

Perennial rhizomatous herbs. *Rhizome* 2.3–3.6 cm wide, creamy white internally, slightly aromatic. *Leafy shoot* 86–110 cm high, robust, slanting or erect. *Leaves* 8–12 in number, 4.3–7 cm apart, spreading on plant; sheath 2–2.4 cm wide, glabrous, margins membranous, non-ciliate; sessile; ligule 2–2.5 cm long, single-lobed, ovate, pale green with red tinge, glabrous, tip rounded, translucent, membranous, closely appressed to the stem; lamina 48.5–52 x 8.7–12.4 cm, elliptic, dark green and glabrous above, pale green and sericeous below; margin undulate, non-ciliate; tip caudate, slightly twisted; base long cuneate; midrib densely sericeous below. *Inflorescence* 15–33 cm long, erect or pendulous, moderately lax; peduncle glabrous. *Bracts* 3.9–4.1 x 1.6–1.8 cm, elliptic, green, pale

green towards base, glabrous, hairy at tip, coriaceous, convolute, non-imbricate; margin hyaline, non-ciliate; tip acute; cincinnus 2-flowered. *Bracteoles* 2.1–2.5 x *c.* 0.3 cm, pale green, glabrous, hairy at tip only, tubular, translucent, closely appressed to the corolla tube, unilaterally split upto 1.1–1.3 cm deep; margin non-ciliate. *Flower* 12.8–13 cm long, white (turn to pale yellow on second day) with red stamen, 4–6 flowers open at a time. *Calyx* 4.7–4.8 cm long, *c.* 4 mm wide at mouth, pale green, glabrous, tubular, translucent, membranous, slightly exceeding bracts, inflated at upper half, lower half closely appressed to the corolla tube, unilaterally split upto *c.* 6 mm deep, 3-toothed at tip, hairy at tips of teeth. *Corolla tube* 7.5–7.6 cm long, *c.* 3 mm wide at mouth, yellow, white towards base, glabrous externally, tube more or less straight. *Corolla lobes* linear, yellow, membranous, drooping from flower, glabrous, 4 or 5-nerved; dorsal lobe 5–5.2 cm long, *c.* 1 mm long beaked at tip; lateral lobes 4.8–5 cm long, non-beaked at tip. *Lateral staminodes* 5.6–5.9 x *c.* 0.3 cm, oblanceolate, white, pale red tinged towards base, reflexed back, margin irregular. *Labellum* 5.7–5.8 x 2.7–2.8 cm, oblanceolate, white, pale red tinged towards base, reflexed back, gradually clawed at base; claw *c.* 5 mm wide, sinus *c.* 0.9 cm deep; margin undulate. *Stamen* 5.3–5.6 cm, red, arching. *Filament c.* 4.5 cm long, 1.2–1.3 mm wide at base, red, arching. *Anther* 1.2–1.3 x *c.* 0.3 cm, oblong, red, lobes parallel, split opens from top to bottom, attached with the filament at *c.* 3 mm above from base; connective red, glabrous, halfway divided (6–7 mm deep), parallel with the filament. *Ovary c.* 3.5 x 4 mm, barrel-shaped, white, glabrous externally. *Style* filiform, white, glabrous, yellow tinged towards stigma. *Stigma* yellow, stigmatic head flat, slanting with a depression at center, hairy, hairs hook-like, exserted at halfway from the anther. *Epigynous glands* two, 3.5–4 mm long, oblong, finger-shaped, yellow. *Fruits c.* 2 x 1.8 cm, globular, three-angled, glabrous, trilocular, surface smooth; fruit wall green externally, orange internally, completely split and reflexed back on dehiscence. *Seeds c.* 5 x 2.5 mm, compactly arranged on column, red, gray when dried, yellow at base, elliptic with a constriction at base,. *Aril* red, yellow when dried, lacerate, basal.

Notes: Closely allied species of *H. spicatum* Buch.-Ham. ex Sm., but can be easily distinguished from it in having arching and rather longer stamen, which is equalizing with labellum and labellum is oblanceolate and bilobed at tip.

Wight (1853) described two new species of *Hedychium* in *Icones Indiae Orientalis*, which includes *H. cernuum* Wight (t. 2011) and *H. venustum* Wight (t. 2012). We could locate some specimens of Wight deposited at E, K and CAL. Label/slip in Wight's handwriting is attached to one of the sheets (*s.n.* K!), which gives the characters to distinguish the two taxa, and is identical with the protologue. This manuscript description and the protologue are contradictory with his illustration. While making the illustrations of *H. cernuum*, the artist erroneously has drawn the infructescence of an *Alpinia* sp.

As mentioned by Wight in his diagnosis, *H. cernuum* is closely related to *H. venustum* but differs in having long petioled leaves and deeply clefted lip. Both are seed setting species with rather high levels of variability and all characters mentioned in MS and protologue are nearly identical fall within the single taxon. A close observation of the types, we came to a conclusion that both are one and the same species with minor variation, which are not enough to keep them as distinct species. Hence, *H. venustum* is synonymized under *H. cernuum*, as the one to be used for the taxon, as it appeared prior to *H. venustum* in the same publication.

But, subsequent workers wrongly treated *H. cernuum* as a synonym of *H. venustum.* Naik and Panigrahi (1961) merged *H. venustum* with *H. griffithianum* Wall. on the basis of the observations that "the relative length of labellum and stamen is a variable character with in a species, particularly *H. venustum*". Later it was also recorded by Rao & Verma (1972) from Assam. Based on the re-examination of cited specimens of Naik and Panigrahi (*l.c.*) and the observation of many live plants, Rao and Verma (1969a) reinstated these as two distinct

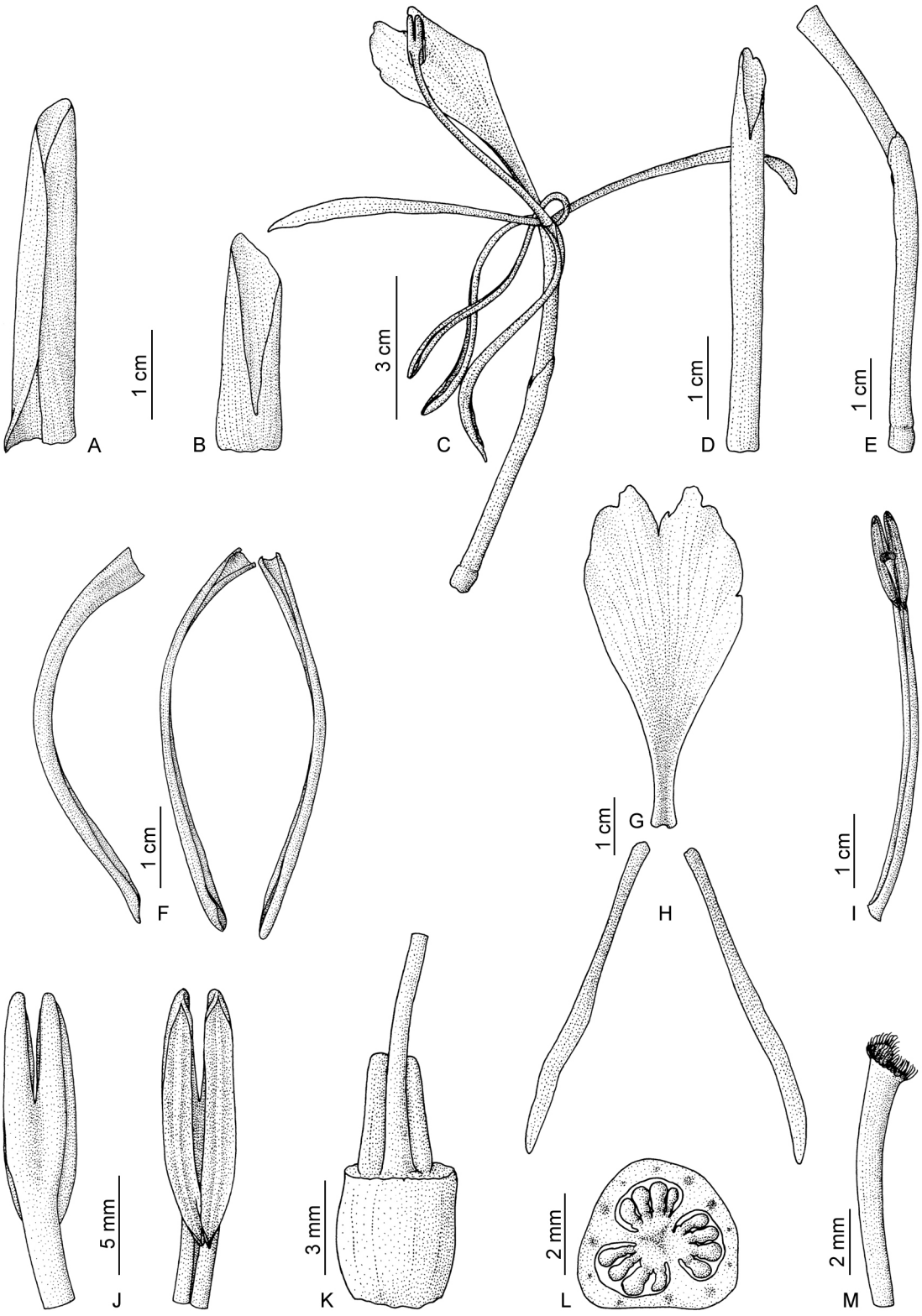

Figure 03. ***H. cernuum***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, back view (left) and front view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

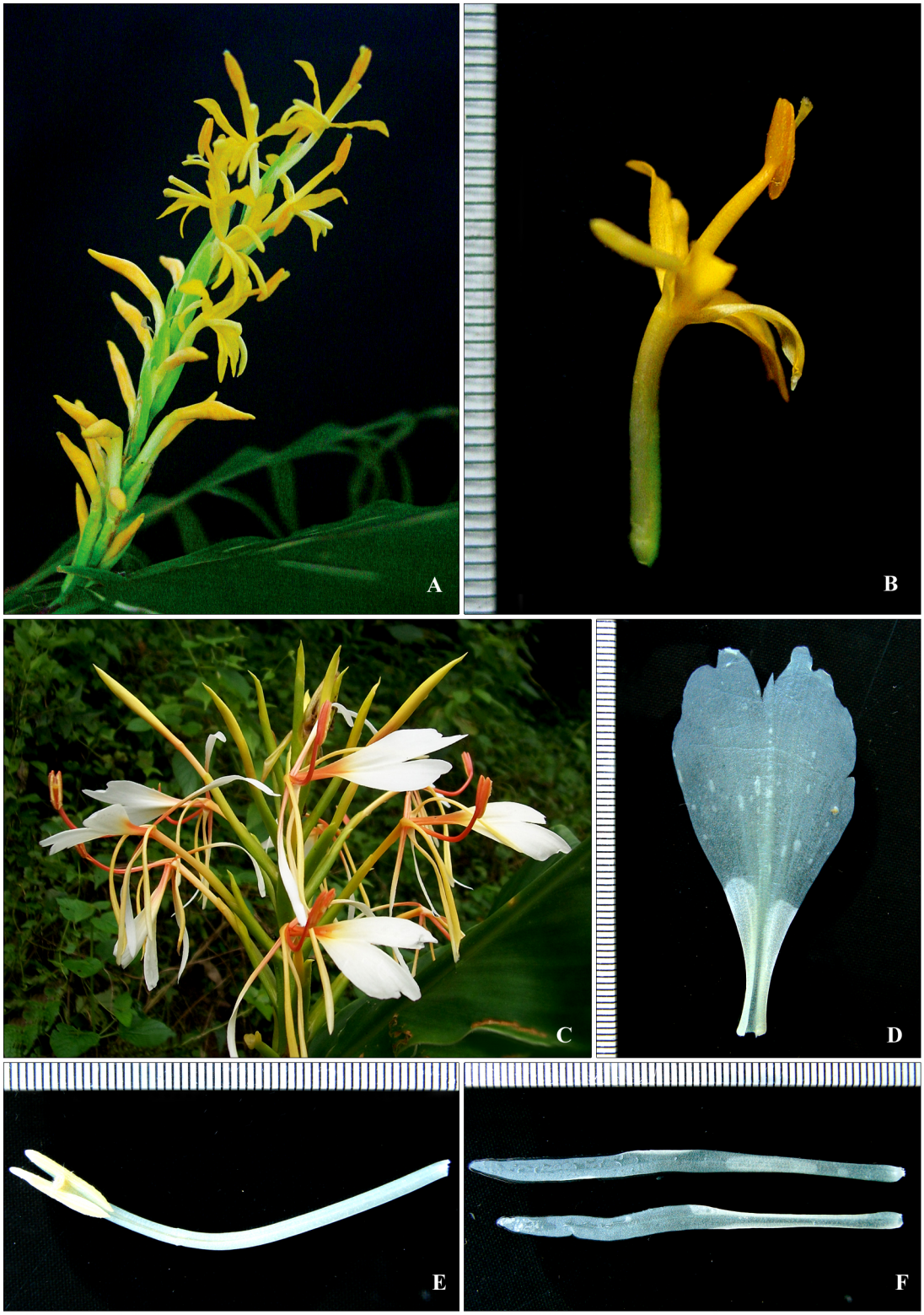

Plate 02. **A & B.** ***H. aureum:*** **A.** inflorescence; **B.** single flower; **C-F.** ***H. cernuum:*** **C.** habit; **D.** labellum; **E.** stamen; **F.** lateral staminodes (**D-E** -from pickled specimens).

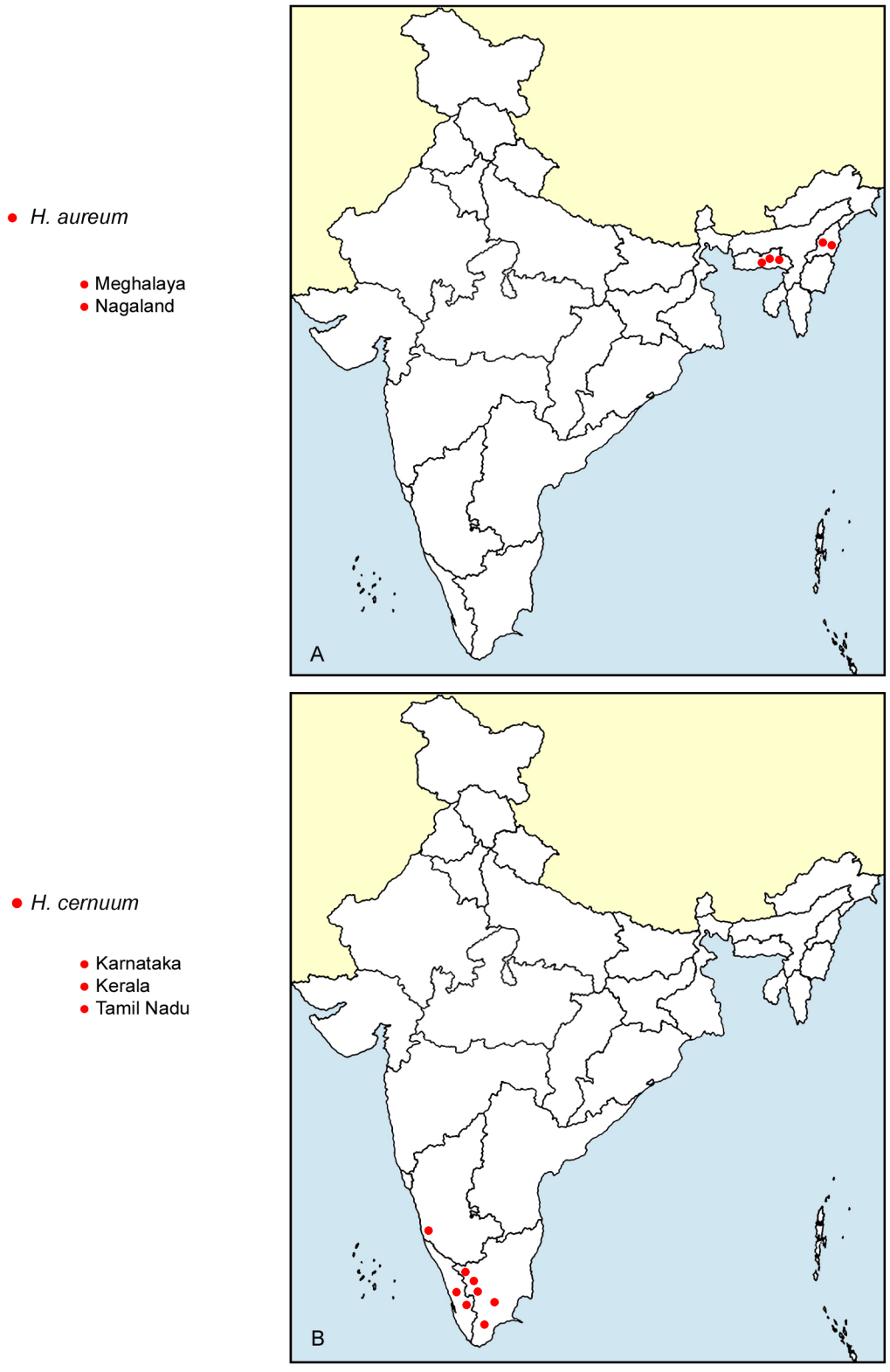

Figure 04. Distribution maps of
H. aureum and ***H. cernuum.***

species. Our studies also confirm this view and identified the cited specimens of Naik & Panigrahi as *H. spicatum*.

Typification: During the search of type specimens we could locate some specimens of the original author at E, K and CAL. Among them *Wight 2803* (CAL!, K!), and *Wight 2802* (CAL!, E!, K!) are identified and designated as the lectotypes of *H. cernuum* and *H. venustum* respectively.

Flowering & Fruiting: August–November.

Distribution: Endemic of Western Ghats of South India at an altitude of 700–1,400 m. (*Figure 04. B*)

IUCN Red list Category: Due to the lesser area of occupancy, geographically distant subpopulations and limited mature individuals, it is assessed against Critically Endangered (CR B1b(i,ii,iv)+2b(i,ii,iv); D; E) category as per IUCN Guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA**. **KARNATAKA**. Concan, *J.D. Hooker & Law s.n.* (K). **KERALA**. IDUKKI Dt.: Kulamavu, ± 700 m., 15 Dec 1982, *C.N. Mohanan 76097* (MH); Munnar, ± 1500 m., *M.G. Prasanth Kumar 86382* (CALI). TRICHUR Dt.: 5 Km. from Malakkapara towards Chalakkudy, 30 Jan 2006, *M. Sabu & E. Sanoj 86175* (CALI). **TAMIL NADU**: COIMBATORE Dt.: Anamalai, by stream, 4000 ft., 13 Dec 1909, *C.E.C. Fischer 1474* (K). CUDDALORE Dt.: Goodaloor Ghat, 1883, *s.coll. s.n.* (MH). MADURAI Dt.: Highway Nits, 4600 ft., 8 Sep 1925, *K.C. Jacob 17574* (MH). NILGIRI Dt.: Balmodies Estate, Ouchter Colony Valley, 1400 m., *J.L. Ellis 34844* (MH). TIRUNELVELI Dt.: Courtallum, Sep 1835, *R. Wight 932* (E).

3 Hedychium coccineum

H. coccineum Buch.-Ham. ex Sm. in A. Rees, Cyclop. 17: n 5. 1811; Roem. & Schult., Mant. Syst. Veg. 14. 1822; Ker Gawler, Bot. Reg. 14: t. 1209. 1829; A. Dietr.,

Sp. Pl. 1: 36. 1831; D. Dietr., Syn. Pl. 1: 10. 1839; Wall. in W.J. Hooker, Hooker's J. Bot. Kew Gard. Misc. 5: 372. 1853, J. Hort. Soc. London 9: 23. 1855; C. Muell., Ann. Bot. Syst. 6: 26. 1861; Baker in J.D. Hooker, Fl. Brit. India 6: 231. 1892; Trimen, Handb. Fl. Ceylon 4: 244. 1898; K. Schum. in A. Engler, Pflanzenr. IV. 46(heft 20): 50. 1904; Haines, Bot. Bihar Orissa 5: 1139. 1924; J.N. Mitra, Monocot. E. India 1: 243. 1958; Naik & Panigrahi, Bull. Bot. Surv. India 3(1): 71. 1961; H. Hara, Fl. E. Himalaya 422. 1966; A.S. Rao & D.M. Verma, Bull. Bot. Surv. India 14: 133. 1972; B.L. Burtt & R.M. Sm. in M.D. Dassanyake & F.R. Fosberg, Revis. Handb. Fl. Ceylon 4: 505. 1983; N.P. Balakr., Fl. Jowai 2: 528. 1983; Karthik. et al., Fl. Ind. Enum. Monocot. 294. 1989; R.M. Sm. in A.J.C. Grierson & D.G. Long, Fl. Bhutan 2: 204. 1991; H.O. Saxena & Brahmam, Fl. Orissa 3: 1905. 1994; S.K. Jain & V. Prakash., Rheedea 5(2): 160. 1995; T.L. Wu & K. Larsen in Z. Wu & P.H. Raven, Fl. China 24: 375. 2000; Press et al., Annot. Checkl. Fl. Pl. Nepal 329. 2000; S. Kumar, Zingber. Sikkim 46. 2001; S. Behura & N.C. Rout, J. Econ. Taxon. Bot. 27(3): 549. 2003; M. Sabu & Pradeep, Folia Malaysiana 6(1&2): 7. 2005; M. Sabu, Zingiber. Costac. S. India 194. 2006; Chaturv. & Moaakum, Folia Malaysiana 9(2): 130. 2008.

*Type***:** NEPAL. Suembu, *Buchanan-Hamilton*, *Savage. Cat. No. 8.22* (holo LINN).

H. angustifolium Roxb., Pl. Coromandel 3: 251. t. 251. 1820 (excl. des.), *non* Roxb. ex Ker Gawl. 1816.

H. roscoei Wall. ex Roscoe, Monandr. Pl. Scitam. n. 2. 1828; A. Dietr., Sp. Pl. 1: 37. 1831; D. Dietr., Syn. Pl. 1: 10. 1839.

Type: Unknown

H. gardnerianum var. *γ pro parte* (*H. roscoei*) Wall. in W.J. Hooker, Hooker's J. Bot. Kew Gard. Misc. 5: 369. 1853; J. Hort. Soc. London 9: 23. 1855; C. Muell., Ann. Bot. Syst. 6: 25. 1861.

H. coccineum var*. roscoei* (Wall. ex Roscoe) Baker in J.D. Hooker, Fl. Brit. India 6: 231. 1892; Karthik. et al., Fl. Ind. Enum. Monocot. 294. 1989.

H. squarrosum Buch.-Ham. in W. Herbert, Banks.

Type: NEPAL. Narainhetty, *Buchanan-Hamilton*, Savage. Cat. No. 8.25 (LINN).

H. coccineum var. *squarrosum* (Buch.-Ham.) Baker in J.D. Hooker, Fl. Brit. India 6: 231. 1892; K. Schum. in A. Engler, Pflanzenr. IV. 46(heft 20): 53. 1904; J.N. Mitra, Monocot. E. India 1: 244. 1958; Naik & Panigrahi, Bull. Bot. Surv. India 3(1): 71. 1961; A.S. Rao & D.M. Verma, Bull. Bot. Surv. India 14: 133. 1972; J. Joseph, Fl. Nongpoh 307. 1982; Karthik. et al., Fl. Ind. Enum. Monocot. 294. 1989; S. Kumar, Zingber. Sikkim 47. 2001.

H. longifolium Roscoe, Monandr. Pl. Scitam. 1/2: t. 59. 1824; Paxton, Paxton's Mag. Bot. 4: 204. 1838; Naik & Panigrahi, Bull. Bot. Surv. India 3(1): 71. 1961; S.K. Jain & V. Prakash., Rheedea 5(2): 161. 1995.

Type: Roscoe, Monandr. Pl. Scitam. 1/2: t. 59. 1824.

H. coccineum var*. longifolium* (Roscoe) Baker in J.D. Hooker, Fl. Brit. India 6: 231. 1892; K. Schum. in A. Engler, Pflanzenr. IV. 46(heft 20): 53. 1904; J.N. Mitra, Monocot. E. India 1: 244. 1958; A.S. Rao & D.M. Verma, Bull. Bot. Surv. India 14: 133. 1972; J. Joseph, Fl. Nongpoh 307. 1982; Karthik. et al., Fl. Ind. Enum. Monocot. 294. 1989. (*Figure 05; Plate 03 & 04*)

Common Names: Scarlet-Garland flower, Long-leaved red Garland-flower.

Terrestrial, perennial rhizomatous herbs. *Rhizome* 2.6–3.5 cm wide, creamy white internally. *Leafy shoot* 120–125 cm high, non-glaucus, slanting with erect inflorescence. *Leaves* 12–18 in number, 3.6–6 cm apart, spreading, sessile; sheath 1.2–1.6 cm wide, margins greenish-pink, curved back, membranous, translucent, pubescent; ligule 1–3 x 1.2–1.4 cm, ovate, single-lobed, truncate or slightly notched

at tip, pale red with green tinges, densely pubescent externally, membranous, translucent, closely appressed to the stem; lamina 26.6–53 x 2.1–6.4 cm, narrow elliptic-lanceolate, dark green above, pale green below, glabrous; margin membranous, translucent, white-red tinged, non-ciliate; tip long caudate, twisted; base cuneate; midrib pubescent below. *Inflorescence* 11–28 cm long, cylindrical, lax, erect. *Bracts* 2.4–4.6 x 1–2.3 cm, widely ovate, green, glabrous or puberulent towards tip, coriaceous, convolute; margin non-ciliate, translucent, membranous, white-pale red, tip acute, cincinnus 1–6 -flowered. *Bracteoles* 1.5–2.7 x 1–2 cm, slightly translucent, obscurely 2-lobed at tip, pale green, white towards base, glabrous, hairy towards tip, tubular at base, outer one completely encircles the cincinnus. *Flower* 7.9–10.5 cm long, red to brick-red, 5–many flowers open at a time, ascending, slightly fragrant. *Calyx* 2.2–3.3 cm long, *c.* 3 mm wide at mouth, pale yellowish-green, pubescent, membranous, translucent, upper 2/3 portion inflated, lower part closely appressed to corolla tube, unilaterally split upto 1–1.1 cm deep, 3-toothed at tip. *Corolla tube* 2.3–3.8 cm long, *c.* 3 mm wide at mouth, red to brick-red, whitish towards base, hairy internally, straight. *Corolla lobes* oblong, red to brick-red, orange-tinged towards tip, membranous, early decaying at base, drooping from flower, glabrous; dorsal lobe 3.4–4.1 x 0.35–0.45 cm, 1–2 mm long beaked at tip; lateral lobes 3.2–3.7 x 0.3–0.4 cm, *c.* 1 mm long beaked at tip. *Lateral staminodes* 2.1–2.5 x 0.3–0.6 cm, obliquely spatulate, red to brick-red, spreading on flower, upper portion reflexed back, outer margin undulate. *Labellum* 1.9–2 x 1.6–2 cm, orbicular, red to brick-red, more deep coloured at centre, spreading on flower, reflexed back on upper half, base cordate, abruptly clawed at base; claw *c.* 3 mm wide; sinus 1–1.2 cm deep; margin undulate, lobes rounded at tip. *Stamen* 5–6.3 cm long, slightly arching. *Filament* 4.4–5.6 cm long, 2–3 mm wide at base, red to brick-red, slightly arching. *Anther* 0.8–1.2 x 0.2–0.3 cm, oblong, deep red, ciliate along thecae margins, split opens from top to bottom, attached with the filament at 2.5–4 mm above from base, thecae axis parallel with the filament; connective deep red, glabrous, non-crested, tip truncate. *Ovary* 2.5–4 x 2.5–4 mm, oblong, pale green, densely pubescent externally. *Style* filiform, white, glabrous,

pubescent towards tip, yellow tinged towards stigma. *Stigma c.* 1 mm wide, yellow, cup-shaped, margin ciliate, hairs hook-like, bulbous based, *c.* 1 mm exserted from the anther. *Epigynous glands* two, 2.5–4.5 mm long, oblong, yellow.

Notes: The species, *H. coccineum* was described by J.E. Smith (1811) on the basis of the observations and specimen gathered by Buchanan-Hamilton from Suembu, Upper Nepal. Ker Gawler (1816) believed that *H. coccineum* and Roxburgh's *H. angustifolium* are one and the same species and treated *H. coccineum* as the synonym of *H. angustifolium*. But later, by identifying the existence of *H. coccineum* as a separate species, he published a corrigendum (as a note) in the *Botanical Register* (1820) and removed *H. coccineum* from the synonyms of *H. angustifolium*. Wallich also agreed with this and noted in *H. angustifolium* in Roxburgh's Flora Indica (1832) and confirmed the existence of *H. coccineum* as a separate species by examining Buchanan's original drawing left at Botanic Garden, Calcutta.

While describing *H. angustifolium*, Roxburgh (1820) provided a detailed description of the species, but with an illustration of *H. coccineum*. Wallich (1853, 1855) also agreed with this error made by Roxburgh and he commented it as a mistake done by Roxburgh's painter while illustrating *H. angustifolium*. Ker Gawler (1829) also described *H. coccineum* in *Botanical Register* (14: t. 1209), in which he provided the description furnished by Wallich, and the synonyms of Roscoe (1824), which was also furnished by Wallich.

H. roscoei was described by William Roscoe in his *Monandrian Plants* (1828) (along with the genus introduction) on the basis of a Latin description provided by Dr. Wallich. Due to the lack of live specimens, he fails to give his own detailed description and colour drawing as in other species. Later A. Dietrich (1831) and D. Dietrich (1839) also followed Roscoe (*l.c.*).

However, Wallich (1853, 1855) reduced it as the variety of *H. gardnerianum* Ker Gawl., var. '*γ'*, along with *H. aurantiacum* Roscoe. And he has mentioned that *H. gardnerianum* is a species which "varies strikingly in the shape and size of the labellum, as also in the general colour of the flower", and colour is orange in var. '*γ'*. But Schumann (1904) transferred this *H. roscoei* in to the synonymy of *H. aurantiacum.*

H. squarrosum was described by Baker (1892) based on the usage of Hamilton in Herbert's Banks. Wallich (1853) treated it as a synonym of *H. angustifolium*, but later he omitted this usage (Wallich 1855).

H. longifolium was described by Roscoe (1824) based on a material sent to Botanical Garden in Liverpool, by Dr. Wallich in 1819. It was sent under the name *H. coccineum*. But Roscoe distinguished it from *H. coccineum* and described it as a new species. As per Roscoe it is close to *H. carneum*, but can be distinguished not only by its leaves, but also by stipule, which is long and white in *H. longifolium* and by flower colour and fragrance. He also distinguished it from *H. coccineum* and *H. angustifolium* in its longer, glaucous leaves, hairy midrib below, broad lateral staminodes, and flowers devoid of fragrance. Wallich (1853, 1855) synonymised it under *H. coccineum*.

Later Baker described the *H. coccineum* in Hooker's *Flora of British India* (1892) and reduced another 5 taxa, *H. angustifolium*, *H. carneum* Lodd., *H. roscoei*, *H. squarrosum* and *H. longifolium*, as the varieties. Schumann (1904) distinguished *H. aurantiacum* from *H. angustifolium* and treated former as separate species, and he treated *H. carneum, H. roscoei*, *H. squarrosum* and *H. longifolium* as the varieties of *H. coccineum*. Based on our studies on the large number live specimens and herbarium specimens from ASSAM, BM, CAL, CALI, E and K, we could separate *H. angustifolium* and *H. carneum* from *H. coccineum*. They can be easily distinguished by their orange-red and flesh-pink coloured flowers respectively, and treated as the varieties of *H. coccineum*. As *H. coccineum* shows wide range of

variation and which is inclusive to other three taxa, they are treated here as the synonyms of the species.

Flowering & Fruiting: June–October.

Distribution: Widely distributed in Nepal, Bhutan, India, Bangladesh, Myanmar, Southwest Yunnan provinces of China, Northern Thailand and Vietnam. In India, it is distributed in Western states like Bihar, Sikkim, Orissa, Uttarakhand and West Bengal, and entire Northeastern states at an altitude of 450–2,000 m. It is also cultivated as an ornamental in South India also. (*Figure 11. A*)

IUCN Red list Category: Because of the wide range of occupancy and good population size in India and neighbouring countries, *H. coccineum* can be categorize as of Least Concern (LC) according to the IUCN-guidlines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA**. **ARUNACHAL PRADESH.** CHANGLANG Dt.: Namdapha, Near 27th mile camp, 29 Aug 1984, *M.S. Swaminathan 84978* (ASSAM); Namdapah, Dollu Pakham, 6000 ft., 25 Dec 1993, *A.S. Choutan 99530* (ASSAM). DIBANG VALLEY Dt.: Amboli, 1300 m., 9 Apr 1999, *M. Bhaumik 3427* (CAL); Angolin, 720 m., 27 Apr 2000, *M. Bhaumik 3299* (CAL). TIRAP Dt.: Gadua, 11 Jul 1861, *D.B. Deb 26655* (ASSM); Deornali, 30 mile to the West of Khonsa, 21 Jun 1961, *D.B. Deb 25904* (ASAM). WEST KAMENG Dt.: Kalaktang, 9 Aug 1970, *P.K. Hajra 54021* (ASSAM); Kalatang on way to Morsling, 10 Aug 1973, *P.K. Hajra 54024* (ASSAM). **ASSAM.** CACHAR Dt.: Haflong, N. Cachar Hills, 2500 ft., 19 Aug 1908, *W.G. Craib 326* (K); Silchar, Jan 1935, *s.coll. 10959* (ASSAM). LAKHIMPUR Dt.: Jeypore, 18 Jul 1935, *C.S. Purkayastha 1964 B* (ASSAM), Hukan Juri, 26 Dec 1945, *M.M. Srinivas 21838* (ASSAM). KAMRUP Dt.: Jasaral Forest, 5 miles south of Rani, 15 Jan 1964, *A.S. Rao 38847* (ASSAM, CAL). **BIHAR**. ROHTAS Dt.: Duphla Hills, Dehiri, Poibot, 2000 ft., 10 Dec 1874, *J.L. Lister 47* (CAL). **MANIPUR**. *s.loc., D.B. Deb 1006* (CAL). TAMENGLONG Dt.: Nungba, 5000 ft., Nov 1907, *A. Meebold 5965* (CAL). **MEGHALAYA**. Khasia, *Griffith 5683* (K), 4-6000 ft., *J.D. Hooker & J. Thomson s.n.* (K), July 1977, 3-4000 ft., *s.coll. 23490* (ASSAM), 4000 ft., Jul 1974, *s.coll. s.n.* (CAL),

2500 ft., 3 Oct 1885, *C.B. Clarke 40615* (CAL); Jhasia forest, 3 Jul 1940, *G.K. Deka 19592* (CAL). EAST KHASI HILLS Dt.: Shillong, 28 Jul 1885, *C.B. Clarke 38360* (K); New colony, Laitumukrah, 30 Jul 1960, *G.K. Deka 21804* (CAL); 5000 ft., 26 Aug 1914, *U. Kanjilal 6742* (CAL); Mawryngkneng to the West of I.B., 20 Oct 1956, *G. Panigrahi 4079* (ASSAM); Pynursla, near Cherrapunji, 25 Aug 1956, *G. Panigrahi 2916* (CAL); Umjaisaw to Sectsohma, 26 Aug 1968, *N.P. Balakrishnan 47121* (ASSAM); Woodlands, 6 Jul 1972, *U. Shukla & N. Goon 34670* (ASSAM); (Cultivated) Pine wood Hotel Compound, Shillong, 17 Jul 1963, *G.K. Deka 35727* (ASSAM). JAINTIA HILLS Dt.: Jowai–Bodarpur Road, 20 Jul 1957, *G.K. Deka 10077* (ASSAM); Jarain-Syndai, 800 m., 17 Aug 1968, *N.P. Balakrishnan 46128* (ASSAM); Jowai–Bodarpur Road, 20 Jul 1957*, G.K. Deka 10077* (ASSAM); Near Jowai, on the road to Jarain, 27 Jul 1965, *N.P. Balakrishnan 42831* (ASSAM, CAL); Way to Dawki, 473 m., N 25°09'79."6, E 092°23'38.3", 16 Aug 2007, *E. Sanoj & T. Rajesh Kumar 94904* (CALI). RI-BHOI Dt.: Umpih, 20 Sep 1917, *U. Kanjilal 7246* (ASSAM); Umsaw, 30 Nov 1934, *C.S. Purkayastha 10943* (ASSAM), 21 Jul 1938, *S.R. Sharma 16775* (ASSAM), 3 Jul 1935, *C.S. Purkayastha 12075* (ASSAM); Balaiba Tilla, ± 2200 ft., 1 Aug 1964, *J. Joseph 37536* (CAL); Nongpoh, ± 2200 ft., 29 Jul 1964, *J. Josph 37432* (ASSAM); Umsaw, 19 Jul 1966, *D.M. Verma 35608* (ASSAM); Umran Forest, 9 Nov 1982, *S.R. Sharma 10370* (ASSAM). SOUTH GARO HILLS Dt.: Baghmara, 900 ft., 3 Sep 1962, *D.B. Deb 29137* (ASSAM). WEST KHASI HILLS Dt.: Markara to Nongstoin, 19 Jun 1985, *G. Panigrahi 16438* (ASSAM). **MIZORAM**. Mizo Hills, *R. Dutta 34083* (ASSAM). **NAGALAND**. Naga Hills, Jun 1985, *N.L. Bor 21216* (ASSAM). KOHIMA Dt.: Kohima, Jul 1886, *D. Prain 21, 22* (CAL), Sep 1886, *D. Prain 23* (CAL). MOKOKCHUNG Dt.: Longsa, Naga Hills, 3000 ft., *N.L. Bor 5073* (K); Kupza, 1261 m., N 26°17'54.0", E 094°28'47.7", 28 Jun 2005, *E. Sanoj 92141* (CALI); Way to Dikku, 643 m., 23 Aug 2006, N 26°19'35.5", E 094°32'57.8", *E. Sanoj & V.P. Thomas 105540* (CALI). PHEK Dt.: Muchojho way to Surhoba, 5 Sep 2006*, E. Sanoj & V.P. Thomas 105592* (CALI); 5 km from Kutsepo, 1746 m., N 25°42'06.2", E 094°27'17.9", 6 Sep 2006, *E. Sanoj & V.P. Thomas 105613* (CALI). ZUNHEBETO Dt.: Ungma, (way to Lumami), 1210 m., N 26°16'35.1", E 094°28'38.2", 28 Jun 2005, *E. Sanoj 92136* (CALI). **ORRISA**.

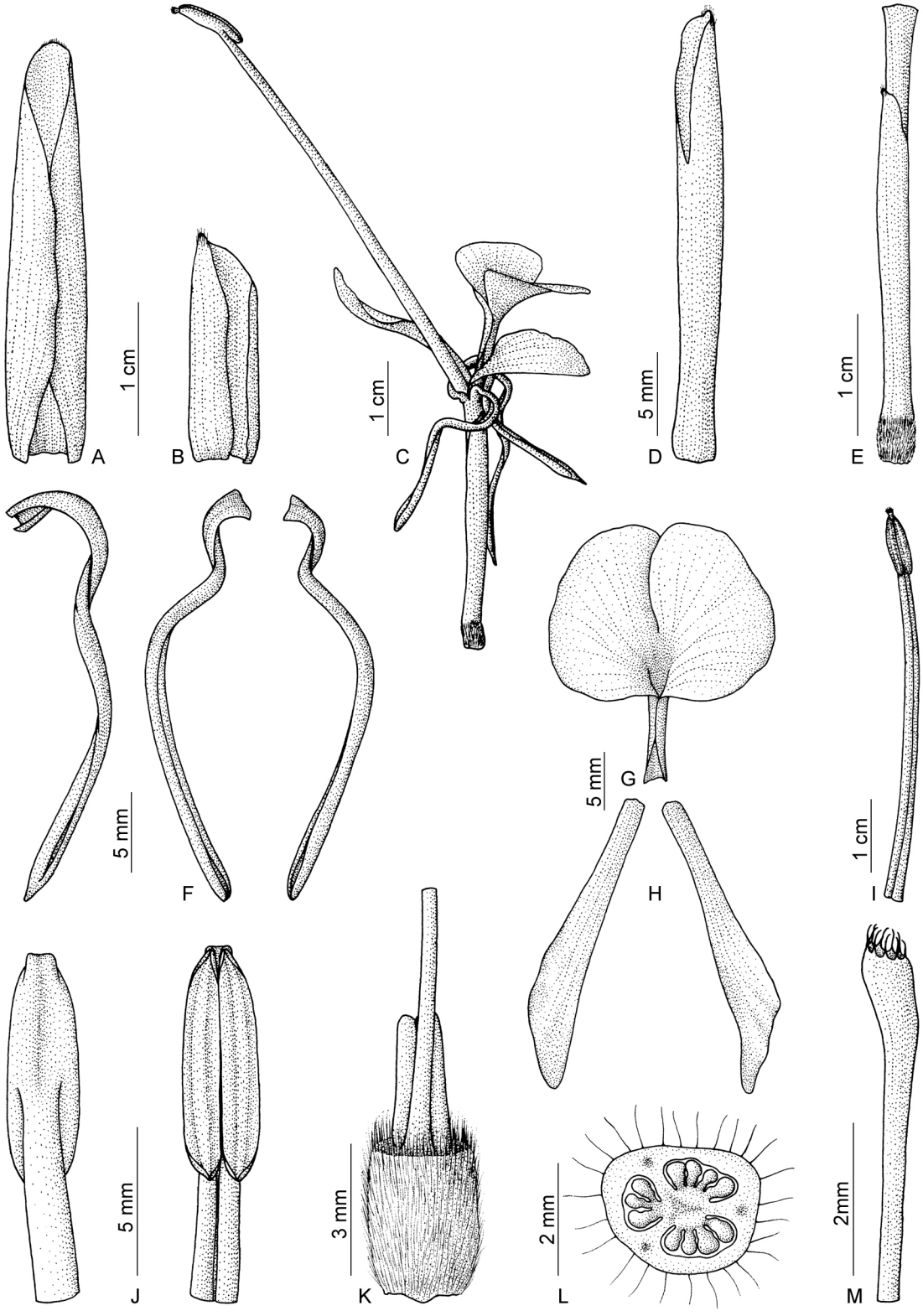

Figure 05. ***H. coccineum***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, back view (left) and front view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

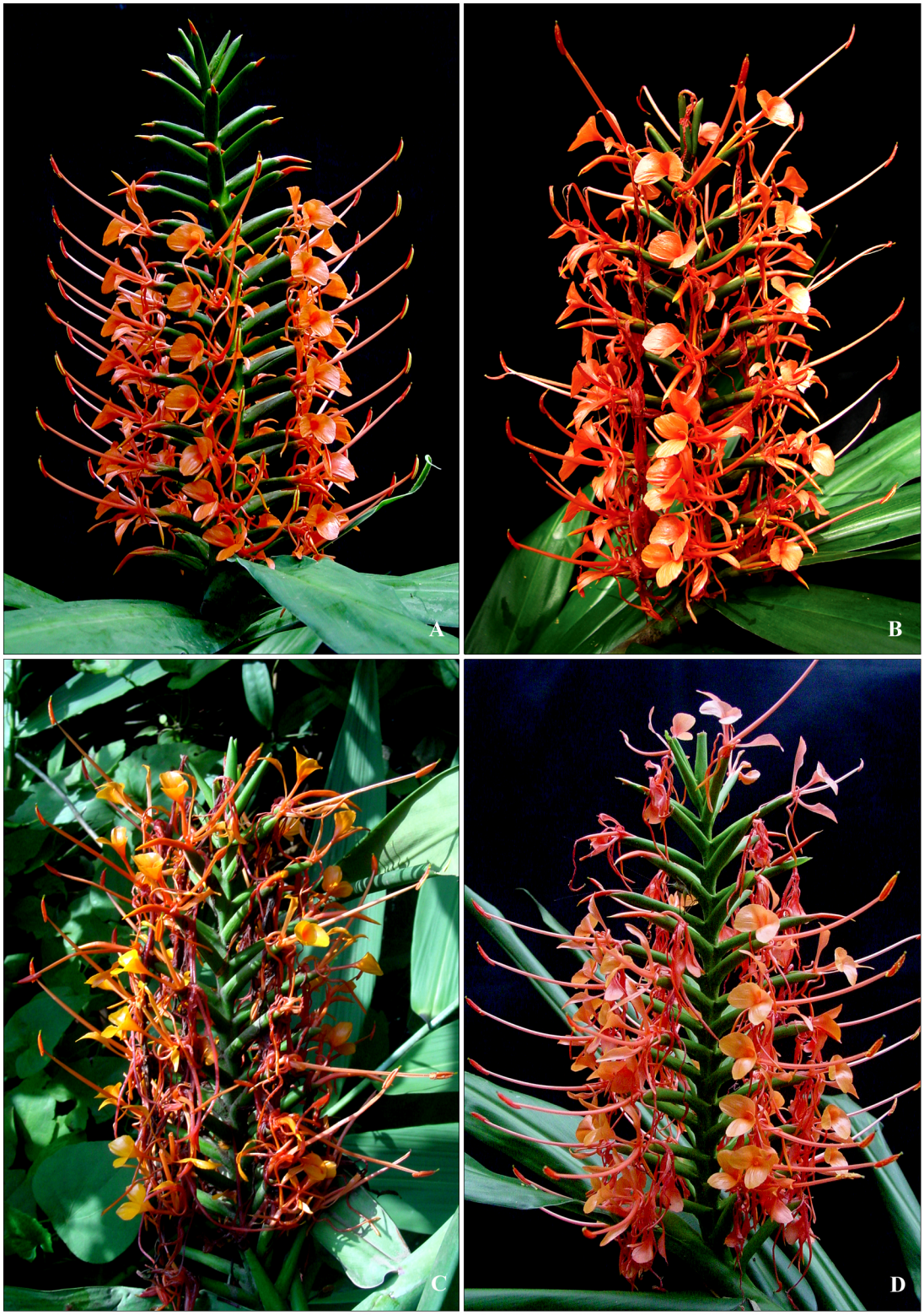

Plate 03. Inflorescences of ***H. coccineum*** showing variation in colour and form.

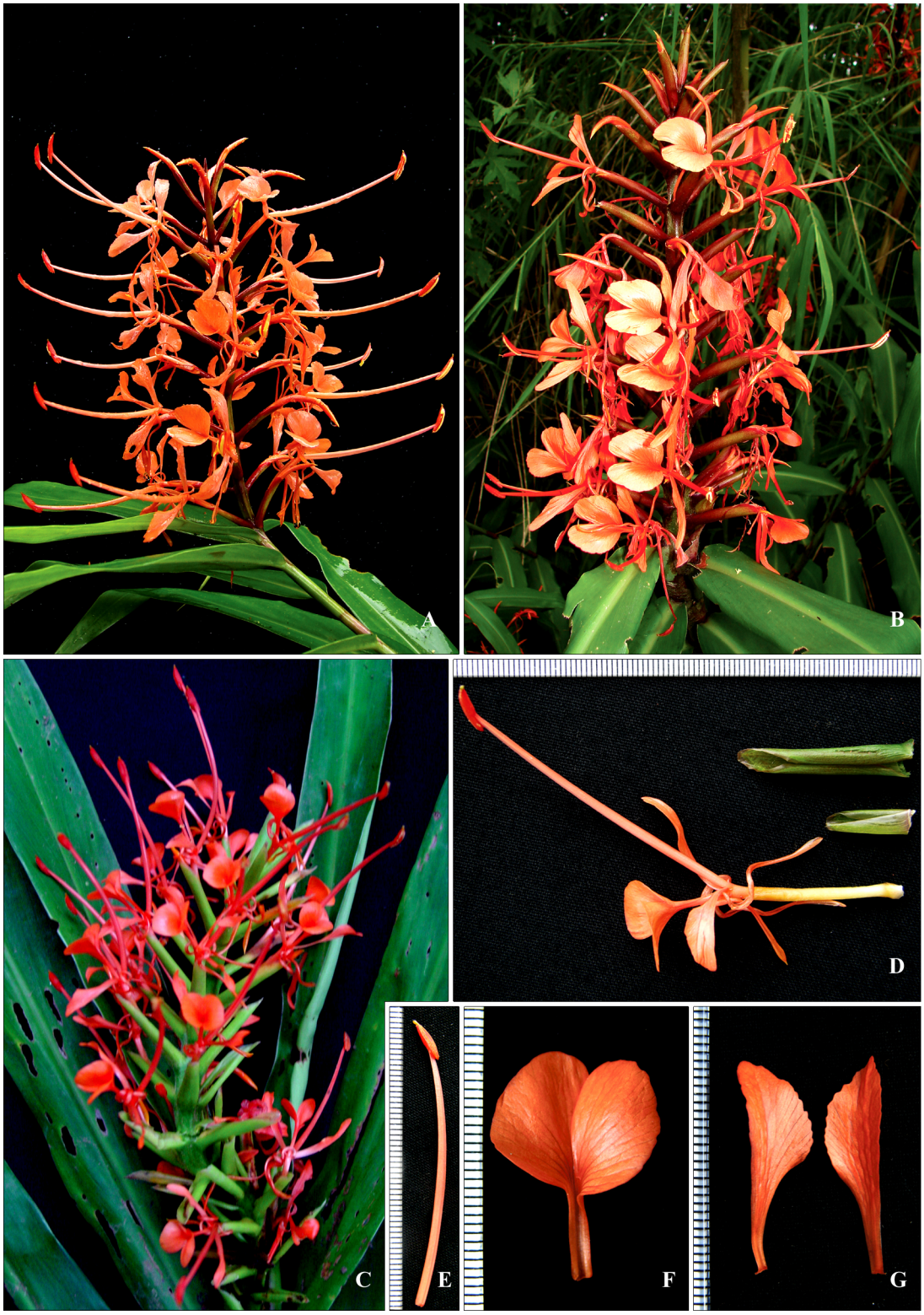

Plate 04. **A-G.** ***H. coccineum*****: A-C.** inflorescences showing variation in colour and form; **D.** single flower, bract and bracteole; **E.** stamen; **F.** labellum; **G.** lateral staminodes.

MAYURBHANJ Dt.: Gurguri to Jenabil, 16 Feb 1958, *G. Panigrahi 12420* (ASSAM, CAL). **SIKKIM**. *s.loc.,* 2000 ft., *J.D. Hooker s.n.* (K); 2000 ft., *J.D. Hooker & J. Thomson s.n.* (CAL). **UTTARAKHAND.** ALMORA Dt.: Gugni, 13 Oct 1975, *B.M. Wadhwa 57647* (BSD). PITHORAGARH Dt.: Kumaon, Harara, 3500 ft., 10 Aug 1845, *s.coll. 1* (CAL); Didihar, Pithoragae, 1800 m., 31 Jul 1970, *C.M. Arora 41341* (BSD); Tejam, Finkola, 1 Aug 1928, *J.F. Duthie 24979* (K); Dafia Dhoora Reserve Forest, 6 Aug 1980, *C.M. Arora 70832* (BSD); Sarju Valley, 19 Aug 1886, *J.F. Duthie 6010* (K); Khalpatal, 13 Aug 1972, *C.M. Arora 49909* (BSD); Jagerar, 5000 ft., *R. Strachery & J.E. Winterbottom 1* (K). DEHRADUN Dt.: Mossoorie, 20 Jul 1899, *Mackinnon s.n.* (CAL); 3, Lakshmi Road, 20 Sep 1976, *A.S. Rao 56943* (BSD). **WEST BENGAL**. DARJEELING Dt.: Parhok, 3000 ft., Jul 1881, *J.S. Gamble 9573* (K); Darjeeling, 15 Aug 1889, *C.B. Clarke 8619* (K).

Key to the varieties *H. coccineum*

1a. Flowers fleshy-pink (pale pink)…… var. ***carneum***

1b. Flowers orange-yellow, scarlet red or brick red…… 2

2a. Flowers 7.9-10.5 cm long; labellum 1.9-2 x 1.6-2 cm; anthers deep red. …… var. ***coccineum***

2b. Flowers 11.3-12 cm long; labellum 2.9-3 x 2.2-2.5 cm; anthers orange …… var. ***angustifolium***

3a **Hedychium coccineum** var**. angustifolium**

H. coccineum var***. angustifolium*** (Roxb. ex Ker Gwal.) Baker in J.D. Hooker, Fl. Brit. India 6: 231. 1892; J.N. Mitra, Monocot. E. India 1: 244. 1958.

H. angustifolium Roxb. [Hort. Beng. 1. 1814, *nom. nud.*] ex Ker Gawl., Bot. Reg. 2: t. 157. 1816 (excl. syn.); Sims, Bot. Mag. 46: t. 2078. 1819; Roxb., Pl. Coromandel 3: t. 251. 1820 (excl. fig.), Fl. Ind. 1: 13. 1832; Paxton, Paxton's

Mag. Bot. 4: 202. 1838; Wall. in W.J. Hooker, Hooker's J. Bot. Kew Gard. Misc. 5: 371. 1853, J. Hort. Soc. London 9: 23. 1855; C. Muell., Ann. Bot. Syst. 6: 25. 1861; Naik & Panigrahi, Bull. Bot. Surv. India 3(1): 71. 1961; Weathers, Bulb Book 269. 1911; S.K. Jain & V. Prakash., Rheedea 5(2): 160. 1995.

Type: Ker Gawler, Bot. Reg. 2: t. 157. 1816.

H. aurantiacum Roscoe, Monandr. Pl. Scitam. 5/6: t. 61. 1825; Paxton, Paxton's Mag. Bot. 4: 203. 1838; A.S. Rao & D.M. Verma, Bull. Bot. Surv. India 14: 134. 1972; N.P. Balakr., Fl. Jowai 2: 528. 1983; Naik & Panigrahi, Bull. Bot. Surv. India 3(1): 71. 1961; R.M. Sm. in A.J.C. Grierson & D.G. Long, Fl. Bhutan 2: 205. 1991; S.K. Jain & V. Prakash., Rheedea 5(2): 160. 1995; Press et al., Annot. Checkl. Fl. Pl. Nepal 329. 2000; S. Kumar, Zingber. Sikkim 45. 2001.

Type: Roscoe, Monandr. Pl. Scitam. 5/6: t. 61. 1825.

H. gardnerianum var. *γ pro parte* (*H. aurantiacum*) Wall. in W.J. Hooker, Hooker's J. Bot. Kew Gard. Misc. 5: 369. 1853, J. Hort. Soc. London 9: 21. 1855; C. Muell., Ann. Bot. Syst. 6: 25. 1861.

(*Figure 06; Plate 05. A–E*)

Common Name: Red-Garland flower.

Terrestrial, perennial rhizomatous herbs. *Rhizome* 2.6–3 cm wide, creamy white internally, pale pink externally, slightly aromatic, covered by brown scales. *Leafy shoot* 120–160 cm high, erect, robust, non-glaucus. *Leaves* 12–16 in number, 4.8–8.4 cm apart, spreading, sessile; sheath 2–3.2 cm wide, margins pink, membranous, translucent, pubescent; ligule 1.8–2.3 x 1.5–2.2 cm, ovate, single-lobed, obtuse-rounded at tip, pink, sericeous externally, membranous, translucent, papery, closely appressed to the stem; lamina 43–59 x 5.6–9.36 cm, elliptic, dark green and glabrous above, pale green and pubescent below; margin undulate,

membranous, translucent, white tinged, non-ciliate; tip long caudate, twisted; base cuneate; midrib densely pubescent below. *Inflorescence* 25.5–38 cm long, cylindrical, lax, erect; rachis angular, green pubescent. *Bracts* 4–5 x 1.9–2.4 cm, elliptic, green-brownish green, sparsely sericeous, densely sericeous towards tip margins, coriaceous, convolute; margin non-ciliate, translucent, membranous, pale red, tip obtuse-acute, cincinnus 2–5 -flowered. *Bracteoles* 2.8–3.2 x 1.4–2.4 cm (outer tubular), moderately translucent, slightly 2 or 3 lobed at tip, pale reddish-green, sparsely sericeous, outer one completely encircles the cincinnus. *Flower* 11.3–12 cm long, orange yellow, many flowers open at a time, ascending, slightly fragrant. *Calyx* 3–3.5 cm long, *c.* 3 mm wide at mouth, pale green, sericeous, membranous, translucent, slightly inflated towards tip, unilaterally split upto 0.8–1.4 cm, 3-toothed at tip. *Corolla tube* 4.9–5 cm long, *c.* 3 mm wide at mouth, pink, white towards the base, hairy internally, slightly bend to one side at centre. *Corolla lobes* oblanceolate, orange-yellow, membranous, early decaying at base, drooping from flower, glabrous; dorsal lobe 3.8–4.1 x *c.* 0.5 cm, *c.* 5 mm long beaked at tip; lateral lobes 3.5–3.8 x *c.* 0.4 cm, non-beaked at tip. *Lateral staminodes* 3.1–3.2 x 0.55–0.7 cm, sword-shaped, orange-yellow, pink towards base, spreading on flower, reflexed back, outer margin undulate. *Labellum* 2.9–3 x 2.2–2.5 cm, orbicular, orange-yellow, pink towards base, spreading on flower, reflexed back on upper half, base truncate, abruptly clawed at base; claw 3–3.5 mm wide; sinus 1.3–1.4 cm deep; margin undulate; lobes fan-shaped, overlapping, obtuse at tip. *Stamen c.* 6.4 cm long, slightly arching. *Filament* 5–5.5 cm long, *c.* 2 mm wide at base, pink, slightly arching. *Anther* 1–1.1 x 0.25–0.3 cm, oblong-elliptic, orange, split opens from top to bottom, attached with the filament at 2.5–3 mm above from base, thecae axis parallel with the filament; connective orange, glabrous, non-crested, tip truncate. *Ovary* 3.5–5 x *c.* 3 mm, oblong, yellow, sericeous externally. *Style* filiform, white, glabrous, pubescent towards tip, yellow-green tinged towards stigma. *Stigma c.* 1.5 mm wide, yellow-green, cup-shaped, margin pubescent, hairs hook-like, 1–2 mm exserted from the anther. *Epigynous glands* two, 4.5–5 mm long, oblong, yellow.

Notes: The specific epithet '*angustifolium'* was first used by Roxburgh (1814) in his *Hortus Bengalensis*. The taxon was first validly published by Ker Gawler in *Botanical Register* (1816). He provided a detailed description of the species and an excellent illustration based on a material introduced to England by Sir Abraham Hume at his bothouse at Wormleybury. In his view, even though it is having some slight differences, he synonymised *H. coccineum* with it, and he considered the differences are natural while comparing the description from a dried with a living specimen. Ker Gawler (*l.c.*) ascribed the species to Roxburgh even before its publication ("But the identity of our plant with the *H. angustifolium* of the late Roxburgh being beyond a cavil, and the account of it having long been written under that title, and now actually printed in the forthcoming fasciculus of the work on the Plants of the Coast of Coromandel, We feel ourselves warranted in adopting it, although not the one first published"). Later, by identifying the existence of *H. coccineum* as a separate species, in a note in *Botanical Register* (Ker Gawler 1820) he corrected the usage of *H. coccineum* by removing it from the synonyms of *H. angustifolium*. Wallich also mentioned in a note (under *H. angustifolium*) in Roxburgh's *Flora Indica* (1832) as "Notwithstanding the opinion which the distinguished Botanist Edwards (Bot. Reg. 2: 157. 1816) has expressed, I am led to suspect that *H. coccineum* of Sir J.E. Smith (1811) is a distinct species, of which I have examined the original drawing, left by my inestimable friend and predecessor Dr. F. Buchanan at the Botanic garden at Calcutta." And in a letter from Wallich to William Roscoe, Wallich observes that, the *H. coccineum* is undoubtedly Hamilton's (Buchanan) plant, distinguished by its ensiform leaves and red colour from the nearest species (Roscoe 1825). Thus he distinguished these two species.

Roxburgh (1820) published the same species in his '*Plants of Coast of Coromandel'* (t. 251) with an illustration of *H. coccineum,* described by Smith (1811), and its distribution in Chittagong, Silhet and eastern parts of Bengal.

While describing *H. coccineum,* Smith (1811) also mentioned Dr. Buchanan's observation about a possible variety of this species "what he conceived to be a variety of this fine species, chiefly differing in its more dense imbricated spike, and orange coloured inner segments of the flower. Its flower stalk indeed was smooth and calyx terminating in two teeth. We have seen no specimen of this, but are inclined to presume it may be a different species". Though Smith did not see this specimen, he considered it as a distinct species.

While describing the species *H. angustifolium,* Sims (1819) suspect that, this is the variety of *H. coccineum* observed by Dr. Buchanan (Smith 1811). He also provided an excellent illustration which is much similar with to the plate number 157 of Ker Gawler (1816).

H. aurantiacum, was described by Roscoe (1825), which was based on a specimen sent by Wallich to Liverpool in 1819, and which flowered continuously for several years in Botanical Garden at Liverpool. While describing *H. aurantiacum*, he also mentioned that, this is conjectured taxon of Buchanan (Smith *l.c.*). Wallich (1853, 1855) remarked that, with the exception of Roscoe's colour figure of *H. aurantiacum* is a perfect representation of *H. angustifolium*, and reduced former as a synonym of latter. Later Baker (1892) reduced *H. angustifolium* as a variety of *H. coccineum* by mentioning very slight differences from type species. We also agreed with Wallich's and Baker's observations and placed *H. aurantiacum* as a synonym of *H. angustifolium* and *H. angustifolium* as a variety of *H. coccineum*.

Flowering & Fruiting: June–September.

Distribution: Tropical regions of Eastern India (Alt. 900-1,800 m.) and Bangladesh. (*Figure 11. A*)

IUCN Red list Category: This species having a fair extend of occurrence, but it is having very limited area of occupancy with geographically wider subpopulations. Hence it is assessed here as the Critically Endangered

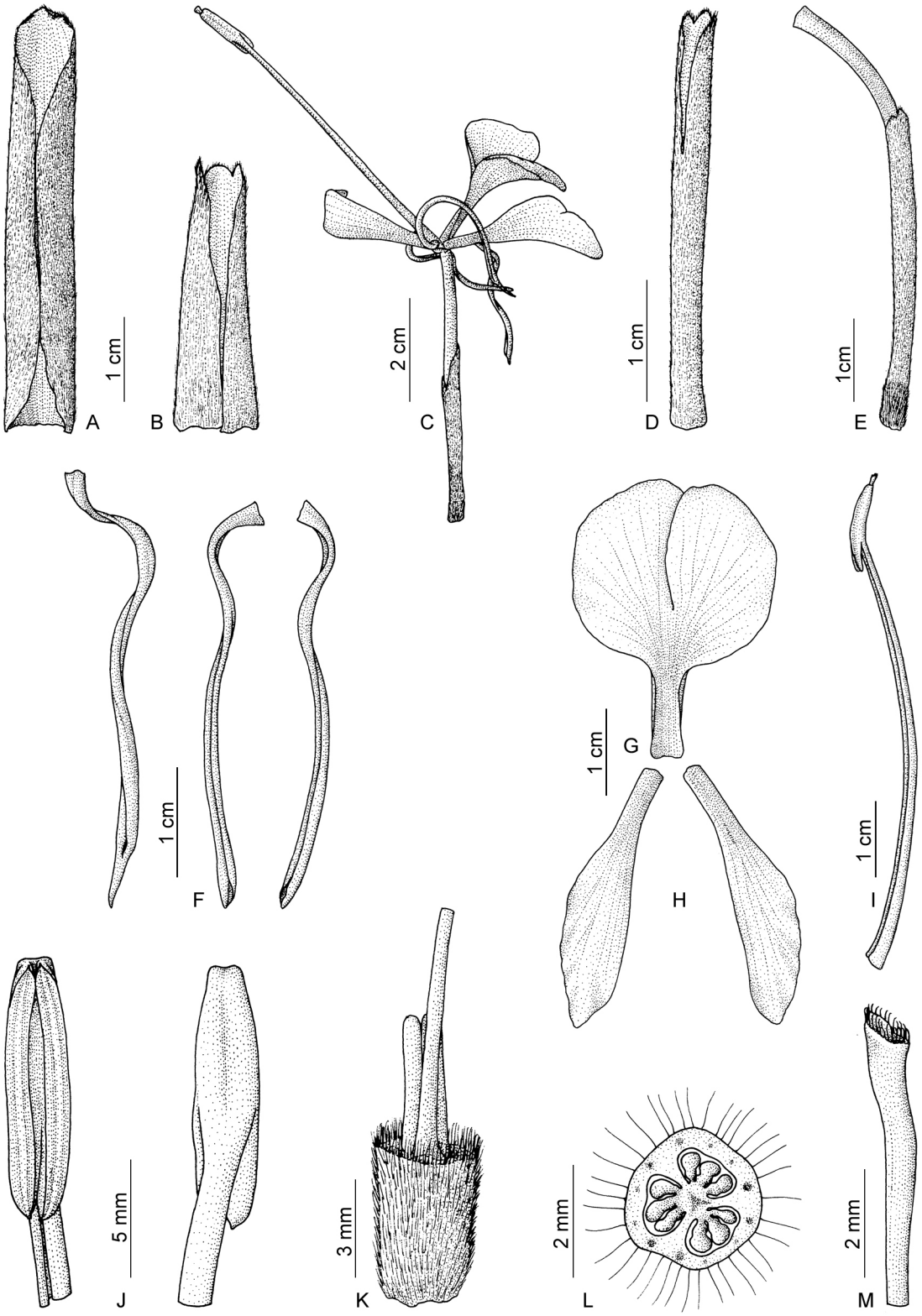

Figure 06. ***H. coccineum*** var. ***angustifolium***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, front (left) and back view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

(CR B1b(i,ii,iv)+2b(i,ii,iv); E) as per IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA**. **ARUNACHAL PRADESH.** LOHIT Dt.: Bohing Village, 6 Oct 1969, *A.S. Rao 48274* (ASSAM, CAL). WEST KAMENG Dt.: Kalaktang, Kameng F.D., 14 May 1958, *G. Panigrahi 15530* (ASSAM). **ASSAM**. DIBRUGARH Dt.: Upper Dihing Reserve, 8 miles from Digboi, *G. Panigrahi 18759* (CAL). KAMRUP Dt.: Jarasal Forest, 5 miles south of Rani, 15 Jun 1964, *A.S. Rao 38847* (ASSAM, CAL). LAKHIMPUR Dt.: Jeypore, 18 Sep 1935, *C.S. Punkayastha 19646* (CAL). **MANIPUR**. *s.loc., D.B. Deb 1853* (CAL). IMPHAL Dt.: Imphal, Waifai, 9 Aug 1853, *D.B. Deb 832* (CAL). **MEGHALAYA**. Khasia, 4-6000 ft., *J.D. Hooker & J. Thomson s.n.* (K), *s.loc.,* 3-4000 ft., *s.coll. 477* (CAL). EAST KHASI HILLS Dt.: Woodlands, 16 Aug 1971, *D.M. Verma 34645* (ASSAM). **NAGALAND**. KOHIMA Dt.: Kohima, 31 Aug 2006, *E. Sanoj & V.P. Thomas 105562* (CALI). **SIKKIM**. *s.loc., J.D. Hooker s.n.* (K). **UTTARAKHAND.** DEHRADUN Dt.: Dehradun, Jul 1898, *J.S. Gamble 27014* (K). **WEST BENGAL**. DARJILING Dt.: Little Rimgeet Valley, 20 Aug 1874, *C.H. 464* (K). *Locality unknown*: *s.loc., Shepherd s.n.* (K).

3b **Hedychium coccineum** var**. carneum**

H. coccineum var***. carneum*** (Lodd.) Baker in J.D. Hooker, Fl. Brit. India 6: 232. 1892; Karthik. et al., Fl. Ind. Enum. Monocot. 294. 1989.

H. carneum Lodd., Bot. Cab. 7(10): t. 693. 1823, *non* Y.Y. Qian 1994; Carey ex Herb. Bot. Mag. 53: t. 2637. 1826; Roscoe, Monandr. Pl. Scitam. 11/12: t. 57. 1827; Paxton, Paxton's Mag. Bot. 4: 203. 1838; K. Schum. in A. Engler, Pflanzenr. IV. 46(heft 20): 53. 1904; Weathers, Bulb Book 269. 1911.

Type: Loddiges, Bot. Cab. 7(10): t. 693. 1823.

H. coccineum var. *β pro parte* (*H. carneum*) Wall. in W.J. Hooker, Hooker's J. Bot. Kew Gard. Misc. 5: 373. 1853, J. Hort. Soc. London 9: 24. 1855; C. Muell., Ann. Bot. Syst. 6: 26. 1861. (*Figure 07; Plate 05. F & G*)

Common Name: Flesh-coloured Garland Flower.

Terrestrial, perennial rhizomatous herbs. *Rhizome* 1.6–2.2 cm wide, creamy white internally, slightly aromatic. *Leafy shoot* 138–158 cm high, erect, robust, non-glaucus. *Leaves* 19–24 in number, 6–8.5 cm apart, spreading, sessile; sheath 2.3–2.5 cm wide, margins pale pink, membranous, translucent, pubescent; ligule 1.5–1.8 x 1.6–1.8 cm long, ovate, single-lobed, truncate at tip, pale pink, pubescent externally, membranous, translucent, papery, closely appressed to the stem; lamina 34–46 x 5–5.8 cm, elliptic, dark green above, pale green below, lower leaves purple below, glabrous; margin undulate, membranous, translucent, white tinged, non-ciliate; tip long caudate, twisted; base cuneate; midrib densely sericeous below. *Inflorescence* 28–33 cm long, cylindrical, lax, erect; rachis pubescent. *Bracts* 3–3.2 x 1.2–1.5 cm, oblong-elliptic, green, glabrous, pubescent towards tip margins, coriaceous, convolute; margin non-ciliate, translucent, membranous, white, tip obtuse, cincinnus 3 or 4-flowered. *Bracteoles* 2–2.4 x 1–1.2 cm (outer tubular), translucent, slightly 2-lobed at tip, pale green, white towards base, glabrous, pubescent towards tip, outer one completely encircles the cincinnus, leathery. *Flower* 11.7–12.5 cm long, fleshy-pink (pale-pink) with pale yellow anthers, many flowers open at a time, spreading, slightly fragrant. *Calyx* 2.8–3 cm long, *c.* 3 mm wide at mouth, white, green tinged towards tip, pubescent, membranous, translucent, lower part closely appressed to corolla tube, upper portion gradually inflated, unilaterally split upto 0.9–1 cm deep, 3-toothed at tip. *Corolla tube* 3.2–3.4 cm long, *c.* 3.5 mm wide at mouth, pale pink, white towards base, glabrous externally, hairy internally. *Corolla lobes* oblanceolate, pale pink, pale greenish tinged towards tip, membranous, early decaying at base, drooping from flower, glabrous; dorsal lobe 4.1–4.2 x *c.* 0.45 cm, *c.* 2 mm long beaked at tip;

lateral lobes 3.8–4 x *c.* 0.45 cm, non-beaked at tip. *Lateral staminodes* 2.5–2.7 x 0.4–0.5 cm, oblanceolate, pale pink, spreading on flower, reflexed back, outer margin irregular, acute at tip. *Labellum* 2.6–2.7 x 1.8–1.9 cm, orbicular, pale pink, deep coloured at centre, spreading on flower, reflexed back on upper half, base truncate-rounded, abruptly clawed at base; claw *c.* 3.5 mm wide; sinus 1.2–1.3 cm deep; margin undulate, obtuse at lobes tip. *Stamen* 6–6.1 cm long, erect, pink with creamy yellow anther. *Filament* 5.4–5.5 cm long, 2 mm wide at base, pale pink, erect. *Anther c.* 10 x 2.5 mm, oblong, pale yellow, pale pink blotched at tip of connective, ciliate in thecae margins, split opens from top to bottom, attached with the filament at *c.* 3 mm above from base, thecae axis parallel with the filament; connective yellow, glabrous, non-crested, tip slightly notched. *Ovary* 2.5–3 x 1.5–2 mm, barrel-shaped, pale green, densely sericeous externally. *Style* filiform, white, glabrous, pubescent towards tip, broadens and green tinged towards stigma. *Stigma c.* 1 mm wide, green, cup-shaped, hairy on margins, hairs hook-like, *c.* 1.5 mm exserted from the anther. *Epigynous glands* two, 3–3.5 mm long, oblong, yellow.

Notes: The species *H. carneum* was first described by Loddiges in *Botanical Cabinet* (Loddiges 1823a) on the basis of an introduced plant from India. Along with the original publication he also provided an excellent colour drawing. William Herbert again published the same epithet for the same taxon in Curtis' *Botanical Magazine* with a colour plate (53: t. 2637. 1826) on the basis of a material send by Carey from Calcutta. Later William Roscoe (1827) described Loddige's *H. carneum* and provided another colour drawing for the species. He also disagreed Wallich's observation (MSS) that, "the present plant is not to be specifically distinguished from *H. elatum* and it varies exceedingly, according to elevation, soil and culture". He was not specifically distinguished it from *H. elatum* R. Br. and states that, it is more closely likely related to *H. angustifolium* and *H. longifolium* than to *H. elatum,* but from both of which it differs in the peculiar appearance of its more scanty spike of flowers, and in its somewhat broader lanceolate leaves. Later, Wallich (1853,

1855) identified *H. elatum*, *H. carneum*. and *H. stenopetalum* Lodd. as the varieties of *H. coccineum* and he accordingly united them under variety 'β' of *H. coccineum.* But the *H. carneum* of Roscoe and of Loddiges are reduced as *H. coccineum*.

Horaninow (1862) reduced it as a synonym of *H. coccineum*, Baker (1892) and Schumann (1904) did not distinguish *H. carneum* of Loddiges/Roscoe with that of Carey and identified a varietal difference with *H. coccineum* and reduced *H. carneum* as a variety of the same. We also agreed with the varietal usage of the taxon and the authorship of Loddiges has to be retained based on priority. This taxon can be easily identified on the basis of flesh-coloured flowers, lax spike and broader leaves.

H. carneum Y.Y. Qian was described by Qian (1994) from Yunnan, South-central China. Since it becomes a later homonym of *H. carneum* Lodd. it has been renamed as *H. neocarneum* T.L. Wu *et al.* (Wu *et. al.* 2000).

Flowering: July–September.

Distribution: Endemic to Meghalaya in India. (*Figure 11. A*)

IUCN Red list Category: We could not locate any other previous collections of this taxon from the major herbaria like ARUN, ASSAM, BM, CAL, E and K other than the present collection. Hence it is assessed against the Critically Endangered (CR B1ab(i,ii,iv,)+2ab(i,ii,iv); E) category as per IUCN Guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010). Present collection from Maghalaya form a rediscovery after a lapse of more than 100 years.

Specimens examined: **INDIA**. **MEGHALAYA**. JAINTIA HILLS Dt.: Jowai, way to Sonapur, 843 m., N 25°12.821', E 092°22.745', 16 Aug 2007, *E. Sanoj & T. Rajesh Kumar 95195* (CALI).

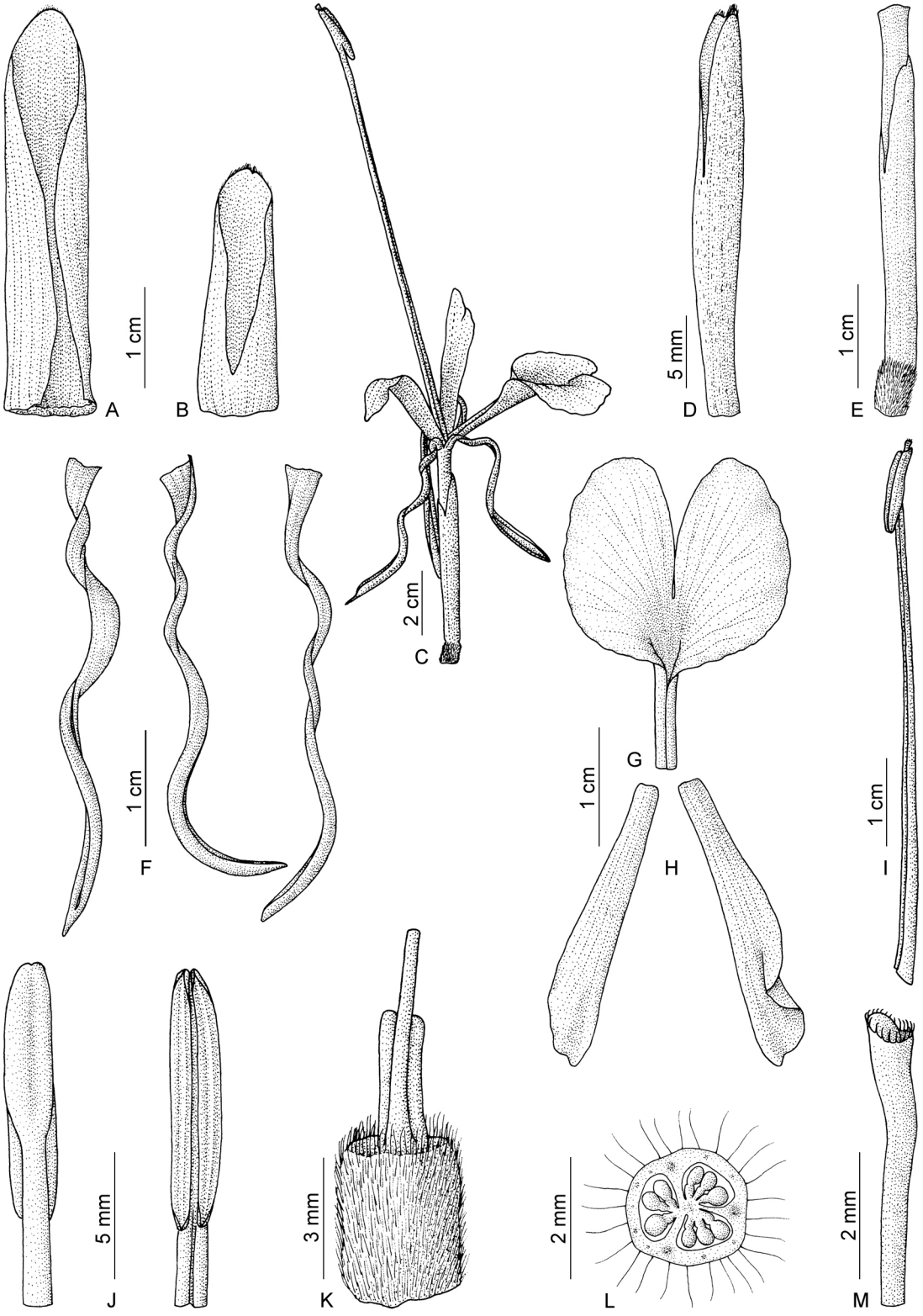

Figure 07. ***H. coccineum*** var. ***carneum***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, back view (left) and front view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

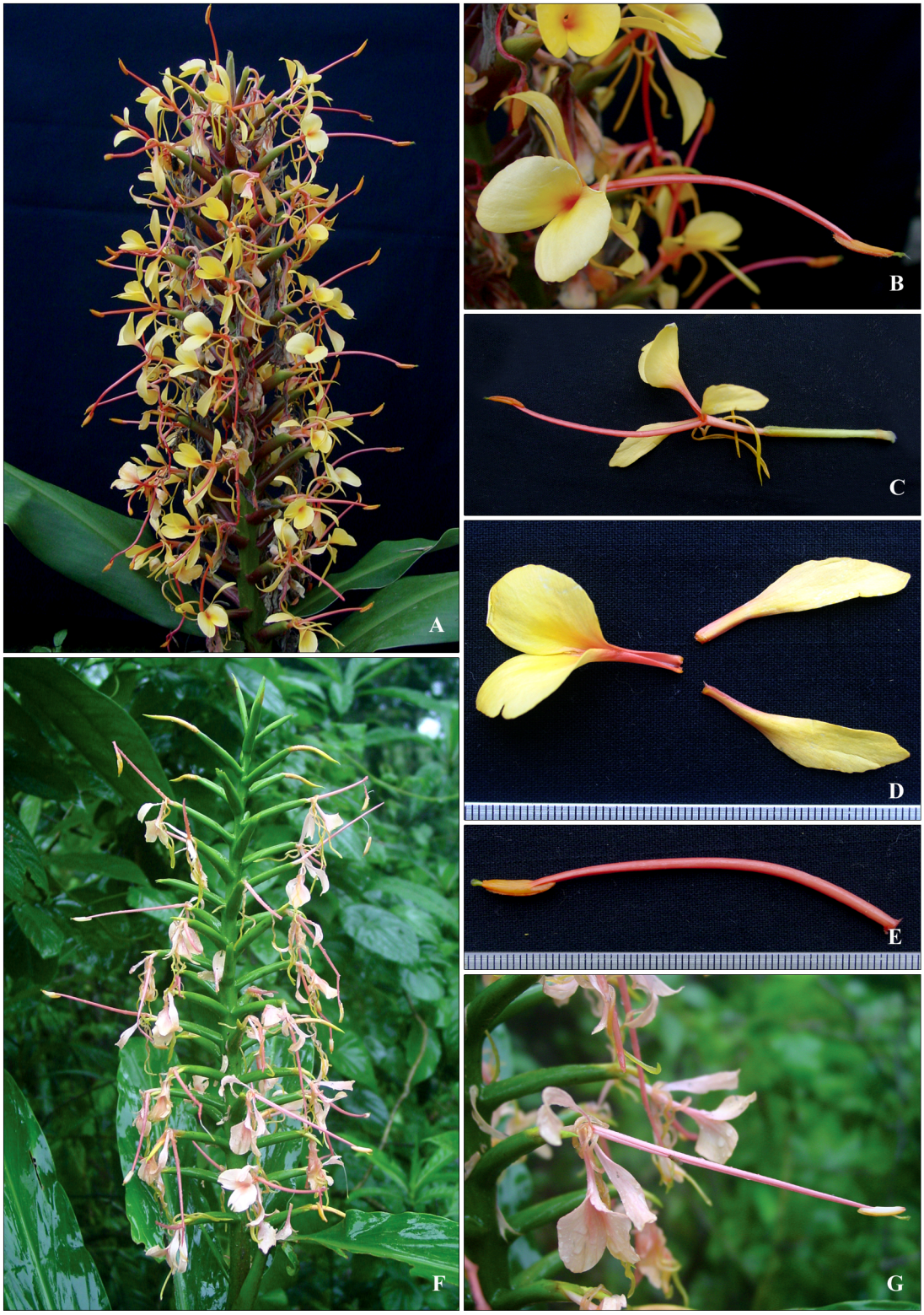

Plate 05. **A-E.** ***H. coccineum*** var. ***angustifolium*****: A.** inflorescence; **B.** flower close-up; **C.** single flower; **D.** labellum and lateral staminodes; **E.** stamen. **F & G.** ***H. coccineum*** var. ***carneum*****: F.** inflorescence; **G.** flower close-up.

H. coronarium J. Koenig in A.J. Retzius, Observ. Bot. 3: 73. 1783; Sims, Bot. Mag. 19: t. 708. 1803; Sm., Exot. Bot. 2: 95. t. 107. 1805; Roxb., Asiat. Res. 11: 325. 1810, Fl. Ind. ed. Carey 1: 9. 1820; Sm. in A. Rees, Cyclop. 17. n. 1. 1811; Spreng., Syst. Veg. 1: 9. 1825; Roscoe, Monandr. Pl. Scitam. 9/10: t. 51. 1826; A. Dietr., Sp. Pl. 1: 31. 1831; Paxton, Paxton's Mag. Bot. 4: 201. 1838; D. Dietr., Syn. Pl. 1: 9. 1839; Wight, Icon. Pl. Ind. Orient. 6: 17. t. 2010. 1853; Wall. in W.J. Hooker, Hooker's J. Bot. Kew Gard. Misc. 5: 325. 1853, J. Hort. Soc. London 9: 15. 1855; C. Muell., Ann. Bot. Syst. 6: 22. 1861; Horan., Prodr. Monogr. Scitam. 24. 1862; Baker in J.D. Hooker, Fl. Brit. India 6: 225. 1892; Trimen, Handb. Fl. Ceylon 4: 245. 1898; K. Schum. in A. Engler, Bot. Jahrb. Syst. 27: 340. 1899, in A. Engler, Pflanzenr. IV. 46(heft 20): 44. 1904; T. Cooke, Fl. Bombay 2: 234. 1907; Weathers, Bulb Book 269. 1911; Turrill, Bull. Misc. Inform. Kew 1914(10): 368. 1914; C.E.C. Fisch., Rec. Bot. Surv. India 9: 178. 1921, in J.S. Gamble, Fl. Madras 3: 1485. 1928; Haines, Bot. Bihar Orissa 5: 1138. 1924; J.N. Mitra, Monocot. E. India 1: 242. 1958; Duthie, Fl. Gangetic Plain 2: 307. 1960; Naik & Panigrahi, Bull. Bot. Surv. India 3(1): 71. 1961; Backer & Bakh. f., Fl. Java 3: 65. 1968; A.S. Rao & D.M. Verma, Bull. Bot. Surv. India 11: 121. 1969, 14: 128. 1972; Ramamoorthy in Saldanha & Nicolson, Fl. Hassan Dist. 768. 1976; Rao & Razi, Fl. Mysore Dist. 581. 1981; J. Joseph, Fl. Nongpoh 305. 1982; B.L. Burtt & R.M. Sm. in Dassanayake & Fosberg., Revis. Handb. Fl. Ceylon 4: 506. 1983; Deb, Fl. Tripura 2: 376. 1983; N.P. Balakr., Fl. Jowai 2: 527. 1983; K.M. Matthew & Britto in K.M. Matthew, Fl. Tamil Nadu Carnatic 3: 1617. 1983; Manilal, Fl. Silent Valley 313. 1988; Karthik. et al., Fl. Ind. Enum. Monocot. 294. 1989; R.M. Sm. in A.J.C. Grierson & D.G. Long, Fl. Bhutan 2: 201. 1991; K.G. Bhat, High. Pl. Ind. Subcont. 4: 87. 1993, Fl. Udupi 631. 2003; Press et al., Annot. Checkl. Fl. Pl. Nepal 330. 2000; H.O. Saxena & Brahmam, Fl. Orissa 3: 1905. 1995; S.K. Jain & V. Prakash., Rheedea 5(2): 160. 1995; S.K. Srivast., High. Pl.

Ind. Subcont. 8(1-33): 21. 1998 (Ind. J. Forest. Addit. Ser. 10); T.L. Wu & K. Larsen in Z. Wu & P.H. Raven, Fl. China 24: 372. 2000; S. Kumar, Zingber. Sikkim 47. 2001; S. Behura & N.C. Rout, J. Econ. Taxon. Bot. 27(3): 549. 2003; M. Sabu & Pradeep, Folia Malaysiana 6(1&2): 8. 2005; M. Sabu, Zingiber. Costac. S. India 196. 2006.

Gandasulium Rumph., Herb. Amboin. 5: 175. t. 69. fig. 3. 1747, *nom. illeg*.

Gandasulium coronarium Rumph. ex Kuntze, Rev. Gen. Pl. 2: 690. 1891.

Type: Gandasulium Rumph., Herb. Amboin. 5: 175. t. 69. fig. 3. 1747.

H. coronarium var*. maximum* Eichler in Martius et al., Fl. Bras. 3(3): 37. t. 10. fig. 1 & 3. 1890, *non* Roscoe 1825.

Type: Eichler in Mart. et al., Fl. Bras. 3(3): 37. t. 10. fig. 1 & 3. 1890.

Hedychium sp. 2. Griff. Not. Pl. Asiat. 3: 419. 1851.

Type: INDIA. July, August, 1834, *Mergue Herb.* 195 (depository unknown).

(*Figure 08; Plate 06. A–F*)

Common Names: Butterfly Lily, Butterfly Ginger Lily, Common Ginger Lily, Sweet-scented Garland Flower, Garland Flower, White Ginger.

Vernacular Names: (Mal.) *Kalyana Sowgandhikam, Sugandhi.* (San.) *Gandraja.*

Terrestrial, perennial rhizomatous herbs. *Rhizome* 2–2.5 cm wide, creamy white internally, slightly aromatic. *Leafy shoot* 56–124 cm high, erect. *Leaves* 9–15 in number, 5–9 cm apart, sessile; sheath 2–2.2 cm wide, green, margins white, membranous, translucent, pubescent; ligule 3.2–5 x 1.9–2.2 cm long, ovate-lanceolate, single-lobed, slightly notched at tip, white with pale green tinge, pubescent externally, membranous, translucent, closely appressed to the stem; lamina 26–42.5 x 5–7.5 cm, elliptic, dark green and glabrous above, pale green and

pubescent below, ascending with stem; margin undulate, membranous, translucent, white tinged, non-ciliate; tip long caudate, twisted, bend down; base cuneate; midrib pubescent below. *Inflorescence* 6.4–8.6 cm long, elliptic, erect; compact with imbricate bracts. *Bracts* 4.2–5.8 x 1.6–2.7 cm, ovate-elliptic, green, glabrous, pubescent towards tip and margins, moderately coriaceous, closely imbricate; margin non-ciliate, translucent, membranous, white; tip obtuse; cincinnus 1–3 -flowered. *Bracteoles* 2–3.6 x 1.4–2.4 cm long, pale green, glabrous, pubescent towards tip, outer one tubular; margin membranous, translucent, non-ciliate. *Flower* 13.8–14.7 cm long, white, spreading, 2–4 flowers open at a time, drooping, highly fragrant. *Calyx* 3.1–5.4 cm long, 4–5 mm wide at mouth, white with pale yellow tinge, glabrous, pubescent towards tip, membranous, translucent, upper half inflated, lower half closely appressed to corolla tube, unilaterally split upto 1.1–1.8 cm, obscurely 3-toothed at tip. *Corolla tube* 8.2–9.6 cm long, *c*. 4.5 mm wide at mouth, white, glabrous externally, hairy internally, bend (90° or more) to one side. *Corolla lobes* oblanceolate, white, membranous, early decaying at base, drooping from flower, glabrous; dorsal lobe 4–4.8 x *c.* 1 cm, pale yellow tinged towards tip, 3–4 mm long beaked at tip, 6–7 -nerved; lateral lobes 4–4.5 x 0.8–0.9 cm, non-beaked at tip, 5–6 -nerved. *Lateral staminodes* 4.7–5.6 x 2.4–3.4 cm, ovate with a basal claw, white, spreading on flower, reflexed back, tip truncate or irregularly lobed. *Labellum* 5–5.4 x 5.2–6.2 cm, very widely ovate, white, pale yellow tinge at centre and towards base, spreading on flower, reflexed back on upper half, abruptly clawed at base; claw 5–7 mm wide; sinus 1.5–2.1 cm deep; lobes elliptic, tip obtuse. *Stamen* 4.2–4.7 cm long, sub-equalizing or shorter than labellum, slightly bend at tip, white with creamy white anthers. *Filament* 3.2–3.6 cm long, *c.* 2 mm wide at base, white, slightly arching. *Anther* 13–15 x 3.5–4 mm, oblong, creamy white, split opens from top to bottom, attached with the filament at 3–4 mm above from base, thecae at an angle of 35°–40° with the filament axis; anther suture creamy yellow; connective white, glabrous, slightly prolonged in to a crest of *c*. 0.5 mm long, tip truncate. *Ovary* 4–4.5 x 3–4 mm, barrel-shaped, pale green, glabrous. *Style* filiform, white, glabrous, pubescent towards tip, green tinged

towards stigma. *Stigma* green, cup-shaped, densely pubescent, hairs hook-like, 1.5–4 mm exserted the anther. *Epigynous glands* two, 3–4 mm long, oblong, bright yellow. *Fruits* 1.9–2.4 x 1.8–2.1 cm, ovoid, three-angled, green, glabrous, trilocular, surface smooth, inner surface orange; reflexed back on dehiscence. *Seeds* 4.5–5 x 3–3.5 mm, broadly elliptic, red, deep brown when dry, surface longitudinally ornamented, transversely constricted, base yellow. *Aril* 6–8 mm long, red, yellow when dry, lacerate, covers basal portion of the seed.

Notes: It is one of the most common and most fragrant species of *Hedychium* with snow-white flowers widely cultivated as an ornamental. During our studies we could collect live specimens from very wide range of localities from all over India, and observed that, it shows a wide range of variation in their vegetative and floral characters.

Type species of the genus, described by Koenig in Retzius' *Observationes Botanicae* (1783), based on a pre-linnaean type, which is collected from Indonesia on Ambon Island (*Gandasulium* Rumph., Herb. Amb. 5: p. 175. t. 69 fig. 3. 1743). Later it was described by Sims in *Curtis' Botanical Magazine* (1803) and mentioned the center of origin probably as China. Smith (1811) mentioned that the local inhabitants of Nepal (*Nawars*) called this species as *'Lutisu Swa',* and this species never produce seeds even in Indian Garden and propagates by rhizomes only. But it is a well known species which produces fruits profusely. Smith (*l.c.*) also mentioned Buchanan's observation of a pale yellow variety of the species in the border of fields among elevated mountains of Upper Nepal. Roscoe (1826) identified it as the *H. flavescens* Lodd. or a hybrid between *H. flavum* Roxb. and *H. coronarium.*

This is the only species of the genus *Hedychium* cited by Roxburgh in his *Asiatic Researches* (1810). In *Flora Indica* (Roxburgh 1820), he commented "the most charming of all the plants of this natural order that I have yet met with; the great length of time it continues to throw out a profusion of large, beautiful, fragrant blossoms makes it particularly desirable". He also doubted about a yellow

tinged variety found at the interior provinces of Nepal and another of pale yellow colour, both are equally fragrant. We feel it may be *H. flavum* or *H. flavum* var. *H. flavescens.*

Robert Wight (1853) described and illustrated this species from Neilgherries, Kotergherry. Later it was described by various authors like Wallich (1853, 1855), Mueller (1861), Horaninow (1862), Baker (1892), Schumman (1900, 1904) *etc.* along with some of its allied species (*i.e., H. flavescens, H. flavum, H. maximum* Roscoe*, H. urophyllum* Lodd*. etc.*) as its varieties.

Flowering & Fruiting: June–October.

Distribution: Native of Myanmar, Northeast India (Alt. 15-1,400 m.) and Southern China, is cultivated as ornamental throughout tropics (Larsen *et al.* 1998). As a source material for paper preparation it is massively cultivated in Brazil (Turrill 1914). (*Figure 11. B*)

IUCN Red list Category: One of the species of *Hedychium* having wide distribution all over India and throughout tropics, and hence it is recognized as Least Concern (LC) as per IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Uses: One of the most commonly cultivated species of *Hedychium*. The brilliant white and delightfully fragrant flowers emerge from overlapping green bracts on dense terminal spike makes the plant much attractive. Flowers are also used for the worship of God. In Northeast India and Malaysia, ladies frequently use the flowers in the hair for decoration. It is also used as a symbol of love (Smith 1811). Csurhes and Hannan-Jones (2008) mentioned that, it is naturalised in south-east and North Queensland. Though slow spreading, it has the potential to be as troublesome as *H. speciosum* var*. gardnerianum* (Ker Gawl.) Sanoj & M. Sabu*.* During early 20th century, it is widely cultivated in Brazil for paper making (Beadle 1917, Turrill 1914). Fresh or dried materials are used as a source material for paper

making. The papers produced from this fiber have been greater tensile strength than the strongest Manila paper produced. Moreover it can be made to bear ink and possess parchment qualities without any sizing or other special treatment (Anonymous 1912). In Hawaii, flowers and roots of this species are used as a remedy for fetid nostrils (Nagata 1971), and used for making leis. The rhizome is stimulant and carminative. A decoction of the stem is gargled for tonsillitis. The flower is eaten as vegetable. It is also a source of perfume (Sirirugsa 1998). In India, the rhizomes are used as a febrifuge, anti-rheumatic, tonic and gargle in Folk system of medicine (Udayan & Balachandran 2009).

Specimens examined: **INDIA**. **ANDAMAN & NICOBAR ISLANDS**. GREAT NICOBAR. East-West Road, 8 Km from Campbell Bay, Near Church, 101 m., N 07°00'09.0", E 093°53'19.5", 28 Sep 2007, *V.P. Thomas & M.C. Shameer 113615* (CALI). SOUTH ANDAMANS. Wright Myo, ± 15 m., 15 Jun 1974, *K. Thothathri 1296* (PBL, CAL); Tirur, 8 May 2002, *M.G. Prasanth Kumar 86330* (CALI). **ARUNACHAL PRADESH**. DIBANG VALLEY Dt.: Thewarygaon, 1300 m., 18 Aug 2000, *M. Bhaumik s.n.* (CAL). PAPUM PARE Dt.: Chimpu, Itanagar (IASR Camps), 1261 m., 27 Aug 2005, N 26°17'54.0", E 094°28'47.7", *E. Sanoj 92150* (CALI). TIRAP Dt.: Jadua to Banferacae, 12 Jul 1961, *D.B. Deb 26688* (ASSAM). **ASSAM**. MARIGAON Dt.: Kholahat R.F., near Balikusi (I mile south), 1 Sep 1964, *N.P. Balakrishnan 39586* (ASSAM). TINSUKIA Dt.: Doomdooma Reserve, 22 Oct 1960, *G. Panigrahi 21696* (ASSAM, CAL). **BIHAR**. Jholkabad, 6 Jan 1961, *G.V. Subba Rao 23225* (ASSAM, CAL). **JHARKHAND**. Chota Nagpur, *J.J. Wood s.n.* (CAL). **KARNATAKA**. Canara. Koorler Garden, May 1853, *D. Ritchie s.n.* (E). KUDAGU Dt.: Coorg, *V.V. Sivarajan s.n.* (CALI). **KERALA**: KOZHIKODE Dt.: Chathamangalam, *Devayani 20302* (CALI); Pantheerankavu, Calicut, Kerala, 15 Aug 2007, *E. Sanoj 94882* (CALI). IDUKKI Dt.: Devikulam, Vallakadavu, 800 m., *Sharma 40483* (MH); Uppuparai, 1000 m., 19 Dec 1914, *K. Vivekanandan 45362* (MH); Nellipara slopes, way to Mlappara, 950 m., 2 Feb 1981, *N.C. Nair 70106* (CAL, MH); On the Way to Mlappara, 20 Feb 2003, *M.G. Prasanth Kumar 86128* (CALI); Way to Mattupetti, 2 Mar 2006**,** *E.A. Babu 86197*

(CALI). MALAPPURAM Dt.: Calicut University Botanic Garden, *Mangaly 6683* (CALI); Calicut University Botanic Garden, 9 Jun 1992, *Bindhu Lakshmi 78814* (CALI). PALAKKAD Dt.: Parambikulam, *A. Meebold 12406* (CAL); Valiyaparathode, Silent Valley, *Satheesh Kumar 10562* (CALI). PATHANAMTHITTA Dt.: Poongavanam, Sabarimalai, 650 m., 15 Feb 1981, *N.C. Nair 70209* (MH, CAL); Pamba, 1025 m., 25 Jun 1968, *D.B. Deb 30368* (MH); Near Pamba river, *Vivekanandan 48354* (MH). QUILON Dt.: Pamba, 1025 m., 1 Oct 1977, *K. Vivekanandan 48359* (MH, CAL). **MADHYA PRADESH**. Mai-Ki Bagiya, 28 Oct 1960, *J.K. Maheswari 4281* (CAL). ANNUPUR Dt.: Sonmuda, 5 Nov 1970, *G. Panigrahi 13335* (CAL), 28 Oct 1960, *J.K. Maheswari 4282* (CAL). UMARIA Dt.: Bandhargarh National Park, near Badra Chila Lake, 16 Oct 2001, *S.K. Srivastava 78546* (BSD). **MEGHALAYA**. Khasia, 2-4000 ft., *J.D. Hooker & J. Thomson s.n.* (CAL, E, MH), *s.loc., Kurz s.n.* (E). EAST KHASI HILLS Dt.: W. Circiut house, *G. Panigrahi* 4960 (ASSAM); Nusa to Wanu, 1441.6 m., 1 Sep 1958, *G. Panigrahi 15018* (ASSAM, CAL); Chenglang to Khela, Shillong, 4500 m., 18 Oct 1959, *R.S. Rao 20288* (ASSAM); Soha Village, 1166 m., 21 Oct 1959, *A.S. Rao 20930* (ASSAM, CAL); Nongkhlow, Northeast of IB, 23 Mar 1962, *G.V. Subba Rao 28179* (ASSAM); Lake Garden, 17 Jul 1963, *G.K. Deka 35734* (ASSAM); Shillong, Lawmulong, 1120 m., 18 Aug 2004, *E. Sanoj 95639* (CALI). JAINTIA HILLS Dt.: Near IB of Jowai, 28 Oct 1956, *G. Panigrahi 4025* (ASSAM, CAL); Jorain Road, 45 miles from Shillong, 20 Aug 1958, *G.K. Deka 17125*, *17126* (ASSAM, CAL); Jowai-Jorain, 1600 m., 13 Aug 2004*, E. Sanoj 95615* (CALI); Shangpung, 4000 ft., *U. Kanjilal 7387* (ASSAM). RI-BHOI Dt.: Umsaw, K&J Hills, 26 Jul 1966, *D.M. Verma 35611* (ASSAM). **NAGALAND**. KOHIMA Dt.: Kohima, 7. 1886, *D. Prain 17* (CAL). **SIKKIM**. *s.loc.,* 4000 ft., *J.D. Hooker s.n.* (MH). EAST SIKKIM Dt.: Between Gangtok and Tadong, 27°13' N, 88°36' E, 1300 m., 1 Aug 1992, *D.G. Long et al. 1010* (E); Ravangala-Sangma, 11 May 2007, *V.P. Thomas & V.A. Muhammed Nissar 95533* (CALI). **TAMIL NADU**. CHENNAI Dt.: Company's Garden, Madras, 1875, *A.N. Henry 51145* (MH). COIMBATORE Dt.: Sholayar submergible area, 1040 m., 26 Dec 1963, *K. Ramamoorthy 18120* (MH); Siruvani valley, 27 Oct 1910, *C.E.C. Fischer 2362* (FRC). DINDIGUL Dt.: Palany Mountains, 1836, *R. Wight 3057* (E). MADURAI Dt.: Near

Kumili, Kerala border, 1060 m., 25 Apr 1960, *B.V. Shetty 10296* (MH, CAL); Cumbam R. F., 2900 m., 29 Sep 1925, *K.C. Jacob 17796* (MH). NILGIRIS Dt.: Ootacunad, 1855, *H.J.B. Bleghram s.n.* (MH). RAMANATHAPURAM Dt.: Mudaliaruthu, ± 1300 m., 20 Feb 1979, *N.C. Nair 61030* (MH). RAMAND Dt.: Mudaliaruthu, 11 Dec 1971, 1100 m., *E. Vajravelu 39340* (MH). SALEM Dt.: Brooklym-Yercaud, 1587 m., 13 Sep 1958, S*ubramanyam 6573* (MH). **UTTER PRADESH.** BAHRAICH, Nishangara, 20 Sep 1984, *G. Panigrahi & S.P. Misra 6424* (CAL). **WEST BENGAL**. DARJEELING Dt.: Monpoo, 3500 ft., 28 Sep 1875*, J.S. Gamble 8143* (K), 5000 ft., 12 Nov 1908, *W.C. Craib 1* (CAL). DAKSHIN DINAJPUR Dt.: Chopra, 26 Aug 1984, *R.N. Banerjee et al. 18733* (CAL); Islampur, 3 Nov 1983, *R.N. Banerjee 16151* (CAL). MIDNAPUR Dt.: Jhargram, 26 Nov 1975, *Sudarsan Maji 2272* (CAL). *Locality unknown*: *s.loc., S.N. Bal s.n.* (CAL); Peninsular India, *Wight 2801, 2804* (CAL).

Key to the varieties of *H. coronarium*

1a. Stamen 5.4-5.5 cm long, longer than labellum; lateral staminodes and labellum white with golden yellow patch at base. …….. var. ***chrysoleucum***

1b. Stamen 4.1-4.7 cm long, shorter than labellum; lateral staminodes and labellum creamy-yellow or white with pale yellow or yellowish-green patch at base, ……2

2a. Flowers white; labellum very widely ovate (5–5.4 x 5.2–6.2 cm); lamina 26-42.5 x 5-7.5 cm. …….. var. ***coronarium***

2b. Flowers creamy-yellow; labellum depressed ovate (4.7–4.9 x 6.2–6.7 cm); lamina 46-51.5 x 7.8-10 cm. …….. var. No. **1**

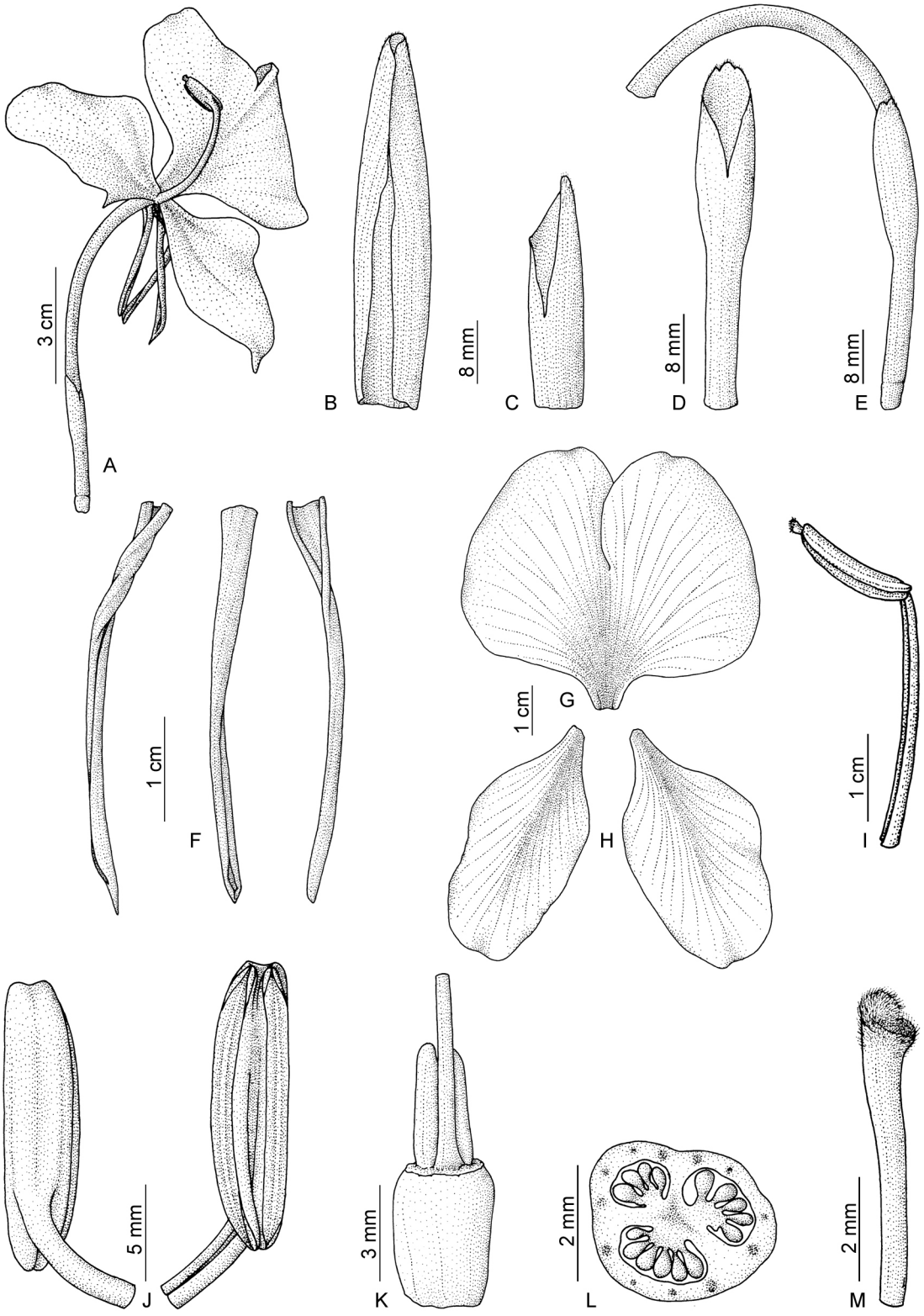

Figure 08. ***H. coronarium***: **A.** single flower; **B.** bract; **C.** bracteole; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, back (left) and front view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

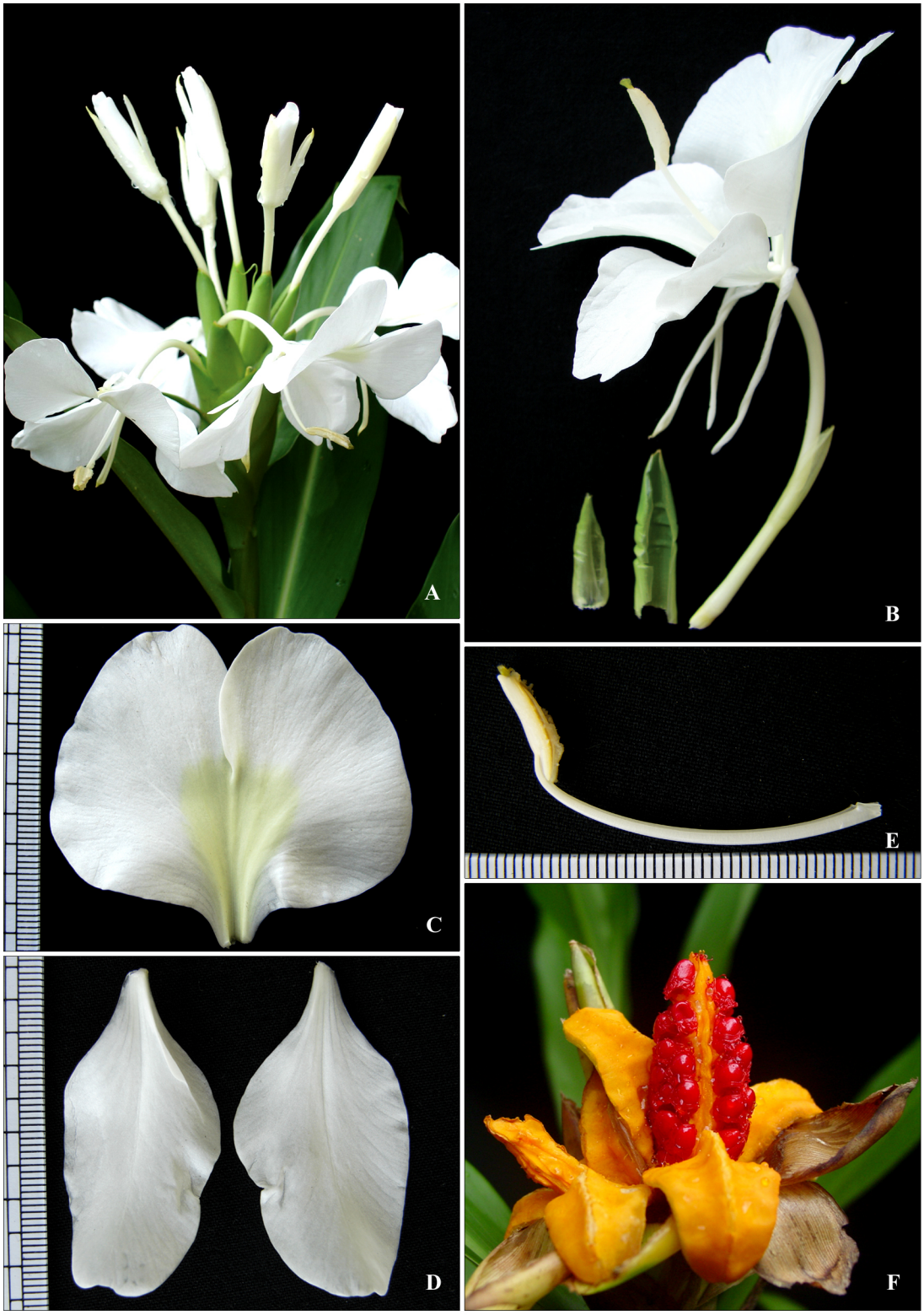

Plate 06. **A-F.** ***H. coronarium*****: A.** inflorescence; **B.** single flower, bract and bracteole; **C.** labellum; **D.** lateral staminodes; **E.** stamen; **F.** dehisced fruit with seeds and aril.

H. coronarium var. ***chrysoleucum*** (Hook.) Baker in J.D. Hooker, Fl. Brit. India 6: 226. 1892; Naik & Panigrahi, Bull. Bot. Surv. India 3(1): 71. 1961; Backer & Bakh. f., Fl. Java 3: 65. 1968; A.S. Rao & D.M. Verma, Bull. Bot. Surv. India 14: 128. 1972; N.P. Balakr., Fl. Jowai 2: 528. 1983; Karthik. et al., Fl. Ind. Enum. Monocot. 294. 1989.

H. chrysoleucum Hook., Bot. Mag. 76: t. 4516. 1850; K. Schum. in A. Engler, Pflanzenr. IV. 46(heft 20): 46. 1904; Weathers, Bulb Book 269. 1911; Turrill, Bull. Misc. Inform. Kew 1914(10): 369. 1914; S.K. Jain & V. Prakash., Rheedea 5(2): 160. 1995; Chaturv. & Moaakum, Folia Malaysiana 9(2): 130. 2008.

Type: W.J. Hooker, Bot. Mag. 76: t. 4516. 1850. (*Figure 09; Plate 07. A–D*)

Common Name: Golden and White Garland flower.

Terrestrial, perennial rhizomatous herbs. *Rhizome* 1.8–2.6 cm wide, creamy white internally, hyaline towards margins, slightly aromatic. *Leafy shoot* 58–88 cm high, erect or slightly slanting. *Leaves* 10–14 in number, at a distance of 6–8 cm, sessile; sheath 2.5–2.7 cm wide, green, pubescent, margins membranous, translucent, more densely hairy than the sheath, closely appressed to stem; ligule 3.7–4.3 x 2–2.7 cm, single-lobed, pale green, sericeous, hyaline, membranous; tip truncate or obscurely notched, margin ciliate; lamina 34–43 x 7.8–11.7 cm, oblong-lanceolate, bright green and glabrous above, light green and pubescent below, densely hairy below at midrib; tip long acuminate, bend down, slightly twisted, *c.* 2 mm long beaked; base cuneate; margins hyaline, non-ciliate, undulate, veins light coloured. *Inflorescence* 8–11 cm long, elliptic, erect, compact with imbricate bracts. *Bracts* 5–5.7 x 2–2.7 cm, broadly elliptic, light green, glabrous, puberulent towards tip, leathery, non-tubular, convolute; tip obtuse; margins hyaline, non-ciliate,

cincinnus 3-flowered. *Bracteoles* 3–3.5 x 1.6–1.9 cm, pale green at midrib, puberulant externally, somewhat leathery, become hyaline towards margins, non-tubular, 3-toothed; tip acute, margins ciliate. *Flower* 13.8–14.5 cm long, white, straight, 1-many open at a time. *Calyx* 4.2–4.5 x 0.4–0.55 cm, pale green, puberulent on upper half, glabrous on lower half, tubular, obscurely 3-toothed at tip, unilaterally split upto 1.3–1.9 cm long. *Corolla tube* 8.6–9 cm long, 4–4.5 mm wide at mouth, creamy-white, white towards base, glabrous externally, hairy internally, curved, *Corolla lobes* oblong, light yellow, drooping from flower, 7-nerved; dorsal lobe 4.2–4.4 x 0.6–0.8 cm, tip 2–2.5 mm long beaked; lateral lobes 4.1–4.3 x 0.7–0.75 cm, non-beaked at tip. *Lateral staminodes* 4.2–4.4 x 1.8–2.1 cm, elliptic, white, golden-yellow patched towards base, spreading on flower. *Labellum* 4.2–4.6 x 4.2–4.4 cm, very widely ovate, white, golden-yellow patched at centre and towards base, lobes spreading, abruptly clawed at base; sinus 1–1.7 cm deep. *Stamen* 5.4–5.5 cm long, straight on flower, bend to one side at the base of anther. *Filament* 4.2–4.3 cm long, *c.* 2 mm wide at base, golden-yellow, glabrous. *Anther* 1.2–1.3 x *c.* 0.3 cm, oblong, light orange, attached with the filament at *c.* 2.5–3 mm above from base; anther suture orange; connective orange; minutely crested at tip, tip truncate or slightly notched, thecae at an angle of *c.* 45° with the filament axis. *Ovary* 6.5–7 x 3–3.5 mm, barrel-shaped, pale green at tip, white towards base, glabrous, ridged longitudinally. *Style* long, filiform, white, glabrous, green tinged towards stigma. *Stigma c*. 1.5 mm exserted from anther, stigmatic head flat, slanting with a depression at center, green, margin densely hairy, hairs hook-like. *Epigynous glands* two, 3–3.5 mm long, oblong, yellow, free from each other. *Fruits* 1.7–2 x 1.5–2 cm, ovoid, three-angled, glabrous, trilocular, surface smooth. *Seeds* 4–4.5 x 3 mm, broadly elliptic, red, brown when dry, surface longitudinally ornamented, base yellow. *Aril* 5–6 mm long, red, yellow when dry, lacerate, membranous, basal.

Notes: It was described by Hooker, on the basis of a material sent by Roxburgh from India, in *Curtis' Botanical Magazine* (1850) with an illustration.

Though Turrill (1914) considered it as a form of *H. flavescens* with the base of the lip and lateral staminodes a deep yellow, he kept it as a separate species. Baker (1892) treated it as a variety of *H. coronarium*, and he separated it from the type species only in its lip colour, *i.e.,* "lip white with a large yellow patch in the centre". By considering wide range of morphological intergrades between *H. coronarium* complex, Naik & Panigrahi (1961) also treated *H. chrysoleucum* as a variety of *H. coronarium* complex along with *H. maximum, H. flavum, H. flavescens* and *H. urophyllum*. This was followed by subsequent workers, including the present treatment. It can be distinguished from *H. coronarium* in having, elliptic lateral staminodes, a little smaller labellum, deep orange-yellow patch at the base of lateral staminodes and labellum and stamen exceeding the labellum.

Flowering & Fruiting: May–October.

Distribution: Distributed in Malaysia, Java and India. In India it is distributed in northeastern states like Arunachal Pradesh, Manipur, Meghalaya, Nagaland and Sikkim, at an altitude of 890-1,800 m. (*Figure 11. B*)

IUCN Red list Category: As it is distributed very sparsely in North-East India and Java with lesser area of occupancy and geographically wide subpopulations, it is assessed against as the Endangered (EN A4ab; B1b(i,ii,iv)+2b(i,ii,iv); C2a(i); E) category as per IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Uses: Cultivated in garden for ornamental use, and for decoration of hairs.

Specimens examined: **INDIA**. **ARUNACHAL PRADESH.** TIRAP Dt.: Soha Village, 21 Oct 1959, *R.S. Rao 20390* (ASSAM). **MANIPUR**. BISHNUPUR Dt.: Leimaran, 27 May 2007, *V.P. Thomas & V.A. Muhammed Nissar 95543* (CALI). **MEGHALAYA**. JAINTIA HILLS Dt.: Jowai, 22 Jan 1957, *G.K. Deka 5020* (ASSAM); Chandigiri way to Nokrak, 896 m., N 25°32.025', E 090°19.756', 9 Aug 2007, *E. Sanoj & T. Rajesh Kumar 95159* (CALI). EAST KHASI HILLS Dt.: BSI Sarroundings,

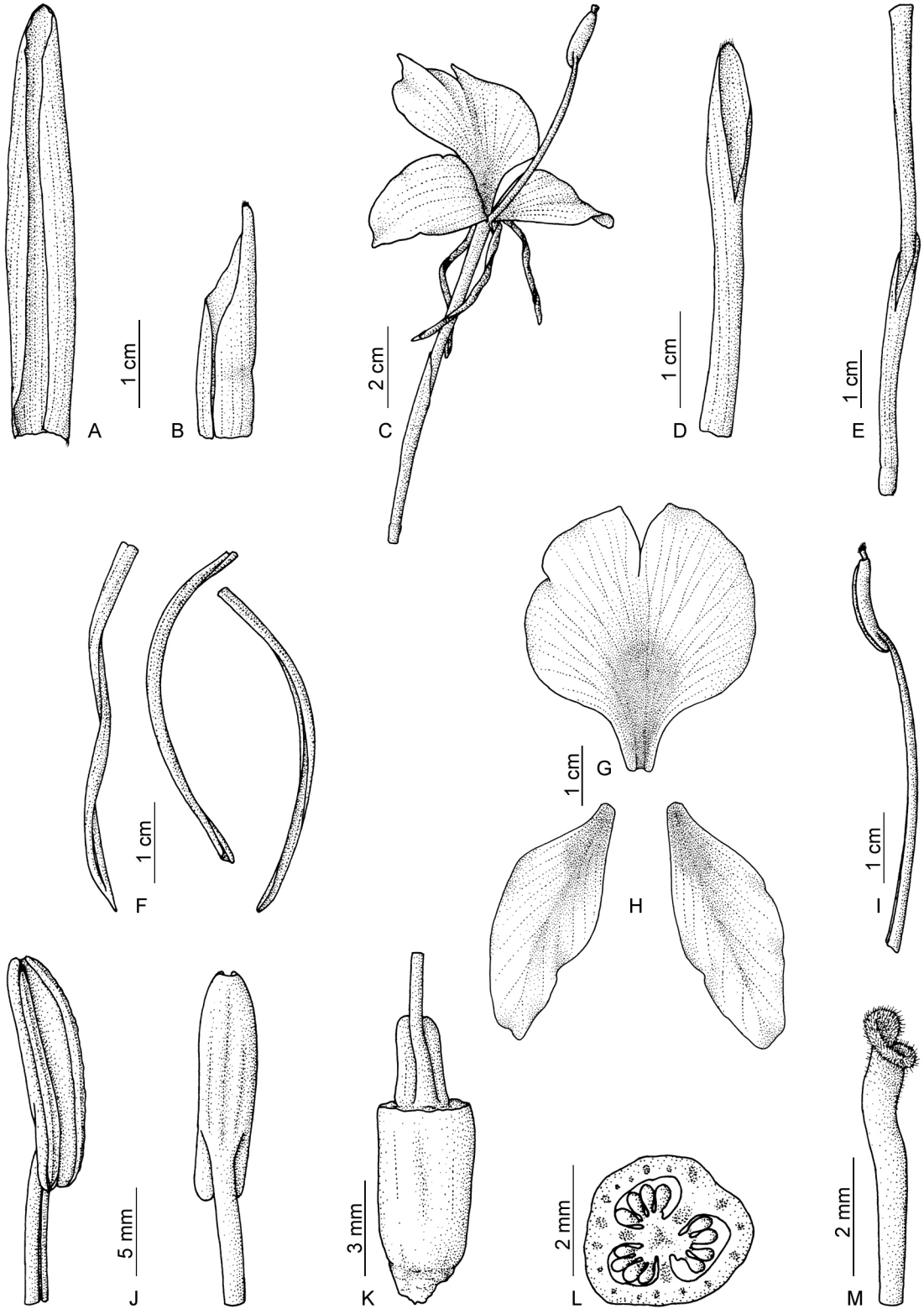

Figure 09. ***H. coronarium*** var. ***chrysoleucum***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, lateral (left) and back view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

Shillong, Laithmukrah, 1470 m., 12 Aug 2004, *E. Sanoj 95605* (CALI). **NAGALAND**. MOKOKCHUNG Dt.: Near Chaturvedi's Home, Mokokchung, 29 Aug 2006, *E. Sanoj & V.P. Thomas 105560* (CALI). KOHIMA Dt.: Minister's Hill, Kohima, 1 Sep 2006, *E. Sanoj & V.P. Thomas 105579* (CALI). **SIKKIM**. EAST SIKKIM Dt.: Gangtok, Near Jeep Stand, 1736 m., N 27°20'38.7", E 088°36'77.5", 22 Aug 2004, *M. Sabu & A.K. Pradeep 92713* (CALI). NORTH SIKKIM Dt.: Kabi, 11 Apr 2005, *E. Sanoj 92761* (CALI).

4b **Hedychium coronarium** var. No. 1

H. coronarium var. No. 1

Type: INDIA. Meghalaya. Jowai, Way to Dawki, near Myntdu Bridge, 1280 m., N 25°26.241', E 092°11.329', 17 Aug 2007, *E. Sanoj & T. Rajesh Kumar 94913.*

(*Figure 10; Plate 07. E–I*)

Terrestrial, perennial rhizomatous herbs. *Rhizome* 2.4–2.8 cm wide, creamy white internally, pale pink externally, aromatic. *Leafy shoot* 116–180 cm high, erect, robust. *Leaves* 14–17 in number, 7–13 cm apart, spreading, sessile; sheath 3.2–3.8 cm wide, green, margins pink, membranous, translucent, pubescent; ligule 4.4–6 cm long, oblong, single-lobed, obtuse at tip, pale green, pubescent externally, membranous, translucent, papery, closely appressed to the stem; lamina 46–51.5 x 7.8–10 cm, elliptic, dark glossy green and glabrous above, pale green and pubescent below; margin highly undulate, membranous, translucent, white tinged, non-ciliate; tip long caudate, twisted; base cuneate; midrib densely pubescent below. *Inflorescence* 10–14 cm long, elliptic, erect, compact with imbricate bracts. *Bracts* 5.2–6.5 x 2.5–3.8 cm, broadly oblanceolate, green, glabrous, pubescent at tip, coriaceous, imbricate; margin non-ciliate, translucent, membranous, white; tip acute; cincinnus *c.* 5-flowered. *Bracteoles c.* 4 x 3.8 cm, deltoid-ovate, slightly 2-lobed at tip, pale green, white towards base, glabrous,

pubescent at tip, non-tubular, leathery; margin non-ciliate. *Flower* 14.5–14.8 cm long, creamy-yellow, 3–5 -flowers open at a time, drooping, slightly fragrant. *Calyx* 4.1–4.3 cm long, 7–7.5 mm wide at mouth, pale green, white towards base, pubescent externally, membranous, translucent, upper half inflated, lower half closely appressed to corolla tube, unilaterally split upto 1.2–1.4 cm, 3-toothed at tip. *Corolla tube* 8.2–9.1 cm long, 6.5–7mm wide at mouth, white, glabrous externally, hairy internally, bend to one side at centre. *Corolla lobes* oblong, creamy yellow, white tinged towards base, membranous, early decaying at base, drooping from flower, glabrous, slightly coiled; dorsal lobe 4.8–5.1 x 1.2–1.3 cm, 8–9 mm long beaked at tip, 5–6 -veined; lateral lobes 4.1–4.3 x 1.1–1.2 cm, *c.* 1 mm long beaked at tip, 4–5 -veined. *Lateral staminodes* 4.6–4.8 x 2.5–2.8 cm, spatulate, creamy-yellow, spreading on flower, reflexed back, tip rounded, margin undulate. *Labellum* 4.7–4.9 x 6.2–6.7 cm, depressed ovate, creamy-yellow, yellowish green tinge at centre and towards base, spreading on flower, reflexed back on upper half, base cordate, abruptly clawed at base; claw 0.9–1 cm wide; sinus 2–2.2 cm deep; margin undulate; lobes overlapping, tip rounded. *Stamen* 4.1–4.2 cm long, shorter than labellum, L-shaped, creamy yellow with orange anther openings. *Filament* 3.1–3.3 cm long, 2.5–3 mm wide at base, creamy yellow, bend to one side at tip. *Anther* 15–16 x 4–4.5 mm, oblong, orange at openings, split opens from top to bottom, attached with the filament at 5–5.5 mm above from base, thecae at an angle of 60°–70° with the filament axis; anther suture orange; connective creamy yellow, glabrous, non-crested, tip truncate. *Ovary* 5–6 x 4.5–5 mm, barrel-shaped, pale green, densely pubescent externally. *Style* filiform, white, glabrous, pubescent towards tip, broadens and green tinged towards stigma. *Stigma c.* 2.5 mm wide, green, cup-shaped, slanting with a depression at center, pubescent, hairs hook-like, *c.* 1.5 mm exserted above the anther. *Epigynous glands* two, *c.* 2.5 mm long, oblong, yellow.

Notes: closely allied to *H. coronarium* but mainly differs from it in having larger lamina, creamy yellow and larger flowers, depressed ovate (wider than long) labellum and orange anther suture (Table 01).

Flowering: May–October.

Distribution: Endemic to Meghalaya, known only from the type locality.

(*Figure 11. B*)

IUCN Red list Category: As it is known only from the type locality and having very narrow area of occupancy with very limited mature individuals, it is assessed against Critically Endangered (CR B1a(i,ii,iv)+2ab(ii); C1+2a(ii); D; E) category as per IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Table 01. Main differential characters of *H. coronarium*, *H. coronarium* var. *chrysoleucum* and *H. coronarium* var. No. 1

Charecters	var. ***coronarium***	var. ***chrysoleucum***	var. **No. 1**
Lamina	26-42.5 x 5-7.5 cm	34-43 x 7.8-11.7 cm	46-51.5 x 7.8-10 cm
Cincinnus	1-3 -flowered	3-flowered	5-flowered
Flower length	13.8-14.7 cm, white	13-14 cm, white	14.5-15 cm, creamy yellow
Lateral staminodes	4.7-5.6 x 2.4-3.4 cm, widely spatulate, white	4.2-4.4 x 1.8-2.1 cm, elliptic, white, deep golden-yellow patch	4.6-4.8 x 2.5-2.8 cm, spatulate, creamy-yellow
Labellum	5-5.4 x 5.2-6.2 cm, very widely ovate, white, pale yellow patch	4.2-4.4 x 4.2-4.4 cm, very widely ovate, white, golden-yellow patch	4.7-4.9 x 6.2-6.7 cm, depressed ovate, creamy yellow, yellowish green patch
Stamen length	4.2-4.7 cm, shorter than lip	5.4-5.5 cm, longer than lip	4.1-4.2 cm, shorter than lip
Anther suture	Creamy-yellow	Orange	Orange
Ovary	Glabrous	Glabrous	Pubescent

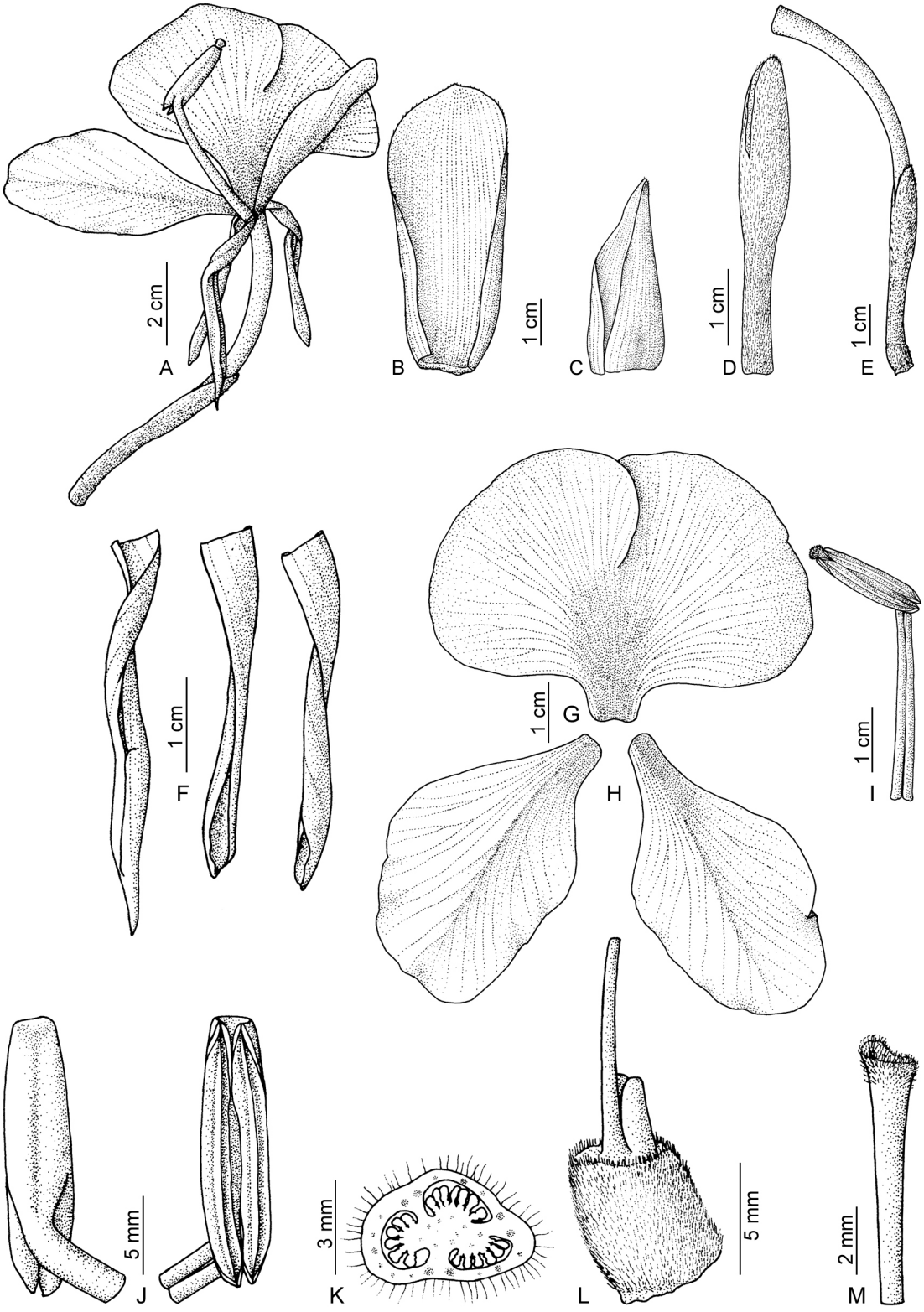

Figure 10. ***H. coronarium*** var. **No. 1**: **A.** single flower; **B.** bract; **C.** bracteole; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, back view (left) and front view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

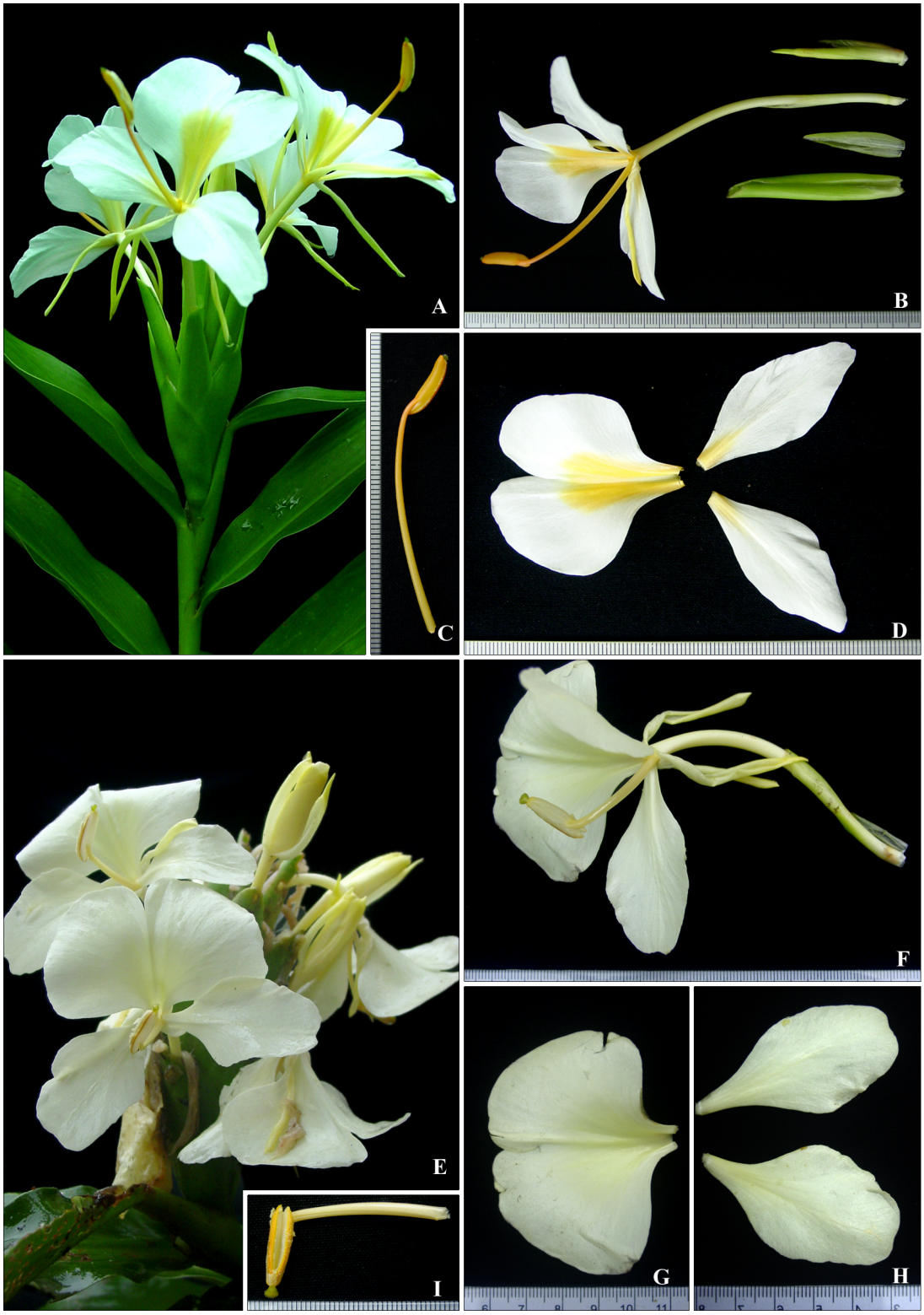

Plate 07. **A-D.** ***H. coronarium*** var. ***chrysoleucum*****: A.** inflorescence; **B. s**ingle flower, bract, bracteoles and cincinnus; **C.** stamen; **D.** labellum and lateral staminodes. **E-I.** ***H. coronarium*** var. **No. 1: E.** inflorescence; **F.** single flower with bracteole; **G.** labellum;**H.** lateral staminodes; **I.** stamen.

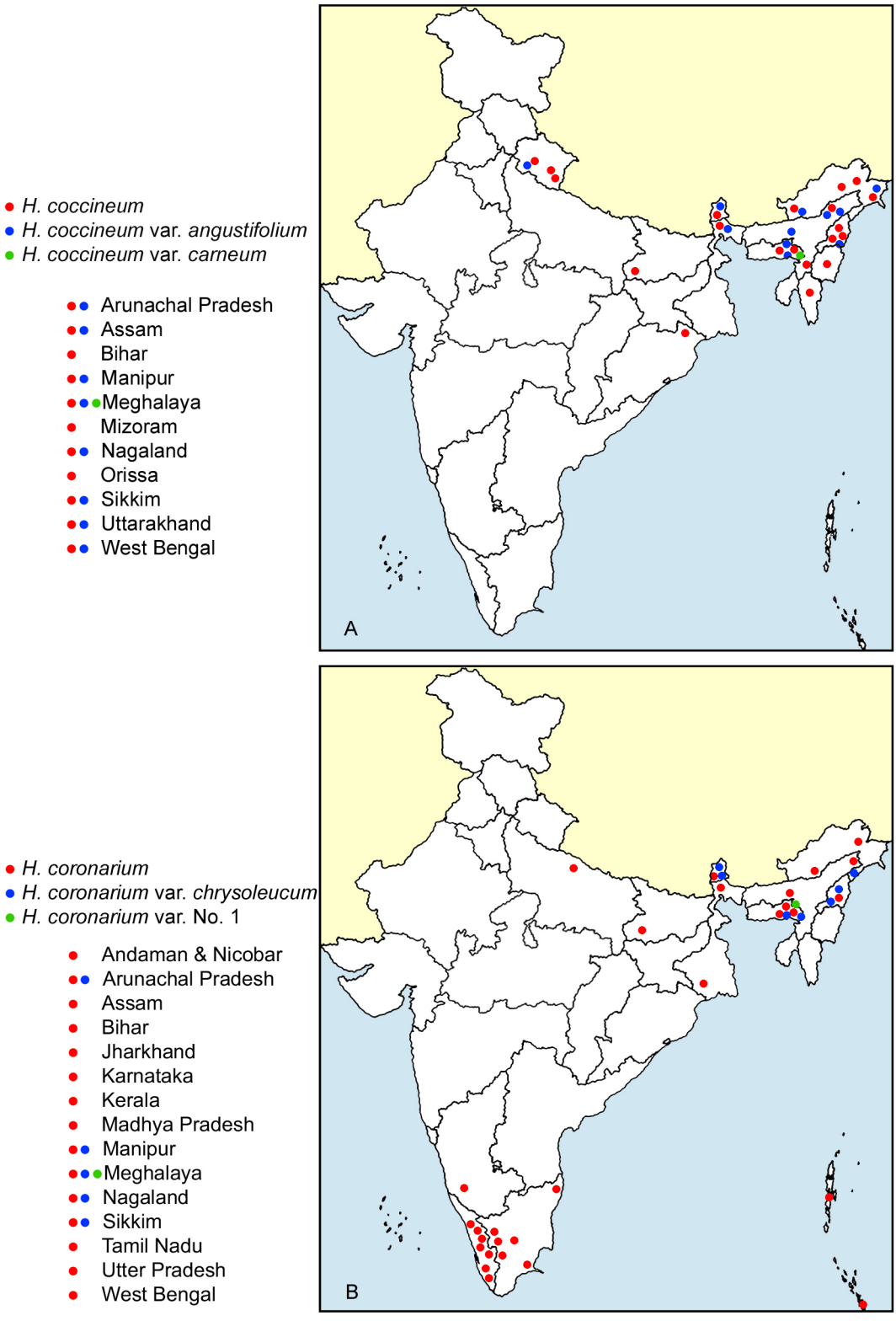

Figure 11. Distribution maps of ***H. coccineum, H. coccineum*** var. ***angustifolium, H. coccineum*** var. ***carneum, H. coronarium, H. coronarium*** var. ***chrysoleucum*** and ***H. coronarium*** var. No. 1.

H. deceptum N.E. Br., Gard. Chron. 71: 209. 1922.

Lectotype (designated here): *s.loc.,* 6 Sep 1920, *H.J. Elwes s.n.* (lecto K!).

H. rubrum A.S. Rao & D.M. Verma, Bull. Bot. Surv. India 11(1&2): 126. 1969, 14: 133. 1972, *syn. nov.*; S.C. Srivast. in S.K. Jain & R.R. Rao, Threat. Pl. India 236. 1983; S.K. Jain & V. Prakash., Rheedea 5(2): 161. 1995; M. Sabu & Pradeep, Folia Malaysiana 6(1&2): 13. 2005.

Type: INDIA. Meghalaya, East Khasi Hills Dt., Experimental Garden, Botanical Survey of India, 'Woodlands', Shillong, 12 Aug 1965, *D.M. Verma 34599* (holo CAL!; iso ASSAM!). (*Figure 12; Plate 08*)

H. greenii auct. non W.W. Sm.: N.E. Br., Gard. Chron. 71: 163. 1922.

Terrestrial, perennial rhizomatous herbs. *Rhizome* 2.4–3 cm wide, creamy white internally, slightly aromatic, covered by brown scales. *Leafy shoot* 100–120 cm high, erect, robust. *Leaves* 12–14 in number, 2.7–3.5 cm apart, spreading, sessile; sheath 1.1–1.2 cm wide, margins pink, membranous, translucent, pubescent; ligule 1.5–1.7 x 1–1.1 cm long, ovate, single-lobed, obtuse at tip, pink, pubescent externally, closely appressed to the stem; lamina 19.5–26 x 3.3–5.4 cm, lanceolate, dark green above, purple-red below, glabrous; margin undulate, membranous, translucent, pink-tinged, non-ciliate, pubescent below; tip long caudate, twisted; base obtuse; midrib densely pubescent below. *Inflorescence* 8–10.5 cm long, elliptic, lax, erect; rachis green with pink tinge, densely pubescent. *Bracts* 3–3.3 x 1.7–1.9 cm, ovate, curved back towards tip, deep pink with green at base, glabrous, pubescent at tip, coriaceous, convolute; margin non-ciliate, translucent, membranous, white; tip acute; cincinnus 2-flowered. *Bracteoles* 1.8–1.9 x 0.6–0.7 cm, tubular towards base, unilaterally split upto 1–1.3 cm deep, slightly translucent, 2-lobed at tip, pink with white at base, glabrous, pubescent at

tip, outer one completely encircles the cincinnus. *Flower* 8–8.3 cm long, deep red, 5–10 flowers open at a time, ascending. *Calyx* 2–2.1 cm long, *c*. 4.5 mm wide at mouth, yellow with pink tinge towards tip and base, pubescent externally, membranous, translucent, upper 3/4 portion inflated, lower part closely appressed to corolla tube, unilaterally split upto 1.6–1.7 cm, 3-toothed at tip. *Corolla tube* 3.2–3.3 cm long, *c*. 4 mm wide at mouth, deep red, yellow towards base, glabrous externally, hairy internally, erect. *Corolla lobes* oblanceolate, deep red, yellow tinged towards tip, membranous, drooping from flower, glabrous; dorsal lobe 3.4–3.5 x *c*. 0.8 cm, *c*. 3 mm long beaked at tip; lateral lobes 3.3–3.4 x *c*. 0.7 cm, minutely beaked at tip (*c*. 0.5 mm). *Lateral staminodes* 3.1–3.3 x 1.1–1.2 cm, spatulate, clawed towards base, deep red, erect, upper half reflexed back, margin undulate, slightly notched at tip. *Labellum* 3.2–3.3 x 3.5–3.6 cm, widely depressed ovate, deep red, erect, upper half reflexed back, base cordate, abruptly clawed at base; claw 5.5–6 mm wide; sinus 1.1–1.2 cm deep; margin undulate, lobes tip rounded. *Stamen* 4.7–4.8 cm long, slightly arching, deep red. *Filament* 4.2–4.3 cm long, *c.* 3 mm wide at base, deep red, slightly arching. *Anther* 9.5–10 x *c*. 3 mm, oblong, deep red, split opens from top to bottom, attached with the filament at 3.5–4 mm above from base, thecae axis positioned at an angle of *c*. 40° with the filament; connective deep red, glabrous, non-crested, tip slightly notched. *Ovary* 3.5–4 x 3–3.5 mm, oblong, brown, densely pubescent externally. *Style* filiform, white, glabrous, green tinged towards stigma. *Stigma c*. 1.5 mm wide, green, cup-shaped, slanting with a depression at center, *c*. 1 mm exserted the anther, pubescent on stigmatic head, hairs hook-like. *Epigynous glands* two, *c.* 3 mm long, oblong, yellow.

Notes: H. deceptum was described by Brown (1922) based on a dried specimen sent by Mr. Elwes to Kew. The photograph of this taxon was first appeared in the *Gardeners Chronicle* in April 8, 1922 (p. 163. Fig. 81), under the name *H. greenii* W.W. Sm., with a description of *H. greenii*. Subsequently Mr. Turrill pointed out the mistake done by Brown by showing some specimens sent by

Mr. Elwes to Kew. Admitting the suggestions made by Turrill, Brown modified the earlier description of *H. greenii* (Gard. Chron. p. 209. Fig. 108. April 29, 1922) by adding the 'wedge shaped base of the labellum'. He also described it as a new species under the name *H. deceptum* with the reproduction of the same photograph, which was earlier misidentified as *H. greenii*, in the same publication. While describing the species, he distinguished it from *H. elwesii* Baker as "This plant completely differs from *H. elwesii* by its much shorter and narrower leaves, a ligule about a quarter of an inch shorter, a dense and broad instead of a lax and narrower spike, and the corolla tube shorter than the bracts instead of much longer than them". He also distinguished it from *H. greenii* "the yellow flowers, narrower leaves, cordate based lip and longer stamen". In his statement ("Unfortunately I had no specimen of the plant nor any information concerning it, only the reduced photograph for identification, which was said to have yellow flowers and was named *H. elwesii*") it is clear that, he has distinguished it so far on the basis of dried specimens and photograph of specimen exhibited by Mr. Elwes. (*Figure 08. B*)

Unaware of the publication of *H. deceptum*, Rao and Verma (1969a) described it as a new species, *H. rubrum* from Meghalaya, India. While describing the species the authors compared it with *H. coccineum*, as "differ in its lanceolate leaves; shorter spike; longer staminodes and lip; shorter stamen". During this revisionary work, we have studied many live specimens and herbarium specimens at ASSAM, CAL, CALI and K of *H. rubrum* in detail and found that it is closely allied to *H. deceptum* except in the colour of the labellum, which is red in the former and yellow in the latter. The identity is also confirmed by comparing it with the type specimen available at Kew (*H. J. Elwes s.n.,* K!). Since the type, protologue and the photograph matches completely (except in the flower colour) with the *H. rubrum*, we treat this species as a synonym of *H. deceptum*. The yellow colour of the flower in *H. deceptum* (as per protologue) may be a colour variant or an error occurred while interpreting the photograph or dried specimens of Mr. Elwes.

Typification: While publishing the species *H. deceptum,* Brown (*l.c.*) casually mentioned about one dried material which has been send by Mr. Elwes to Kew, based on which he had described this species. While studying herbarium at Kew, we could find out the same specimen mentioned by Brown and is designated here as Lectotype (*H.J. Elwes s.n.*, K!) of *H. deceptum.*

Flowering: July–September.

Distribution: Endemic to Khasia and Jaintia Hills of Meghalaya and Naga Hills of Nagaland at an altitude of 600–1,600 m. Because of the beauty of the deep-red elegant bouquet like-inflorescence, it attracts the plant cultivators and has also become an ornamental Ginger in North-eastern states of India. (*Figure 14. A*)

IUCN Red list Category. Due to the rarity and limited distribution of *H. deceptum* in the wild, this species is assessed here as Vulnerable (VU A4ad+3; B1ab(i,ii,iv)+2ab(ii); D2) according to the IUCN guidelines and it is facing a high risk of extinction in the wild (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA**. **MEGHALAYA**. EAST KHASI HILLS Dt.: Woodlands, 16 Sep 1961, *V.N. Naik s.n.* (ASSAM), 28 Sep 1965*, A. S. Rao 37068 A, B* (ASSAM), 1 Aug 1968, *A. S. Rao 35695 A* (ASSAM), 7 Aug 1970, *D. M. Verma 38430* (ASSAM), 16 Aug 1971, *D. M. Verma 34644* (ASSAM), 3 Aug 1972, *U. Shastry 34690* (ASSAM), 4 Aug 2003, *M. Sabu & A. K. Pradeep 92510* (CALI), 30 Jul 1960, *G. K. Deka 21805* (ASSAM); Near Prasarbharathi Radio station, 1180 m., 16 Aug 2004, *E. Sanoj 95635* (CALI). JAINTIA HILLS Dt.: Jowai-Bodarpur Road, 90 miles from Shillong, 22 Jul 1957, *G.K. Deka 10135* (ASSAM); Way to Ladrimbai, 473 m., N 25°09.769', E 092°23.833', 16 Aug 2007, *E. Sanoj & T. Rajesh Kumar 94906* (CALI). **NAGALAND**. MOKOKCHUNG Dt.: Meinkiong, 1347 m., N 26°20'07.0", E 094°33'05.5", 24 Jun 2005, *E. Sanoj 92126* (CALI); Longhum Village, 28 Aug 2006, *E. Sanoj & V. P. Thomas 105554* (CALI). KOHIMA Dt.: Ministers Hill, 1 Sep 2006, *E. Sanoj & V. P. Thomas 105580* (CALI).

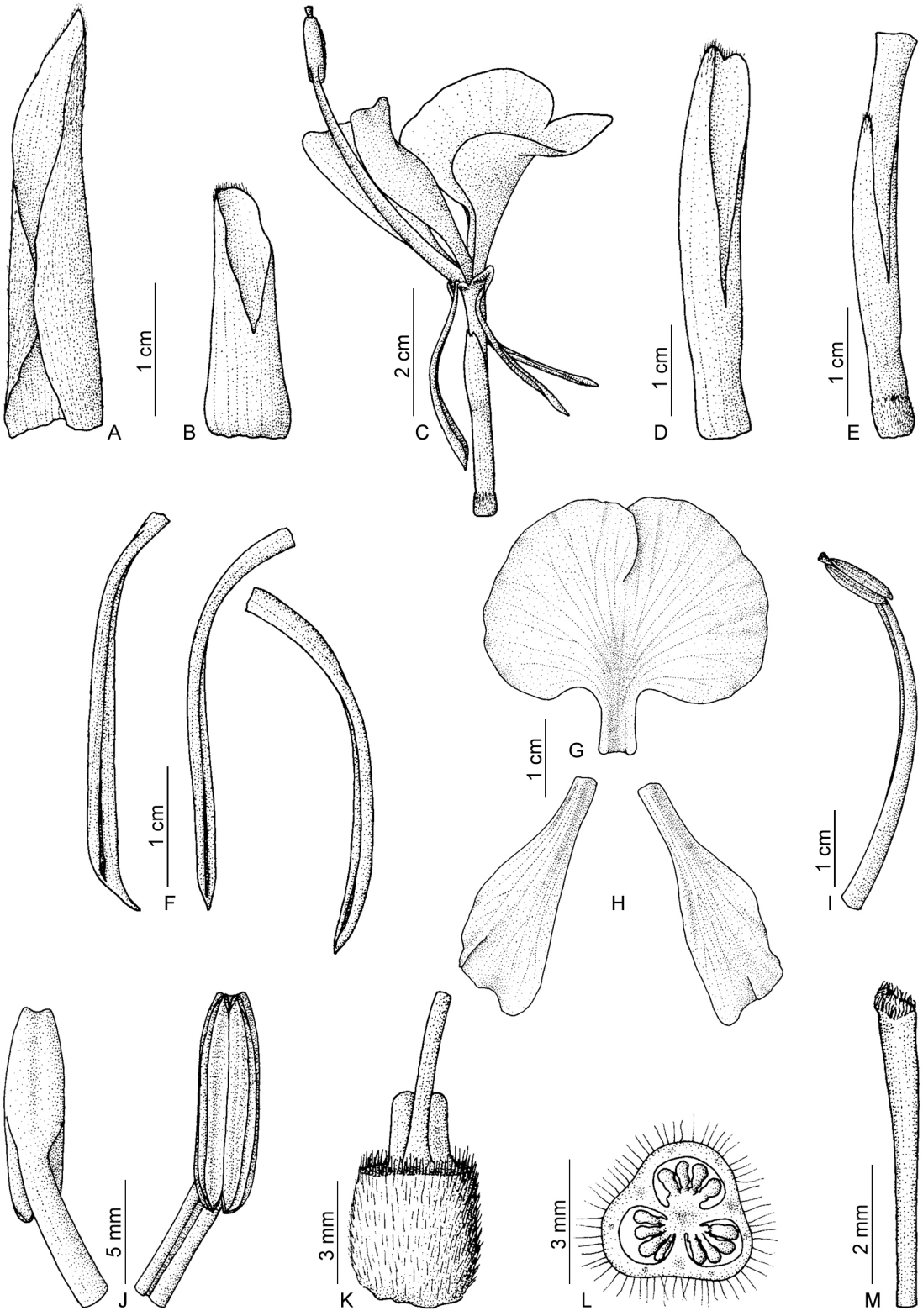

Figure 12. ***H. deceptum***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, back (left) and front view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.



Plate 08. ***Hedychium deceptum*: A.** inflorescence; **B.** photograph published in Gard. Chron. p. 209. 1922 is reproduced; **C.** single flower, bract and bracteole; **D.** labellum; **E.** lateral staminodes; **F.** dorsal and lateral corolla lobes; **G.** stamen.

H. densiflorum Wall. [Numer. List. 6552, *nom. nud*.] in W.J. Hooker, Hooker's J. Bot. Kew Gard. Misc. 5: 368. 1853; Baker in J.D. Hooker, Fl. Brit. India 6: 227. 1892; K. Schum. in A. Engler, Pflanzenr. IV. 46(heft 20): 49. 1904; J.N. Mitra, Monocot. E. India 1: 242. 1958; Naik & Panigrahi, Bull. Bot. Surv. India 3(1): 71. 1961; A.S. Rao & D.M. Verma, Bull. Bot. Surv. India 14(1-4): 130. 1972; Karthik. et al., Fl. Ind. Enum. Monocot. 294. 1989; R.M. Sm. in A.J.C. Grierson & D.G. Long, Fl. Bhutan 2: 202. 1991; S.K. Jain & V. Prakash., Rheedea 5(2): 160. 1995; T.L. Wu & K. Larsen in Z. Wu & P.H. Raven, Fl. China 24: 373. 2000; Press et al., Annot. Checkl. Fl. Pl. Nepal 330. 2000; S. Kumar, Zing. Sikkim 50. 2001.

Type: NEPAL. Mount Shivapura, 1821, *Wallich 6552* (holo K, Microfische!).

H. sino-aureum Stapf, Bull. Misc. Inform. Kew 1925(10): 432. 1925, *syn. nov.*

Type: CHINA. Yunnan, in thickets by streams near Tali-fu, 1750 m., *Forrest 6914* (holo K!). (*Figure 13; Plate 09. A–C*)

Perennial, rhizomatous herbs. *Rhizome* 2–3 cm wide, creamy white internally, slightly aromatic. *Leafy shoot* 90–130 cm high, reclined with erect inflorescence. *Leaves* 10–14 in number, 4.5–6.7 cm apart, spreading, sessile; sheath 1.2–1.4 cm wide, red tinged towards ligule, margins red, membranous, translucent, glabrous; ligule 1–1.1 x *c*. 1 cm, oblong, single-lobed, rounded at tip, red, puberulent externally, membranous, moderately translucent, closely appressed to the stem; lamina 28–31 x 4.5–5.8 cm, elliptic, dark green above, pale green below, glabrous; margin highly undulate, membranous, translucent, white tinged, non-ciliate; tip long acuminate, twisted; base cuneate. *Inflorescence* 11–17 cm long, elliptic, dense, erect. *Bracts* 18–19 x 5–5.5 mm, elliptic, pale green, glabrous, convolute; margin non-ciliate, translucent, membranous, white, tip slightly

notched, cincinnus 1-flowered. *Bracteoles* 8–10 x *c.* 2 mm, tubular, membranous, translucent, rounded or slightly notched at tip, pale green, white towards base, glabrous, puberulent towards tip, unilaterally split upto 4 mm. *Flower* 2.8–3 cm long, orange-red, turn to red on 2nd day, nearly entire inflorescence open at a time, ascending, slightly fragrant. *Calyx* 1.3–1.4 cm long, *c.* 2 mm wide at mouth, tubular, white, pale green towards tip, glabrous, puberulent at tip, membranous, translucent, upper half inflated, lower part closely appressed to corolla tube, unilaterally split upto 3.5–4 mm deep, 3-toothed at tip. *Corolla tube* 1.8–1.9 cm long, *c.* 2 mm wide at mouth, white, orange-red towards tip, glabrous externally, hairy internally, slightly bend to one side towards tip. *Corolla lobes* 12–13 x *c*. 3 mm, elliptic, yellow, bright yellow towards tip, membranous, glabrous; dorsal lobe *c.* 0.5 mm long beaked at tip; lateral lobes non-beaked at tip. *Lateral staminodes* 8–8.5 x *c.* 5 mm, elliptic, cuneate towards base, orange-red, spreading on flower, obtuse at tip. *Labellum* 9–10 x *c*. 8 mm, very widely obovate, orange-red, spreading on flower, base cuneate; sinus 3.5–4 mm deep, rarely with an additional lobe in the sinus, lobes acute at tip. *Stamen* 1.4–1.5 cm long, straight. *Filament* 8–8.5 mm long, *c.* 1.5 mm wide at base, orange-red, pale coloured towards base, straight. *Anther c.* 6.5 x 2.5 mm, oblong, orange-red, pale coloured at mouth openings, hairy at thecae margins, split opens from top to bottom, attached to the filament at *c.* 1 mm above from base, thecae parallel with the filament; connective orange-red, glabrous, non-crested, tip truncate; very minutely spurred. *Ovary c.* 2 x 2 mm, barrel-shaped, yellow, glabrous, smooth. *Style* filiform, white, glabrous, yellow tinged towards stigma. *Stigma c.* 1 mm wide, yellow, cup-shaped, mouth margin ciliate, *c.* 1 mm exserted from the anther. *Epigynous glands* two, *c.* 1 mm long, oblong, yellow.

Notes: H. densiflorum is a unique species characterized by their dense and long inflorescence with small flowers, nearly entire flowers in the inflorescence open at a time and they are smaller with orange-red colour, which turn to red on second day. The species was described by Wallich (1853) based on his collection

(*Wallich 6552*) from Nepal. While describing the species, he was not quite confident that, it is distinct from *H. gracile* Roxb. as a species, and also he has never observed *H. gracile* in Nepal or its west.

H. densiflorum is closely allied to *H. aureum* and *H. hookeri* C.B. Clarke, but readily differs from them in having orange-red flowers and longer and denser inflorescence. The spike is dense flowered and looks like erect 'foxtail orchid' (*Rhynchostylis retusa* Blume).

Another species, *H. sino-aureum* Stapf has been described by Stapf (Bull. Misc. Inform. Kew 1925(10): 432. 1925) from the Yunnan, China. In the protologue the original author says that it differs from *H. densiflorum* only in leaf size, shape and vestiture and smaller sized flowers. But based on the studies of type at K and protologue, we recognized it as a smaller flowered form of *H. densiflorum* and hence treated as conspecific.

Flowering & Fruiting: July–August.

Distribution: Well distributed in high altitudes of India, China and Bhutan, sparsely found in S.E. Tibet, Nepal and Myanmar. In India it is distributed in Arunachal Pradesh, Meghalaya, Sikkim and West Bengal at an altitude of 1,600–1,900 m. They usually grow in open and water dripping earth cuttings or steep areas in large clumps. (*Figure 14. B*)

IUCN Red list Category: Due to the lesser area of occupancy, geographically distant subpopulations, it is assessed against Endangered (EN B1b(i,ii,iv)+2(i,iv); E) category as per IUCN Guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA**. **ARUNACHAL PRADESH**. DIBANG VALLEY Dt.: Thewarigaon, 1300 m., 28 Nov 1996, *M. Bhaumik & M.K. Pathak 1127* (CAL); Mayudia–Hunli, 1800–2000m., 18 Aug 2000, *M. Bhaumik 2857* (CAL); Way to

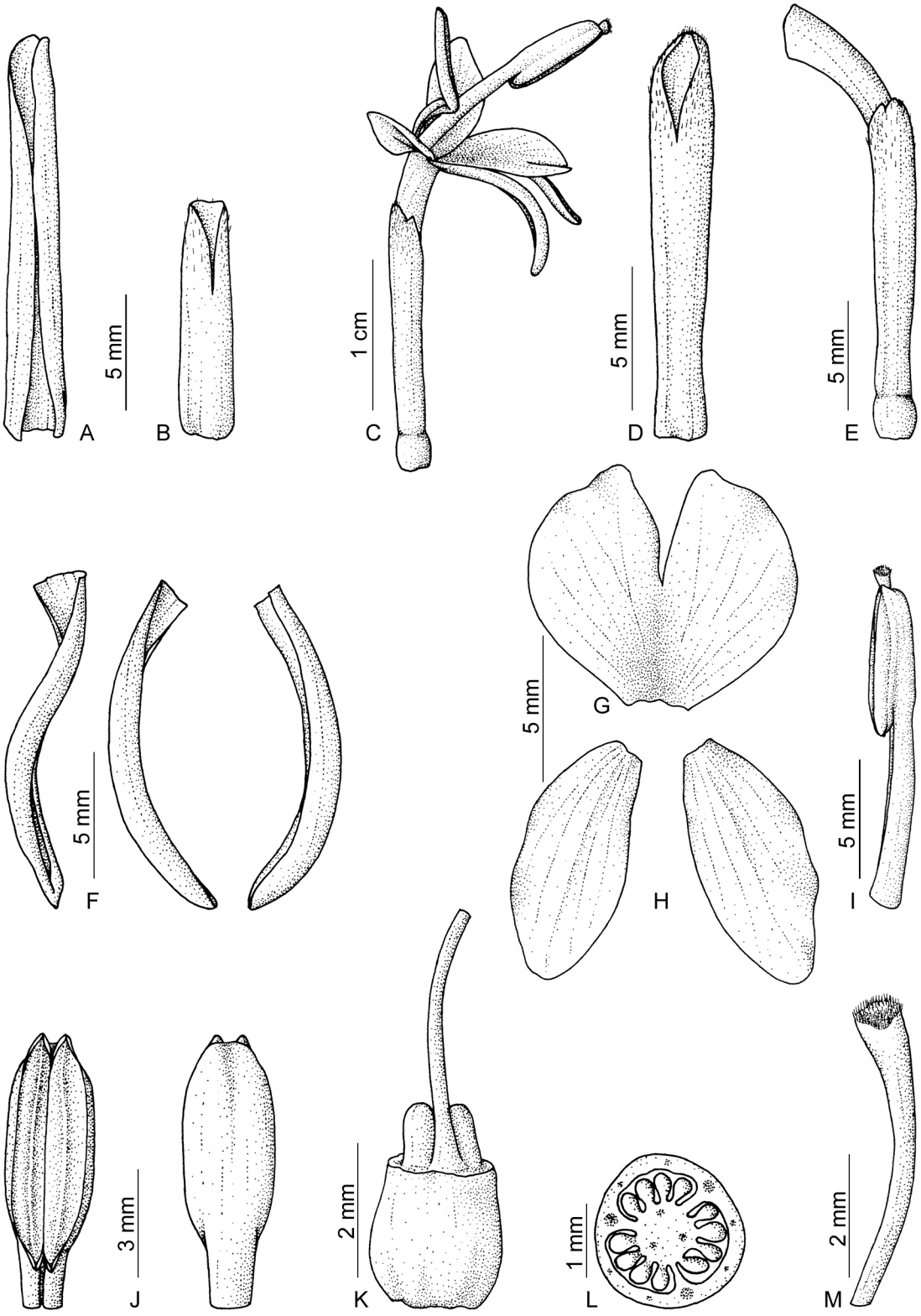

Figure 13. ***H. densiflorum***:**A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, front (left) and lateral view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

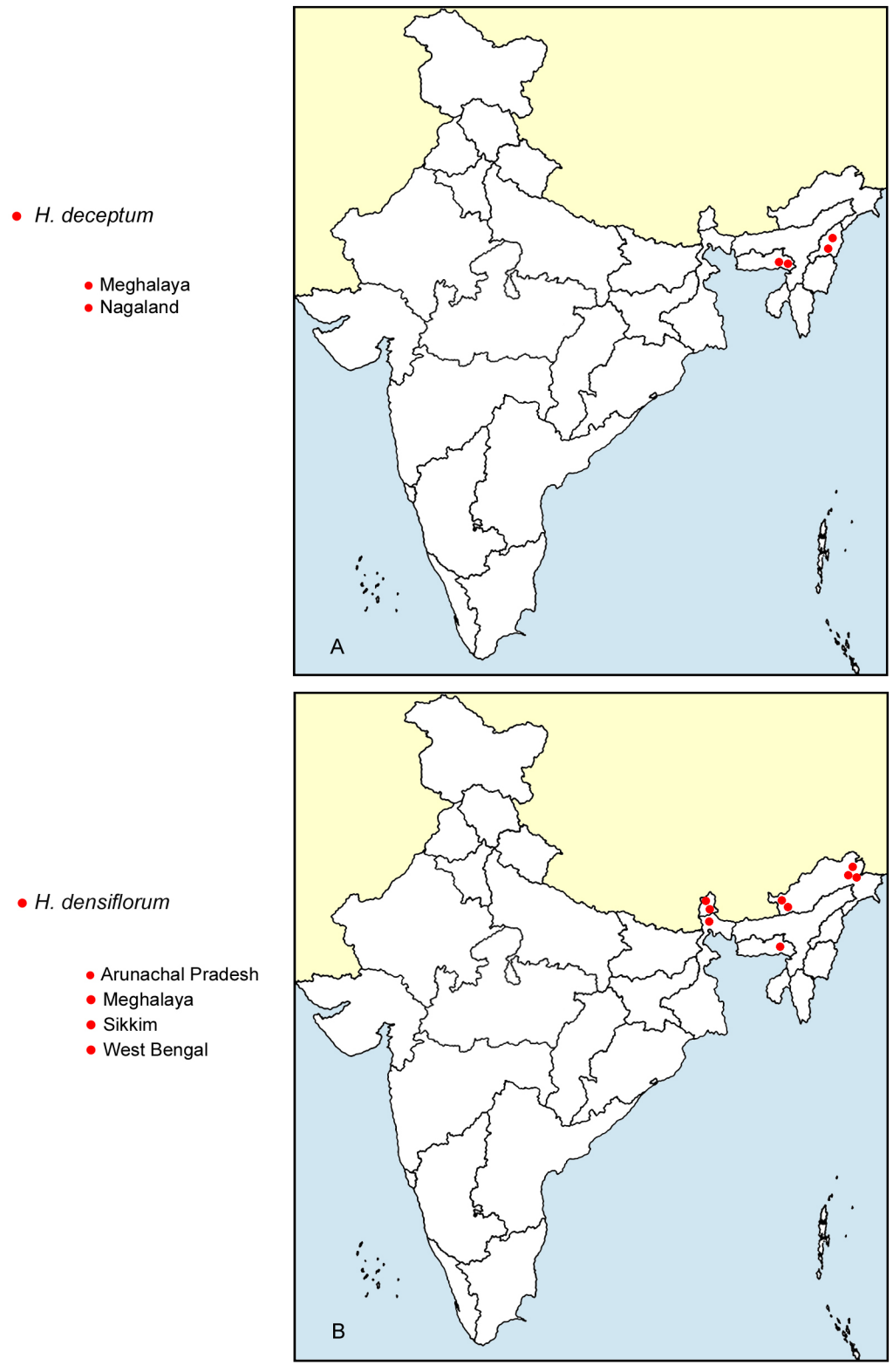

Figure 14. Distribution maps of
H. deceptum and ***H. densiflorum.***

Mayudia from Roing, 1838 m., N 28°14'23.7", E 095°52'12.5", 12 Aug 2009, *E. Sanoj & T. Rajesh Kumar 105666* (CALI), 2173 m., N 28°15'05.0", E 095°52'55.1", 12 Aug 2009, *E. Sanoj & T. Rajesh Kumar 105667* (CALI); Towards Hunli from Mayudya, 2434 m., N 28°18'42.1", E 095°56'59.7", 13 Aug 2009, *E. Sanoj & T. Rajesh Kumar 105674*, *105676*, *105677* (CALI). TAWANG Dt.: Near Zimithang, 20 Aug 1976, *P.K. Hajra 68374* (ASSAM); Near Zimithang, Lumpu Village, 21 Aug 1976, *P.K. Hajra 68431* (ASSAM). WEST KAMENG Dt.: Rupa-Ligaon road, near a fall, 8 Aug 1973, *P.K. Hajra 54012* (ASSAM); Kalaktang, 17 Aug 1958, *M. Ramaswamy 16616* (ASSAM). **MEGHALAYA**. EAST KHASI HILLS Dt.: Woodlands, introduced from Kameng, 12 Aug 1971, *A.S. Rao 50792* (ASSAM). **SIKKIM.** *s.loc.,* 6-8000 ft., *J.D. Hooker s.n.* (K); *s.loc.,* 5000-6000 ft., 1877, *G. King s.n.* (CAL); *s.loc., J.D. Hooker & J. Thomson s.n*. (CAL); *s.loc.,* 6500 ft., 21 Sep 1874, *G. King 1012* (CAL); 5000 ft., 1881, *G. King s.n.* (CAL), 5500 ft., 1879, *G. King s.n.* (CAL). NORTH SIKKIM Dt.: Eastern bank of Tista, above Rabom, 27°39'N, 88°36'E, 16 Jul 1996, *D.G. Long & H.J. Noltie 252* (E). **WEST BENGAL.** DARJILING Dt.: Darjileeing, 1863-4, *Griffith 5662* (K); Rungbee, 6500 ft., 5 Aug 1870, *s.coll. 12316 B* (CAL); Ghoom, 7500 ft., 30 Jul 1913, *G.H. Cave s.n.* (E). *Locality unkonown. s.loc., s.coll. 2048* (CAL).

7 Hedychium elatum

H. elatum R. Br., Bot. Reg. 7: t. 526. 1821; Lodd., Bot. Cab. 9(6): t. 856. 1824; Spreng., Syst. Veg. 1: 9. 1825; Roscoe, Monandr. Pl. Scitam. 5/6: t. 63. 1825; A. Dietr., Sp. Pl. 1: 35. 1831; Paxton, Paxton's Mag. Bot. 4: 203. 1838; D. Dietr., Syn. Pl. 1: 10. 1839; Horan., Prodr. Monogr. Scitam. 26. 1862; Baker in J.D. Hooker, Fl. Brit. India 6: 232. 1892; K. Schum., in A. Engler, Pflanzenr. IV. 46(heft 20): 54. 1904; J.N. Mitra, Monocot. E. India 1: 244. 1958; Karthik. et al., Fl. Ind. Enum. Monocot. 295. 1989; R.M. Sm. in A.J.C. Grierson & D.G. Long, Fl. Bhutan 2: 205. 1991; S.K. Jain & V. Prakash., Rheedea 5(2): 160.

1995; Press et al., Annot. Checkl. Fl. Pl. Nepal 330. 2000; Chaturv. & Moaakum, Folia Malaysiana 9(2): 133. 2008.

Lectotype (designated here): Nepal, 1821, *Wallich 6549 A* (Lecto K!).

H. coccineum var. *β pro parte* (*H. elatum*) Wall. in W.J. Hooker, Hooker's J. Bot. Kew Gard. Misc. 5: 373. 1853, J. Hort. Soc. London 9: 24. 1855; C. Muell., Ann. Bot. Syst. 6: 23. 1861. (*Figure 15; Plate 09. D–G*)

Common Name: Tall Garland Flower, Comtesse de Vande's Tall Garland-flower.

Terrestrial, perennial rhizomatous herbs. *Rhizome* 2.8–4 cm wide, creamy white internally, pale pink externally, slightly aromatic. *Leafy shoot* 137–300 cm high, robust. *Leaves* 12–16 in number, 5.7–13.2 cm apart, spreading, sessile; sheath 2–2.8 cm wide, margins pink tinged, membranous, translucent, sparsely pubescent; ligule 2.7–3.2 x 2.4–2.8 cm, ovate, single-lobed, rounded or obtuse at tip, pale pinkish, densely sericeous externally, membranous, translucent, papery, closely appressed to the stem; lamina 45–62 x 6.3–8.4 cm, elliptic, dark green and glabrous above, pale green and sericeous below; margin undulate, membranous, translucent, pink tinged, non-ciliate; tip long caudate, twisted; base cuneate; midrib densely sericeous below. *Inflorescence* 52–60 cm long, cylindrical, lax, erect; peduncle green, pubescent. *Bracts* 3.6–3.8 x 1.2–1.4 cm, elliptic, green, glabrous, hairy at tip, coriaceous, convolute; margin non-ciliate, translucent, membranous, white, tip obtuse, cincinnus 1 or 2-flowered. *Bracteoles* 2–2.6 x 1.2–1.4 cm, non-tubular, obtuse at tip, pale green, white towards base, glabrous, hairy at tip, outer one completely encircles the cincinnus. *Flower* 11–11.3 cm long, white with a pink stamen, many flowers open at a time, ascending, become descending on second day, slightly fragrant. *Calyx* 3.2–3.3 cm long, *c.* 3.5 mm wide at mouth, pale green, upper half sparsely pubescent and inflated, lower half glabrous and closely appressed to corolla tube, membranous, translucent, unilaterally split upto 0.7–1 cm deep, 3-toothed at tip. *Corolla tube* 5.6–5.7 cm long, *c.* 3 mm wide at mouth,

white, reddish-pink towards tip, hairy internally, glabrous towards base, erect. *Corolla lobes* elliptic, pink, orange-yellow towards tip, membranous, early decaying at base, drooping from flower, glabrous; dorsal lobe 3.2–4 x *c.* 0.6 cm, *c.* 1 mm long beaked at tip; lateral lobes 3.6–3.9 x *c.* 0.6 cm, non-beaked at tip. *Lateral staminodes* 3.2–3.5 x 1.1–1.2 cm, obliquely elliptic, clawed towards base, white, reddish-pink at base where it joins with the filament and corolla tube, spreading on flower, reflexed back, margin undulate, tip truncate. *Labellum* 3.2–3.5 x 3.1–3.2 cm, very widely ovate, white, reddish-pink at centre, spreading on flower, reflexed back on upper half, base cordate, abruptly clawed at base; claw *c.* 4 mm wide; sinus 1.5–1.6 cm deep; margin undulate, lobes rounded at tip. *Stamen* 5–5.3 cm long, reddish-pink, erect. *Filament* 4.2–4.5 cm long, *c.* 2 mm wide at base, reddish-pink, erect. *Anther* 1–1.1 x *c.* 0.3 cm, oblong-elliptic, creamy white at openings, ciliate along margins of thecae, attached with the filament at *c.* 2 mm above from base, thecae axis parallel with the filament; connective pink, glabrous, prolonged to *c.* 1 mm long crest, tip rounded. *Ovary* 3.5–4 x *c.* 2.5 mm, oblong, pale green, pubescent externally, angular. *Style* filiform, white, glabrous, broadens and green tinged towards stigma. *Stigma c.* 1.5 mm wide, green, cup-shaped, stigmatic head ciliate, hairs hook-like, *c.* 1.5 mm exserted from the anther. *Epigynous glands* two, *c.* 4 mm long, oblong, yellow.

Notes: As mentioned by Baker (1892) it is very difficult to distinguish from some forms of *H. coccineum* when dried. But it can be distinguished from other taxa of *Hedychium* in having much robust habit, larger flowers and white coloured labellum with reddish-pink at the centre and reddish-pink stamens.

It was described by Brown (1821) from Banksian Museum, London, based on a specimen of Wallich from Nepal. He compared it with *H. speciosum* Wall. and distinguished from it in having shorter spike, tiers of fascicle in three, 3-flowered cincinnus, Labellum bifid with blunt tips and non-fragrant flowers. The accompanying drawing was prepared from a plant at garden of Comtesse de Vandes at Bayswater, Europe, raised from seed sent by Wallich. Later in *Botanical*

Register (Ker Gawler 1823) a note appeared as it was having perceptible musky fragrance.

The colour drawing, based on an Indian plant introduced from Calcutta Garden, again appeared in *Botanical Cabinet* (Loddiges 1824).

Based up on the live plant sent by Loddiges to the Liverpool Garden, Roscoe (1825) described the species with a much long (18 inches) inflorescence. He also observed that, the figures in Bot. Cab. t. 856. 1824 (Loddiges 1824) and Bot. Reg. t. 526. 1821 (Brown 1821), have smaller inflorescence, probably from a smaller plant which give an inadequate idea of this most magnificent plant. He also distinguished it from *H. carneum* Lodd. (in the observation of *H. carneum*) with its Chalky-white colour and a crimson spot in the centre, and mentioned that Wallich (MSS) treated it under *H. carneum* by saying *H. elatum* varies exceedingly according to elevation, soil and culture.

As per his observations, Wallich (1853, 1855) also treated *H. elatum* as a variety 'β' of *H. coccineum* along with *H. carneum*, *H. stenopetalum* and *H. barbatum* Wall. He also mentioned "Roscoe's and Loddiges' *H. carneum* seems rather come under the normal from" *i.e.,* under *H. coccineum*. But the descriptions and drawings of *H. carneum* (Loddiges 1823a, Herbert 1826, Roscoe 1827) are one and the same and treated as a variety of *H. coccineum* in the present work.

Horaninow (1862) in his *Prodromus Monographiae Scitaminearum* treated *H. elatum* as a separate species, and reduced *H. stenopetalum* and *H. barbatum* under *H. elatum* variety 'β'.

Baker (1892) treated *H. elatum* as a species and also mentioned that, *H. elatum* and *H. aurantiacum* are very difficult to distinguish when dried from some of the forms of *H. coccineum*, and he cited only *Wallich 6549 A & B* and hence he deliberately excluded from citing several of Wallich's specimens.

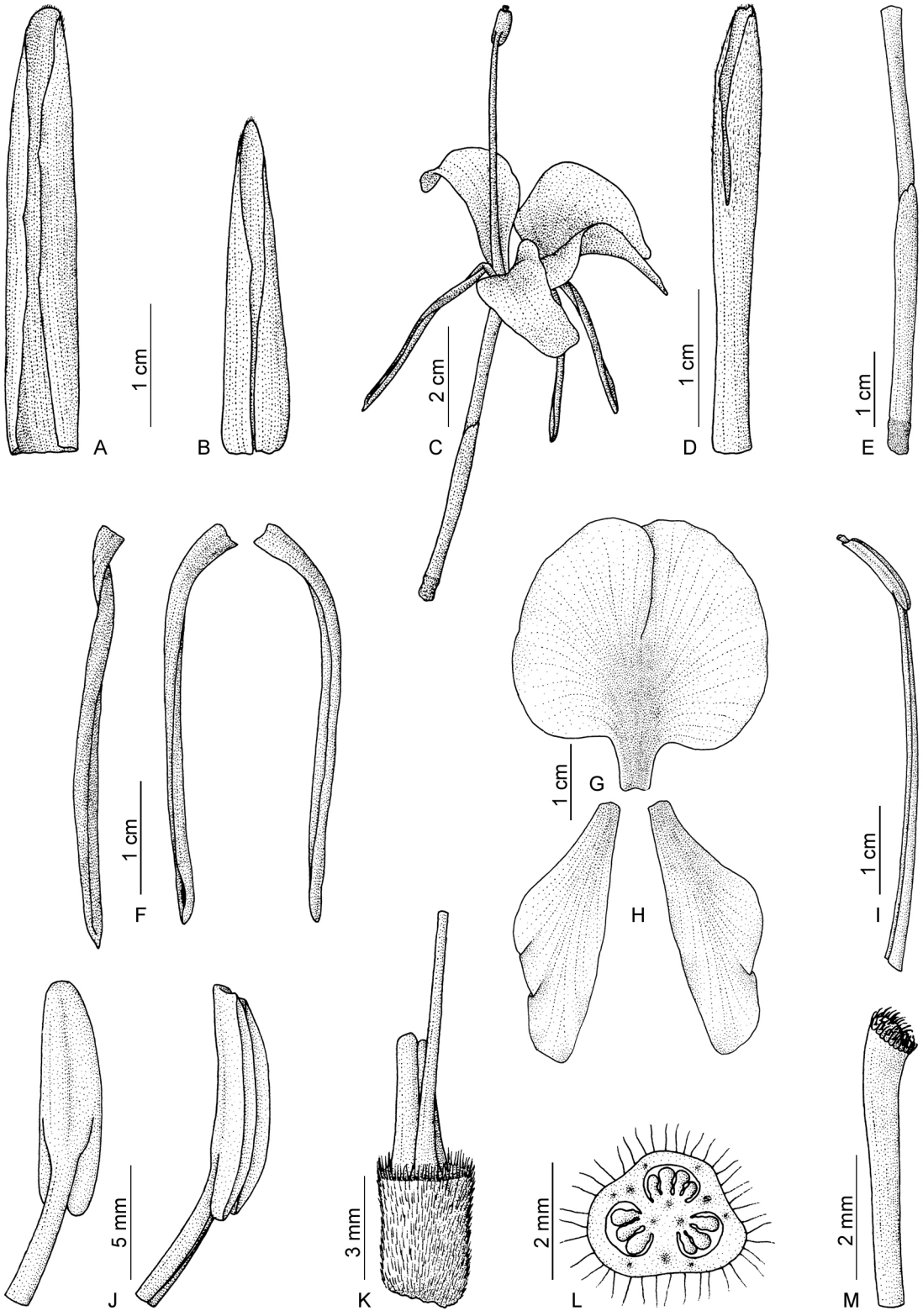

Figure 15. ***H. elatum***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, back (left) and lateral view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

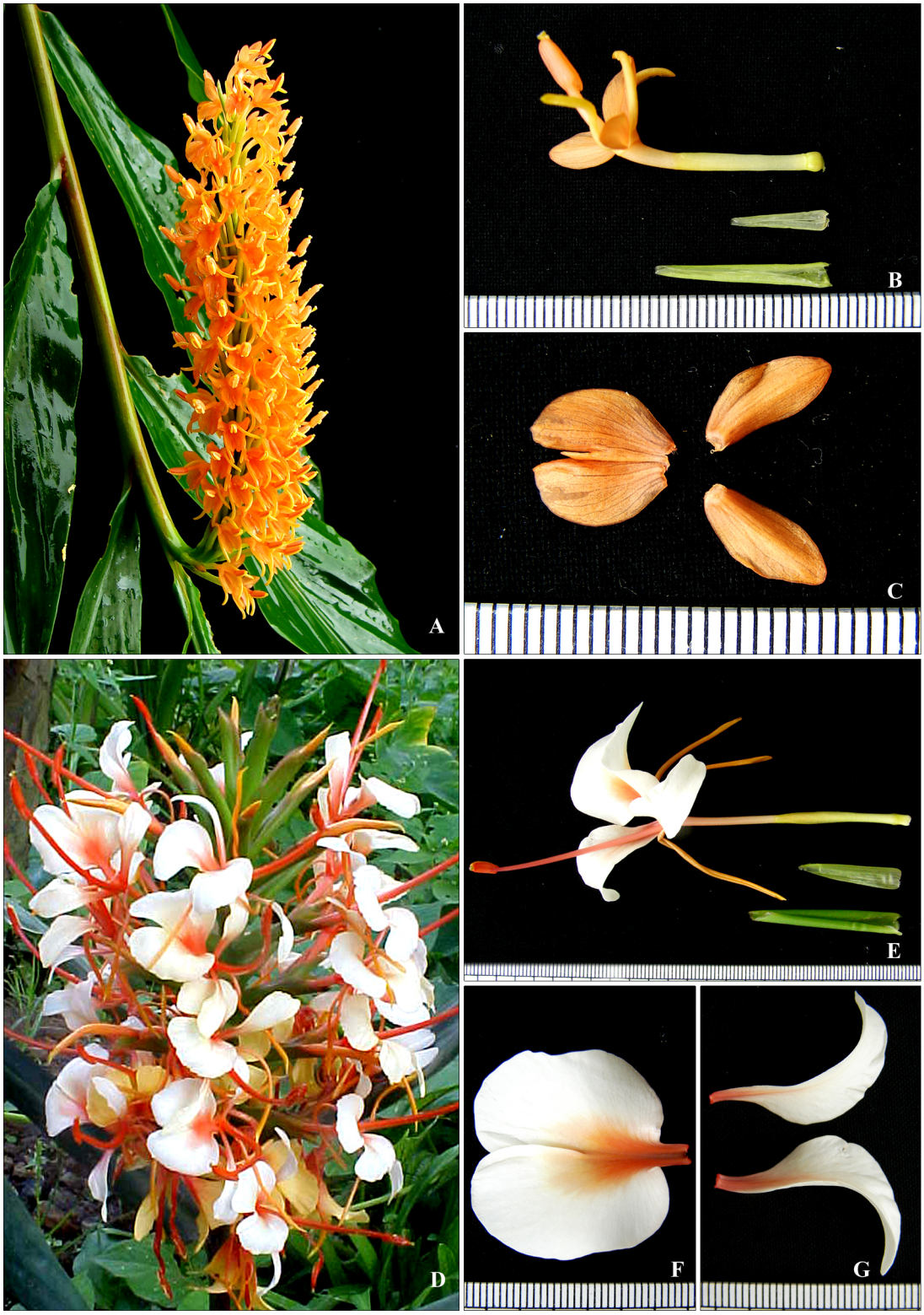

Plate 09. **A-C. *H. densiflorum*: A.** inflorescence; **B.** single flower, bract and bracteole; C. labellum and lateral staminodes. **D-G. *H. elatum*: D.** inflorescence; **E.** single flower, bract and bracteole; **F.** labellum; **G.** lateral staminodes.

Typification: While describing the species, R. Brown (1821) used a specimen sent by Wallich from Nepal. Whereas, Schumann (1904) cited a specimen (*Wallich 6549 B*) collected by R. Brown in 1826 from Kumaon, India as lectotype. As the type locality of the species is specified in the protologue as Nepal, *Wallich 6549 A* is redesignated here as lectotype, which was collected in 1821 from Nepal.

Flowering & Fruiting: June–August.

Distribution: Distributed in Nepal, Myanmar and Southern Yunnan provinces of China. In India, it located from Assam, Nagaland, Northern West Bengal and Eastern Uttarakhand at an altitude of 1,500–1,800 m. (*Figure 18. A*)

IUCN Red list Category: This species is known only from a few collections from India and adjacent countries. In India based on the available information, it can be considered Critically Endangered (CR A4a; B2b(i,ii,iv) according to IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA**. **ASSAM**. LAKHIMPORE Dt.: Jeypore, 18 Jul 1935, *C.S. Purkayastha 19645* (ASSAM). **KERALA**. THRISSUR Dt.: Cultivated, introduced from Northeast India, 9 Jul 2007, *M. Sabu 95040* (CALI). **NAGALAND**. KOHIMA Dt.: Kohima, 4500 ft., 1886, *D. Prain 20* (CAL); Behind Secretariat, 1517 m., N 25°42'47.2", E 094°06'25.6", 2 Sep 2006, *E. Sanoj & V.P. Thomas 105588* (CALI). **UTTARAKHAND.** PITHORAGARH Dt.: Kumaon, 3-4000 ft., 13 Aug 1886, *J.F. Duthie 6010* (CAL). **WEST BENGAL.** JALPAIGURI Dt.: Muraghat Forest, Sep 1894, *H.H. Haines 493* (K). *Locality unknown. s.loc.,* E.I.C. *s.coll. s.n.* (E).

8 Hedychium ellipticum

H. ellipticum Buch.-Ham. ex Sm. in A. Rees, Cyclop. 17. n. 2. 1811; Roem. & Schult., Mant. Syst. Veg. 16. 1822; Spreng., Syst. Veg. 1: 9. 1825; Roscoe, Monandr. Pl. Scitam. 5/6: t. 55. 1825; A. Dietr., Sp. Pl. 1: 33. 1831; Lodd., Bot. Cab. 19(9): t. 1881. 1833; Paxton, Paxton's Mag. Bot. 4: 204. 1838; D. Dietr., Syn.

Pl. 1: 9. 1839; Wall. in W.J. Hooker, Hooker's J. Bot. Kew Gard. Misc. 5: 327. 1853, J. Hort. Soc. London 9: 17. 1855; C. Muell., Ann. Bot. Syst. 6: 23. 1861; Horan., Prodr. Monogr. Scitam. 25. 1862; Baker in J.D. Hooker, Fl. Brit. India 6: 228. 1892; K. Schum. in A. Engler, Pflanzenr. IV. 46(heft 20): 47. 1904; Weathers, Bulb Book 269. 1911; J.N. Mitra, Monocot. E. India 1: 243. 1958; Naik & Panigrahi, Bull. Bot. Surv. India 3(1): 71. 1961; A.S. Rao & D.M. Verma, Bull. Bot. Surv. India 11: 123. 1969, 14: 131. 1972; J. Joseph, Fl. Nongpoh 305. 1982; Deb, Fl. Tripura 2: 377; 1983; N.P. Balakr., Fl. Jowai 2: 529. 1983; Karthik. et al., Fl. Ind. Enum. Monocot. 295. 1989; R.M. Sm. in A.J.C. Grierson & D.G. Long, Fl. Bhutan 2: 202. 1991; S.K. Jain & V. Prakash., Rheedea 5(2): 160. 1995; Press et al., Annot. Checkl. Fl. Pl. Nepal 330. 2000; S. Kumar, Zingiber. Sikkim 50. 2001; M. Sabu & Pradeep, Folia Malaysiana 6(1&2): 8. 2005.

Type: NEPAL. Narainhetty, cultivated, *Buchanan-Hamilton* Savage Cat. No. 8. 31 (holo LINN, iso BM).

H. fastigiatum Wall. [Numer. List. 6540. 1832, *nom. nud.*] ex Voigt Hort. Subrub. Calcutt. 570. 1845.

Type: Nepal, 1821, *Wallich 6540* (K, Microfische!). (*Figue 16; Plate 10. A–D*)

Terrestrial or epiphytic perennial rhizomatous herbs. *Rhizome* 2.3–3.2 cm wide, creamy white internally, pale pink externally, slightly aromatic. *Leafy shoot* 79–90 cm high, erect, robust. *Leaves* 12–13 in number, 6.5–7.7 cm apart, spreading, sessile or petiolate; petiole 4–6 mm long; sheath 1–1.5 cm wide, margins pink, membranous, translucent, glabrous; ligule 1–1.3 x 1.4 cm, ovate, single-lobed, truncate or slightly notched at tip, pink, pubescent externally, membranous, translucent, papery, closely appressed to the stem; lamina 31–34 x 10.4–11 cm, elliptic, dark green above, pale green, glabrous on both sides; margin highly undulate, membranous, translucent, white tinged, non-ciliate; tip long

caudate, twisted, drooping; base obtuse; midrib glabrous below. *Inflorescence* 6–8 cm long, eliiptic, dense, erect. *Bracts* 3.1–3.2 x 1–1.2 cm, elliptic, green, pale green towards base, glabrous, coriaceous, imbricate; margin non-ciliate, translucent, membranous, tip obtuse, cincinnus 1-flowered. *Bracteoles* 9–10.5 x 2.5–3 cm, tubular, membranous, translucent, tip obtuse, white, puberulent, closely appressed to flower. *Flower* 13.4–14 cm long, white with red stamen, turn to pale yellow on second day, many flowers open at a time, ascending, fragrant. *Calyx* 3.1–3.2 cm long, *c.* 2.5 mm wide at mouth, white, green tinged at tip, glabrous, sparsely hairy at the tip of teeth, membranous, translucent, closely appressed to corolla tube, unilaterally split upto 1.4–1.5 cm, 3-toothed at tip. *Corolla tube* 6–6.2 cm long, *c.* 3 mm wide at mouth, pale yellow, white towards base, glabrous externally, hairy internally, erect. *Corolla lobes* oblong, pale yellow, membranous, drooping from flower, glabrous, slightly coiled; dorsal lobe 5.1–5.4 x *c.* 0.4 cm, *c.* 1 mm long beaked at tip; lateral lobes 5.2–5.4 x *c.* 0.3 cm, non-beaked at tip. *Lateral staminodes* 3.6–3.7 x 0.45–0.5 cm, spatulate, white, yellow tinged towards base, erect, slightly reflexed back, tip obtuse. *Labellum* 2.8–2.9 x 0.7–0.75 cm, spatulate, white, yellow tinged towards base, erect, slightly reflexed back on upper half, gradually clawed towards base; claw *c.* 3 mm wide; sinus 1–3 mm deep; lobes acute at tip. *Stamen* 7–7.1 cm long, slightly arching. *Filament* 6.2–6.3 cm long, *c.* 2 mm wide at base, red, pale coloured towards base, slightly arching. *Anther* 1.6–1.7 x *c.* 0.2 cm, oblong, red, curved back, split opens from top to bottom, attached with the filament at 3–4 mm above from base, thecae axis parallel with the filament; connective red, glabrous, non-crested, tip truncate. *Ovary* 2.5–3 x 2–2.5 mm, barrel-shaped, pale green, pubescent externally. *Style* filiform, white, glabrous, green tinged towards stigma. *Stigma c.* 1 mm wide, green, cup-shaped, stigmatic head hairy, hairs hook-like, *c.* 1 mm exserted from the anther. *Epigynous glands* two, fused towards base, 1.5–2 mm long, oblong, pale yellow. *Fruits* 0.9–1 x 0.8–0.9 cm, loculicidal capsule, ovate, three-angled, glabrous, trilocular, surface smooth; fruit wall green externally, orange internally (when burst open). *Seeds c.* 4

x 2 mm, ovate, blood-red, yellow at base, longitudinally lined, compactly arranged on central column. *Aril* 4–5 mm long, red, membranous or lacerate.

Notes: H. ellipticum is a distinct species with erect spatulate labellum and lateral staminodes. It forms a sort of three-pronged tweezer with outward pointing tips. *H. gracile* var. *calcaratum* (A.S. Rao & D.M. Verma) Sanoj & M. Sabu, has a similar upright labellum but the flowers are smaller than the size of *H. ellipticum*. *H. radiatum* A.S. Rao & P.K. Hajra is another closely related taxon, but differs from it in having fastigiate spike with closely imbricating green bracts, minutely emarginate spatulate labellum, which is smaller than lateral staminodes, non-uniformly red (red becomes paler towards base) stamen *etc.*

It was described by Smith in Rees' *Cyclopedia* (17. n. 2. 1811) based on the Buchanan's collection from Narainhetty, Upper Nepal in 1802. According to Buchanan it is a common ornamental species in Nepal, locally called as '*Tecucha Swa*'. Shortly after the discovery of this species by Buchanan, it was introduced to Liverpool Garden. From where Loddiges described this species in *Botanical Cabinet* (1833a) along with a colour drawing.

Meanwhile, it was also described by Roscoe in *Monandrian Plants* (1825) based on a material sent by Dr. Wallich from Calcutta and Mr. Brocager from Hoogly, Bengal. Wallich (1832) in his catalogue published another species *H. fastigiatum* Wall. (Numer. List. 6540) as *nomen nudum*. It was described on the basis of one of his collections from Nepal in 1821. The material mentioned by Roscoe is most probably same with this material, which was sent by Wallich to Liverpool when he was the Superintendant of the Botanic Garden, Calcutta. It seems that, this confusion had also been identified by Wallich, thus he excluded the usage of *H. fastigiatum* from his later publications (1853, 1855).

Voigt (1845) in his catalogue of plants in the Botanical Garden Calcutta placed *H. ellipticum* Buch.-Ham. ex Sm. as a distinct species and *H. ellipticum* Roscoe as the

synonym of *H. fastigiatum* Wall. and mentioned that it has been introduced to Calcutta Garden from Nepal in 1818. Based on the protologue, drawing and Wallich's herbarium studies, we could conclude that, Wallich's *H. fastigiatum* and Buchanan's *H. ellipticum* are conspecific. Extensive studies on the live specimens also warrant this treatment.

H. griersonianum R.M. Sm., (Smith 1991a) is another allied species of *H. ellipticum* and differs from it in having more elongate inflorescence, considerably smaller, uniformly cream flowers and the shortly exserted corolla tube.

Flowering & Fruiting: June–September.

Distribution: Nepal, Bhutan, northern Myanmar, southwest Yunnan province in China and northern Thailand. In India it is found in Arunachal Pradesh, Meghalaya, Nagaland, Sikkim, Uttarakhand and West Bengal. It grows in open forest, rock crevices or as an epiphytic form at an altitude of 1,500–2,000 m.

(*Figure 18. B*)

IUCN Red list Category: Due to the fair extend of occurrence, area of occupancy, it is assessed against Vulnerable (VU A4a; B1b(i,ii,iv)+2b(ii); D2) category as per IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA**. **ARUNACHAL PRADESH**. DIBANG VALLEY Dt.: Thewarygaon, 1800 m., 18 Aug 2000, *M. Bhaumik 2948* (CAL); Hunli, 1600 m., 21 Aug 2000, *M. Bhaumik 2992* (CAL). **MEGHALAYA**. Khasi Hills, Jun 1876, 3-4000 ft., *s.coll. 244* (ASSAM); K&J Hills, 9 Sep 1955, *H. Deka 23419* (ASSAM). EAST KHASI HILLS Dt.: Shilllong, Raj Bhavan, 8 Jul 1963, *G.K. Deka 35989* (ASSAM); Woodlands Compound, 23 Jun 1965, *H. Deka 37047* (ASSAM), 12 Aug 1965, *D.M. Verma 37058* (ASSAM); Lower New Colony, 10 Jun 1968, *P.K. Hajra 38126* (ASSAM); Introduced

in Woodlands, 6 Jul 1972, *U. Shukla & M. Goon 34674* (ASSAM); Mawlei, 8 km from Shillong towards Guwahati, 2 Aug 2003, *M. Sabu & A.K. Pradeep 92503* (CALI); Shillong B.S.I Surroundings, 1470 m., 12 Aug 2004, *E. Sanoj 95604* (CALI); Barapani, 1190 m., 14 Aug 2004, *E. Sanoj 95623* (CALI); Barapani-Umiam, Shillong, Meghalaya, 1050 m., 14 Aug 2004, *E. Sanoj 95630* (CALI); E.B. Garden, Barapani, 2005, *B.K. Sinha 112006* (ASSAM). JAINTIA HILLS Dt.: Jowai, Cloriat area, 2-miles from Dak-Banglaw, 26 May 1956, *R.S. Rao 2557* (ASSAM); Near Waterfalls, between Jowai & Jorain, K & J Hills, 30 May 1965, *N.P. Balakrishnan 42219* (ASSAM); Umjaisaw to Scitrohma, 900 m., 26 Aug 1968, *N.P. Balakrishnan 47120* (ASSAM); Jowai, Shangpung, 1374 m., N 25°28.414", E 092° 19.135", 12 Aug 2007, *E. Sanoj & T. Rajesh Kumar 95180* (CALI). RI-BHOI Dt.: Umsaw Forest, Aug 1936, *S.R. Sharma 13560* (ASSAM); Nongpoh, 28 Jun 1949, *G.K. Deka 22928* (ASSAM), Hill top, 1 Aug 1964, *J. Joseph 37533* (ASSAM). WEST KHASI HILLS Dt.: Maoslangdep to Mairang Kheny, 5000 ft., 8 Jun 1911, *I.H. Burkill & S.C. Banerji 35242* (CAL); Nongkhlaw, about 4 miles from Mairong, 15 Jun 1958, *G. Panigrahi 16199* (ASSAM). **NAGALAND**. Naga Hills, Thesaina, Aug 1886, *D. Prain 3* (CAL); Naga Hills, Jun 1935, *N.L. Bor 21208* (ASSAM). PHEK Dt.: Jotsoma, 1578 m., N. 25°40'03.2", E 094°03'48.2", 31 Aug 2006, *E. Sanoj & V.P. Thomas 105566* (CAL). **SIKKIM**. *s.loc.,* 3500 ft., 10 Jul 1874, *G. King 974* (CAL); *s.loc.,* 1875-6, *G. King s.n.* (K, CAL); *s.loc.,* 2-5000 ft., *J.D. Hooker s.n.* (K, CAL); Badanitam, *J.S. Gamble 9725* (K); Mut-lu suh, 2500 ft., Jul 1868, *T. Anderson s.n.* (CAL). EAST SIKKIM Dt.: 5 km from Mangan towards Gangtok, 22 Aug 2004, *M. Sabu & A.K. Pradeep 92715* (CALI). NORTH SIKKIM Dt.: Dikchu, 5 Jul 1909, *Smith & Cave 818* (CAL). **UTTARAKHAND**. PITHORAGARH Dt.: Kumaon, Kali Village, 3-4000 ft., 11 Jul 1986, *J.F. Duthie 6013* (CAL); Bherpakha, 5000 ft., 23 Jul 1907, *N. Gill 95* (CAL); Thal-Berinag, 1000 m., 28 Jul 1970, *s.coll. 41311* (BSD). **WEST BENGAL**. DARJEELING Dt.: Darjeeling, Badawtacu, 2000 ft., Aug 1881, *J.S. Gamble 9725* (CAL); Mongpu, 4000 ft., 30 Jul 1913, *G.H. Cave s.n.* (E); Between Kurseong and Punkabarie, 950 m., 11 Aug 1922, *D.G. Long et al. 1288* (E).

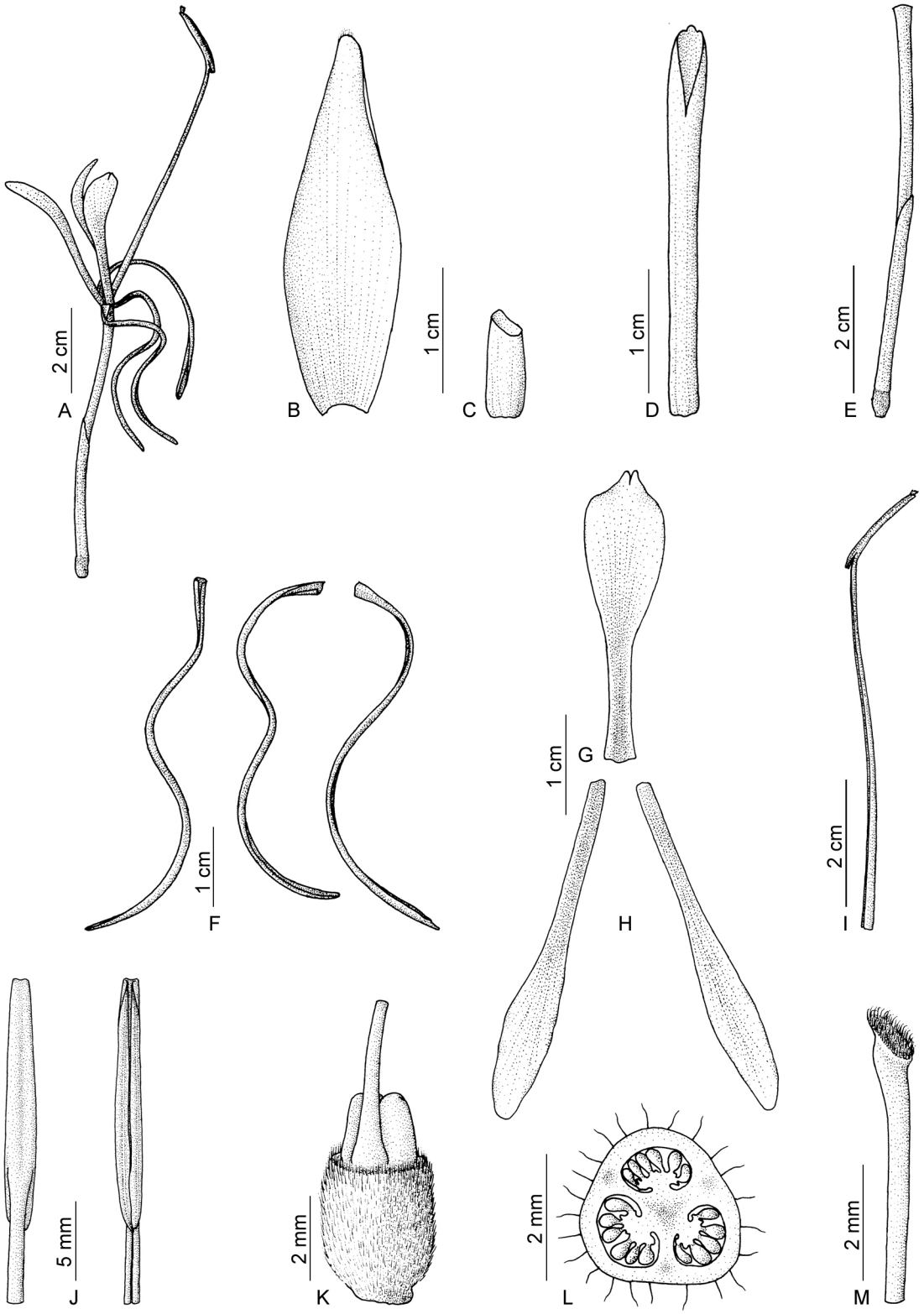

Figure 16. ***H. ellipticum***: **A.** single flower; **B.** bract; **C.** bracteole; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, back (left) and front view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

Key to the varieties of *H. ellipticum*

1a. Inflorescence elliptic with imbricate bracts; bracts green, elliptic, obtuse at tip; flower 13.4–14 cm long; lateral staminodes 3.6–3.7 cm long, longer than labellum; stamen 7–7.1 cm long……. var. ***ellipticum***

1b. Inflorescence cone-like with closely imbricate bracts; bracts reddish-brown with green tinge, obovate, rounded at tip; flower 11.2–11.5 cm long; lateral staminodes 2.9–3 cm long, equalizing with labellum; stamen 5.5–5.6 cm long…….. var. ***radiatum***

8a **Hedychium ellipticum** var**. radiatum**

H. ellipticum var***. radiatum*** (A.S. Rao & P.K. Hajra) Sanoj & M. Sabu, *stat. nov.*

H. radiatum A.S. Rao & P.K. Hajra, Bull. Bot. Surv. India 16(1-4): 163. 1974; S.C. Srivast. in S.K. Jain & R.R. Rao, Threat. Pl. India 236. 1983; Karthik. et al., Fl. Ind. Enum. Monocot. 296. 1989; S.K. Jain & V. Prakash., Rheedea 5(2): 161. 1995.

Type: INDIA. Arunachal Pradesh. Nyertsephu-Wana camp road, 6 Sep 1974, *A.S. Rao 56655* (holo ASSAM!; iso ASSAM!, BSD).

(*Figure 17; Plate 10. E–H*)

Terrestrial, perennial rhizomatous herb. *Rhizome c*. 2 cm across, light creamy internally, brown outside, slightly aromatic. *Leafy shoot* 80–100 cm high, slanting with erect inflorescence, robust. *Leaves* 10–12 in number, 5–7.4 cm apart, spreading; petiole 1.2–2.3 cm long, green with reddish-brown tinges and patches; sheath 1.5–1.7 cm wide, green with reddish-brown tinges and patches, glabrous,

margins membranous, translucent; ligule 1.2–1.5 x 1.3–1.4 cm, ovate, single-lobed, slightly notched at tip, reddish-brown, pubescent externally at centre, membranous, translucent, papery, closely appressed to the stem; lamina 26–35 x 7.7–12 cm, elliptic, glossy green above, pale green below, glabrous on both sides; margin undulate, membranous, translucent, white tinged, non-ciliate, pubescent below; tip long caudate, twisted; base obtuse. *Inflorescence* 7–10.5 cm long, elliptic, dense, erect, cone-like. *Bracts* 3–3.4 x 1.2–2 cm, obovate, reddish-brown with green tinge, densely pubescent at base, become sparse towards tip, coriaceous, closely imbricate; margin non-ciliate, translucent, membranous, white, rounded at tip, cincinnus 1-flowered. *Bracteoles* 1.6–1.7 x *c.* 3.3 cm, tubular, translucent, membranous, unilaterally split upto 3–4 mm, pinkish-green, glabrous, puberulent towards tip. *Flower* 11.2–11.5 cm long, white with red stamen, many (32-45) flowers open at a time, ascending, slightly fragrant. *Calyx* 2.9–3 cm long, *c.* 2.5 mm wide at mouth, pinkish-yellow, puberulent externally, membranous, translucent, closely appressed to corolla tube, unilaterally split upto 5–5.5 cm, obscurely 3-toothed at tip. *Corolla tube* 5.3–5.4 cm long, *c.* 3 mm wide at mouth, yellow with pink tinge towards tip, internally hairy, bend to one side at centre. *Corolla lobes* oblanceolate, greenish-yellow, membranous, drooping from flower, glabrous, slightly coiled; dorsal lobe 4.5–4.6 x *c.* 0.25 cm, *c.* 2.5 mm long beaked at tip, 5-veined; lateral lobes 4.2–4.3 x *c.* 0.3 cm, non-beaked at tip, 4-veined. *Lateral staminodes* 2.9–3 x 0.5–0.6 cm, narrowly oblanceolate, white, turning to creamy on second day, pale yellow at base, erect on flower, slightly reflexed back, tip rounded. *Labellum* 2.7–2.9 x 0.9–1 cm, obovatee, white, turning to creamy on second day, pale yellow at base, erect on flower, slightly reflexed back on upper half, base, gradually clawed towards base; claw *c*. 3 mm wide; sinus 0.6–0.7 mm deep; lobes tip rounded at tip. *Stamen* 5.5–5.6 cm long, slightly arching, red, become light coloured towards base. *Filament* 4.5–4.6 cm long, *c.* 2 mm wide at base, red, become light coloured towards base slightly arching. *Anther c*. 1.4 x 0.25 cm, oblong, curved back , red, split opens from top to bottom, attached with the filament at 3–3.5 mm above from base, thecae axis parallel with the filament;

connective red, slightly prolonged to a small crest (*c*. 0.5 mm), tip rounded. *Ovary* 4–4.5 x 3–3.5 mm, barrel-shaped, creamy, densely pubescent externally. *Style* filiform, white, glabrous, green tinged towards stigma. *Stigma c.* 1 mm wide, green, cup-shaped, slanting with a depression at center, pubescent, hairs hook-like, *c.* 1.5 mm exserted from the anther. *Epigynous glands* two, *c.* 2 mm long, oblong, yellow.

Notes: *H. radiatum* was described by Rao and Hajra (1974) based on a cultivated material at Woodlands Experimental Garden, Shillong, originally brought from Arunachal Pradesh. It is a closely allied species of *H. ellipticum*. and can be distinguished from it by its strobilus-shaped inflorescence, ovate with round tipped, reddish brown and densely imbricate bracts, equal sized lateral staminodes and labellum, 6-7 mm deeply emarginate labellum, shorter (5.5-5.7 cm) and red stamen. Which are not enough to keep them at specific level, hence, *H. radiatum* is reduced as a variety of *H. ellipticum*.

We could also locate one variant of this taxon from Kohima, Nagaland, which differs in having laxly imbricate bracts with obtuse tip, creamy yellow flowers, longer lateral staminodes (3.6–3.9 cm) and labellum (3–3.2 cm). But these differences are not sufficient to assign any rank.

Flowering: August–September.

Distribution: It is rare and endemic to Arunachal Pradesh. We could locate live specimens from other three localities of Arunachal Pradesh. Usually grows in crevices of moist rocks along with grasses and ferns, at an altitude of 1,300-1,600 m.

(*Figure 18. B*)

IUCN Red list Category: Due to the very restricted distribution of the species in three localities of Arunachal Pradesh and destruction of the habitat by the construction works and natural threats this species should be categorized as

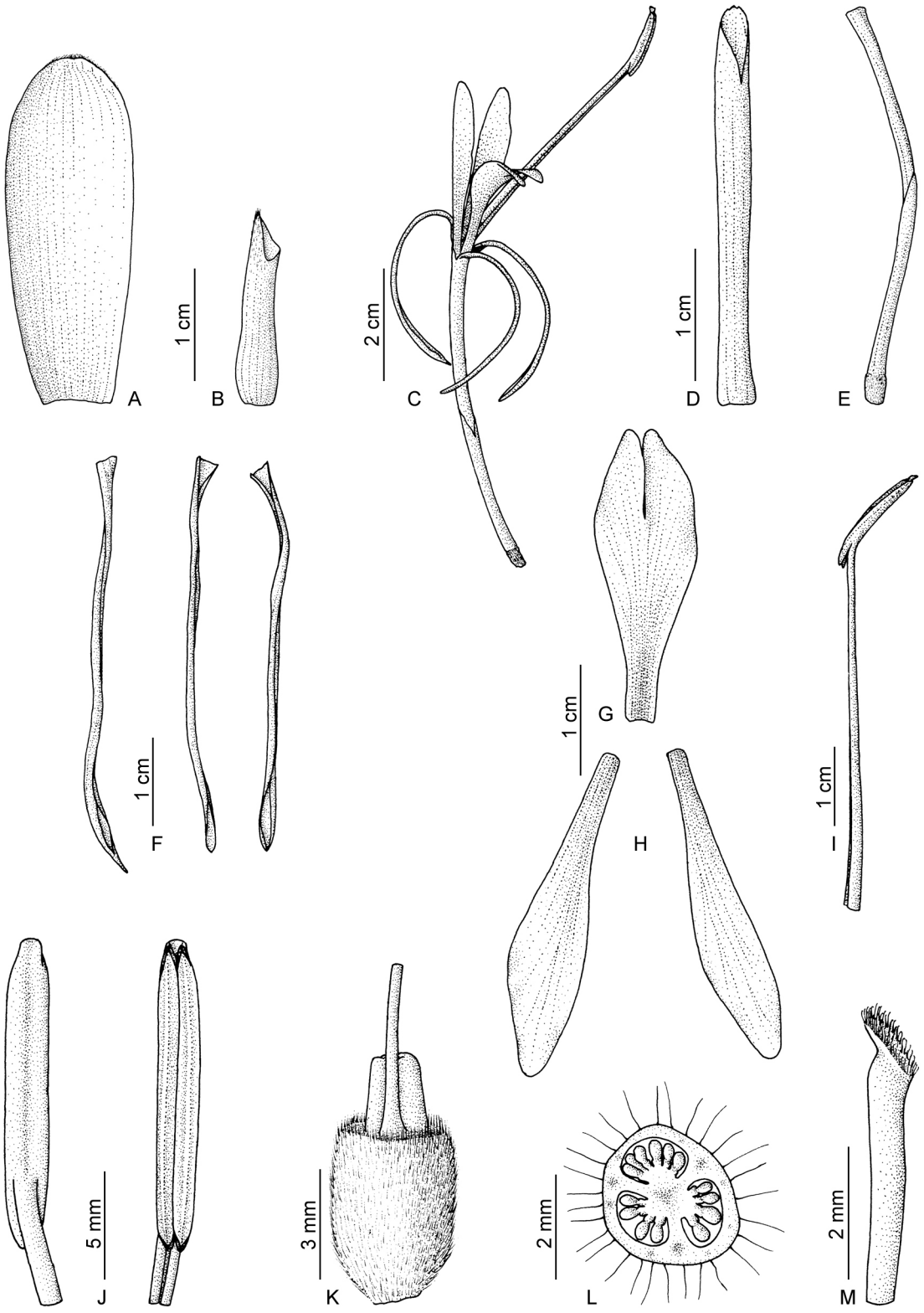

Figure 17. ***H. ellipticum*** var. ***radiatum***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, back view (left) and front view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.



Plate 10. **A-D.** ***H. ellipticum*****: A.** inflorescence; **B.** single flower, bract and bracteole;**C.** labellum; **D.** lateral staminodes. **E-H.** ***H. ellipticum*** var. ***radiatum*****: E.** inflorescence; **F.** single flower, bract and bracteole; **G.** labellum; **H.** lateral staminodes.

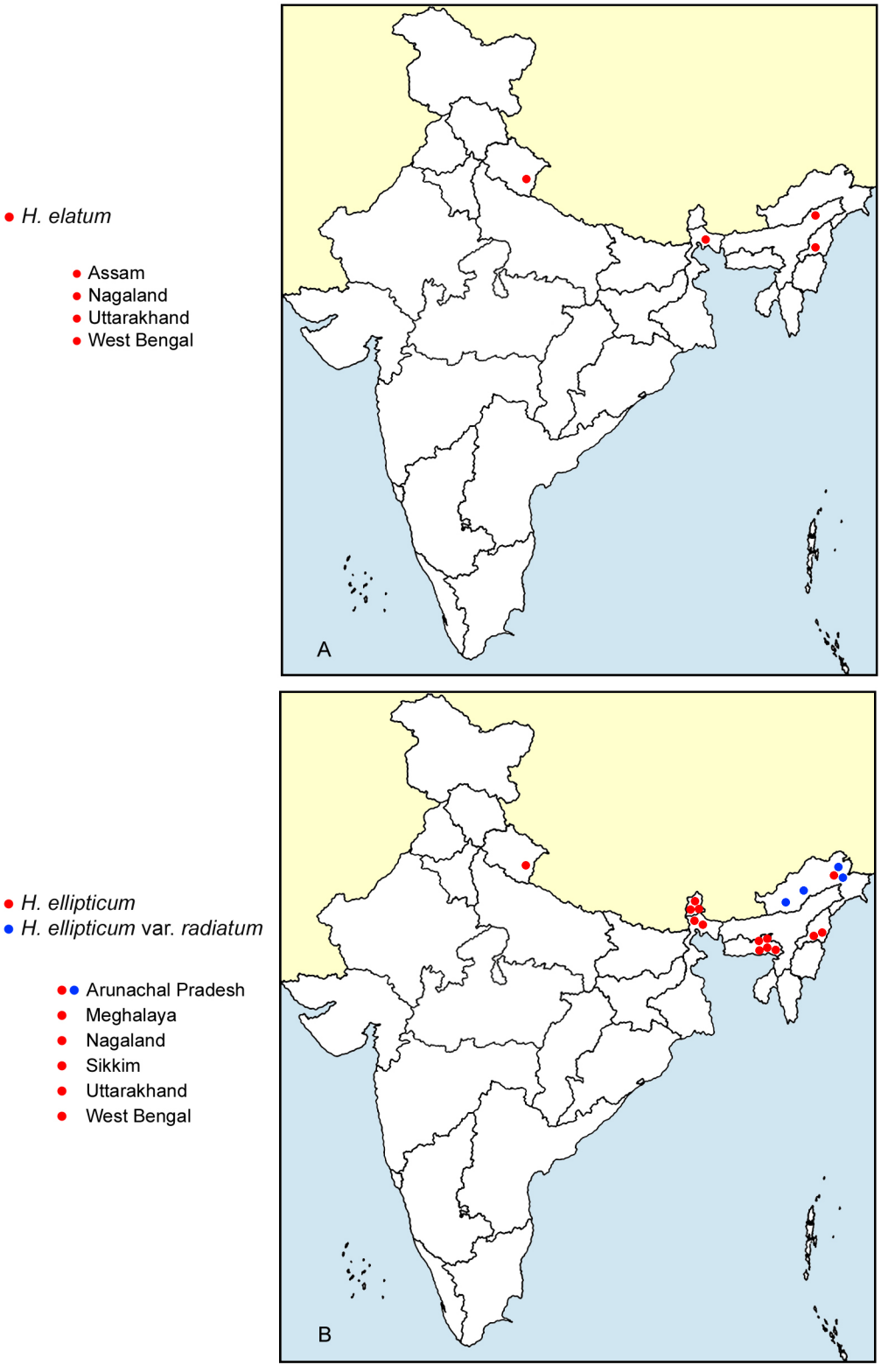

Figure 18. Distribution maps of
H. elatum, H. ellipticum and ***H. ellipticum*** var. ***radiatum***.

Critically Endangered (CR B1b(i,ii,iv)+2(i); E) as per IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA**. **ARUNACHAL PRADESH**: DIBANG VALLEY Dt.: Thewarygaon, 1300 m., 18 Aug 2000, *M. Bhaumik 2848* (CAL); Hunli, 1600 m., 21 Aug 2000, *M. Bhaumik 29992* (CAL); Way to Mayudya from Roing, N 28°13'10.7", E 095°47'57.9", 12 Aug 2009, *E. Sanoj & T. Rajesh Kumar 105663* (CALI). EAST KAMENG Dt.: 5 km from Seppa towards Bomdila, 11 Aug 2003, *M. Sabu & A.K. Pradeep 92548* (CALI). LOWER SUBANSIRI Dt.: 2 Km from Panjam towards Ziro, 8 Aug 2003, *M. Sabu & A.K. Pradeep 92539* (CALI).

9 Hedychium flavum

H. flavum Roxb., [Hort. Beng. 1. 1814, *nom. nud.*] Fl. Ind. ed. Carey, 1: 81. 1820 (rep. 1: 12. 1832), *non* J. Sims 1823 *nec* Hook. 1831; Lodd., Bot. Cab. 7(1): t. 604. 1822; Roem. & Schult., Mant. Syst. Veg. 16. 1822; Spreng., Syst. Veg. 1: 9. 1825; Roscoe, Monandr. Pl. Scitam. 3/4: t. 49. 1825; A. Dietr., Sp. Pl. 1: 32. 1831; Paxton, Paxton's Mag. Bot. 4: 202. 1838; D. Dietr., Syn. Pl. 1: 9. 1839; Wall. in W.J. Hooker, Hooker's J. Bot. Kew Gard. Misc.5: 326. 1853, J. Hort. Soc. London 9: 16. 1855; C. Muell., Ann. Bot. Syst. 6: 23. 1861; Horan., Prodr. Monogr. Scitam. 24. 1862; K. Schum. in A. Engler, Pflanzenr. IV. 46(heft 20): 45. 1904; Turrill, Bull. Misc. Inform. Kew 1914(10): 369. 1914; Karthik. et al., Fl. Ind. Enum. Monocot. 295. 1989; T.L. Wu & K. Larsen in Z. Wu & P.H. Raven, Fl. China 24: 372. 2000.

Epitype (designated here): Loddiges, Bot. Cab. 7(1): t. 604. 1822.

H. coronarium var. *flavum* (Roxb.) Baker in J.D. Hooker, Fl. Brit. India 6: 226. 1892; N. P. Balakr., Fl. Jowai 2: 528. 1983.

H. subditum Turrill, Bull. Misc. Inform. Kew 1914(10): 370. 1914.

Type: Roscoe, Monandr. Pl. Scitam. 3/4: t. 49. 1825.

Hedychium coronarium var*. subditum* (Turrill) Naik in V.N. Naik & G. Panigrahi, Bull. Bot. Surv. India 3(1): 71. 1961; A.S. Rao & D.M. Verma, Bull. Bot. Surv. India 14: 129. 1972; N. P. Balakr., Fl. Jowai 2: 528. 1983; S.C. Srivast. in S.K. Jain & R.R. Rao, Threat. Pl. India 235. 1983. (*Figure 19; Plate 11. A–D*)

Common Name: Yellow Garland Flower.

Perennial rhizomatous herbs. *Rhizome* 2.9–3.4 cm wide, creamy-white internally, slightly aromatic. *Leafy shoot* 98–112 cm high, slightly slanting. *Leaves* 8–10 in number, 5.2–10 cm apart, spreading, reflexed back, sessile; ligule 3.1–3.4 x 1.5–1.7 cm, single, slightly lobed at tip, ovate, pale green, sericeous externally, membranous, transluscent, closely embracing the stem; lamina 26–37.5 x 6–8.2 cm, elliptic, green and glabrous above, pale green and pubescent below, hairs green or hyaline; margin translucent, non-ciliate; midrib sericeous below; tip long acuminate; base obtuse. *Inflorescence* 7.5–10.5 cm long, erect, lanceolate, compact with imbricate bracts. *Bracts* 4.6–5.3 x 2.5–3.6 cm, imbricate, ovate-obovate, green, pubescent externally, hairs green or hyaline, glabrous towards base, leathery, tip acute-rounded, margins translucent, cincinnus 2-flowered. *Bracteoles* 2.3–2.4 x 1.5–1.6 cm, ovate, outer one tubular, green, densely pubescent externally, leathery, translucent towards base, 2 or 3-lobed at tip, margin ciliate at lobes. *Flowers* 12.5–13 cm long, sulphur yellow, slightly aromatic, flowers curved at the center. *Calyx* 3.3–3.5 x 0.4 cm, light green, densely pubescent externally, tubular, membranous, upper half inflated, lower half closely appressed to corolla tube, 3-toothed at tip, unilaterally split upto 0.8–0.9 cm, lobes minutely pouched at tip. *Corolla tube* 7.9–8 cm x 2–2.5 mm, creamy-white, white towards base, curved at centre about 90°, pubescent externally, become glabrous towards base, glabrous internally, hairy in the margins of the furrow through which style passes. *Corolla*

lobes 3.7–3.8 cm long, yellow, slightly green tinged towards tip, glabrous, drooping from flower, dorsal lobe 5–5.5 mm wide, elliptic, *c.* 4 mm long beaked at tip, 5–6 nerved; lateral lobes *c.* 5 mm wide, oblanceolate, non-beaked at tip. *Lateral staminodes* 3.9–4.1 x 1.4–1.5 cm, narrowly elliptic, sulphur yellow, tip obtuse, oblique, glabrous, margin crumpled and undulate, curved back. *Labellum* 3.8–4 x 3.3–3.6 cm, very widely ovate, sulphur yellow, deep yellow blotched at center and towards base, sinus *c.* 1.9 cm deep, abruptly clawed at base, claw *c.* 3 mm wide at base, margin undulate, curved back. *Stamen* 4.3–4.5 cm long. *Filament* 3.3–3.4 cm long, 1.5–2 mm wide at base, sulphur yellow, becomes white at base, straight and right angled with lip. *Anther* 1.3–1.4 x *c.* 0.25 cm, elliptic-oblong, yellow, attached with the filament at 2–2.5 mm above from base, thecae at an angle of *c.* 70° with the filament axis; anther suture yellow; connective yellow, tip prolonged in to a small crest; crest 1–1.5 mm long, yellow truncate at tip, glabrous. *Ovary* 5 x 3–3.5 mm, barrel-shaped, pale green, densely pubescent externally. *Style* long, filiform, white, broadens and green tinged towards stigma. *Stigma* cup-shaped, stigmatic head flat, slanting with a depression at center, covered by a flap-like structure from back, green, hairy, hairs hook-like, exserted the anther by 1.5–2 mm. *Epigynous glands* two, unequal, 4–4.5 mm long, finger-shaped, yellow.

Notes: The name *H. flavum* was first applied by Roxburgh in his *Hortus Bengalensis* (1. 1814) to a plant called by natives as '*Kattea-tilook-seer*', collected by M.R. Smith on 1810 from Silhet, NE Bangladesh. While describing the species, he fail to provide any description or any material or illustration based on which the description was made. This is probably one of the reasons for the extreme confusion about the identity of the species. Subsequently, it appeared in Roxburgh's *Flora Indica* (1820, 1832) with a local name as *'Kattia-rityam'.*

Loddiges (1822a) also described this species along with a drawing based on a material supposed to be used by Roxburgh, since both of them used Smith's collections from Silhet on 1810. This drawing is the first pictorial representation of *H. flavum.*

Later, Roscoe (1825) described the Roxburgh's *H. flavum* along with an excellent illustration, based on a Silhet material sent by Dr. Carey from Serarampore to the Botanic Garden, Liverpool.

Due to the similarity of the specific epithet with *H. flavescens*, there has been a substantial amount of misidentification of these two taxa in later publications. Hooker (1831) described the species *H. flavum* on the basis of a material from Wallich collected from the Irawadii, Burma. But the description and drawing provided by them were based on an entirely different species, *i.e., H. urophyllum*. Sims (1823) also described *H. flavum* (Bot. Mag. 50: t. 2378. 1823) based on a material by Rev. William Herbert from Spofforth. But the description and the illustration provided by him was of *H. flavescens*.

Turrill (1914) considered *H. flavum* of Roscoe (1825) is quite different from Roxburgh's *H. flavum*, and he proposed a new epithet for the former, *H. subditum* Turrill. He reached this conclusion based up on an illustration at Kew and BSI Calcutta, said to be Roxburgh's (No. 2153). But Roxburgh never mentioned about this drawing in any of his publications (1814, 1820, 1832). Moreover the Wallich Herbarium represented two materials *Wallich 6542 A & B,* both of these are much different from this illustration. We observed the *H. flavum* of Roxburgh and Roscoe are one and the same, and hence *H. subditum* is treated as conspecific with *H. flavum* Roxb.

Baker (1892) reduced it as a variety of *H. coronarium* under the section *Gandasulium* (stamen much longer than the lip). Based on live and herbarium specimens we also reached the conclusion that, *H. flavum* is closely allied to *H. flavescens* and are having only varietal differences, and we reduced the latter as the variety of former.

Typification: Roxburgh described *H. flavum* species based on a material sent by R.M. Smith from Silhet on 1810, to Calcutta garden. From where it was sent to

England and described by Loddiges (1822a) as the same species. It is supposed that both of them used same material of R.M. Smith, and hence Loddiges, Bot. Cab. 7(1): t. 604. 1822. is designated as the epitype.

Flowering: July–October.

Distribution: Distributed in very small area of Northeast India (southeast Meghalaya and Nagaland) and adjacent parts of Bangladesh, at 900–1,200 m. altitudes. (*Figure 24. A*)

IUCN Red list Category: In India known only from the Meghalaya and Nagaland. As having very restricted, sparse distribution and facing high risk of extinction in wild, the species is assessed against Endangered (EN B1b(i,ii,iv)+2b(ii,iv,v); D; E) category as per IUCN Guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA**. **MEGHALAYA**. Khasia, 3-4000 ft., *J.D. Hooker & J. Thomson s.n.* (K, MH). EAST KHASI HILLS Dt.: Lawkyntang, 21 Aug 1937, *N.L. Bor 15626* (ASSAM); Pynursla, introduced in Woodlands, 8 Aug 1965, *D.M. Verma, 34596* (ASSAM); Barapani, E.B. Garden, 2005, *B.K. Sinha 112005* (ASSAM). JAINTIA HILLS Dt.: Jowai-Bodarpur Road, 22 Jul 1957, *G. K. Deka 10133* (ASSAM, CAL); Jorain-Syndai, 700 m., 17 Aug 1968, *N.P. Balakrishanan 46156* (ASSAM), 1450 m., 20 Aug 1968, *N.P. Balakrishnan 46886* (ASSAM). WEST KHASI HILLS Dt.: Nongkhlaw, 24 Aug 1976 *G.H. Bhaumik 60418* (ASSAM). **NAGALAND**. Naga Hills, Piffinsa, 19 Oct 1885, *C.B. Clarke 40935 A* (K). PHEK Dt.: Jotsoma, 1521 m., N 28°39'08**.**5", E 94°01'0.5", 31 Aug 2006, *E. Sanoj & V.P. Thomas 105578* (CALI). KOHIMA Dt.: Behind Secretariat, Kohima, 1517 m., N 25°42'47.2", E 094°06'25.6", 2 Sep 2006. *E. Sanoj & V.P. Thomas 105590* (CALI). **WEST BENGAL**. HOWRAH. Dt.: Calcutta Garden, 17 Jan 1829, *s.coll. 1104* (E). *Locality unknown*: *s.loc.,* 1822, *s.coll. s.n.* (K); *s.loc.,* 10 Sep 1823, *s.coll. s.n.* (K).

Key to the varieties of *H. flavum*

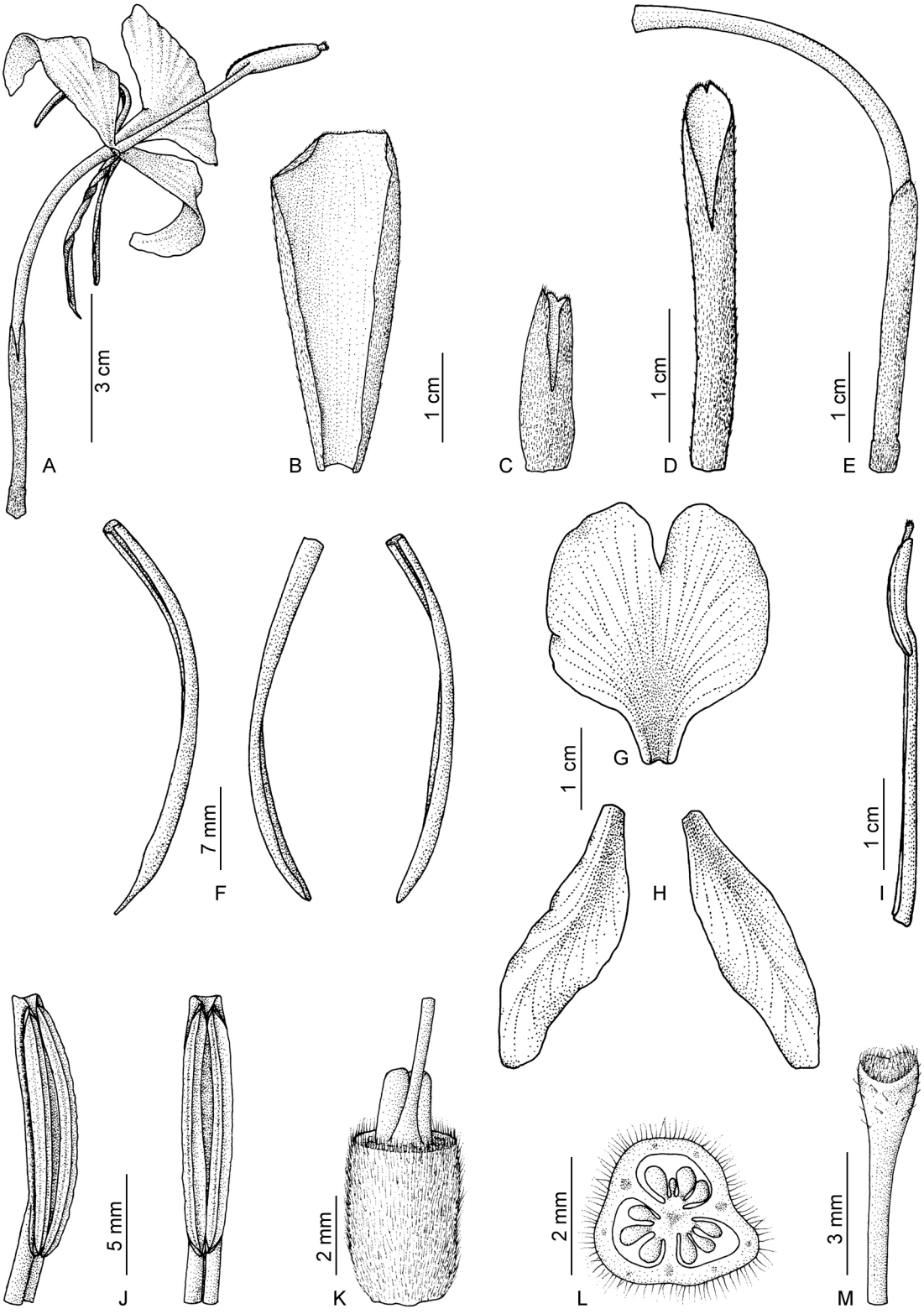

Figure 19. ***H. flavum***: **A.** single flower; **B.** bract; **C.** bracteole; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, lateral view (left) and front view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

1a. Lamina lower surface and bracts outer surface hyaline or green hairy; flower 12.5-13 cm long; corolla tube 7.9-8 cm long; lateral staminodes 3.9-4.1 x 1.4-1.5 cm; labellum 3.8-4 x 3.3-3.6 cm; stamen 4.3-4.5 cm long…… var***. flavum***

1b. Lamina lower surface and bracts outer surface golden yellow hairy; flower 15.3-15.6 cm long; corolla tube 9-9.1 cm long; lateral staminodes 5-5.1 x 1.6-1.8 cm; labellum 5-5.2 x 4-4.2 cm; stamen 5.5-5.8 cm long …… var***. flavescens***

9a **Hedychium flavum** var. **flavescens**

H. flavum var. ***flavescens*** (Lodd.) Sanoj & M. Sabu, *stat. nov*.

H. flavescens Lodd., Bot. Cab. 8(3): t. 723. 1823, *non* Lindl. 1852; Carey *ex* Roscoe, Monandr. Pl. Scitam. 3/4: t. 50. 1825; Paxton, Paxton's Mag. Bot. 4: 203. 1838; Wight, Icon. Pl. Ind. Orient. t. 2008 & 2009. 1853; Trimen, Handb. Fl. Ceylon 4: 245. 1898; K. Schum. in A. Engler, Pflanzenr. IV. 46(heft 20): 46. 1904; Turrill, Bull. Misc. Inform. Kew 1914(10): 369. 1914; C.E.C. Fisch. in J.S. Gamble, Fl. Madras 3: 1485. 1928; Lourteig, Adansonia Ser. 2. 12(1): 123. 1972; Manilal & Sivar., Fl. Calicut 288. 1982; B.L. Burtt & R.M. Sm. in M.D. Dassanyake & F.R. Fosberg, Rev. Handb. Fl. Ceylon 4: 507. 1983 (*ex. syn.*); K.M. Matthew & Britto in K.M. Matthew, Fl. Tamil Nadu Carnatic 3: 1618. 1983; Karthik. et al., Fl. Ind. Enum. Monocot. 295. 1989; K.G. Bhat, High. Pl. Ind. Subcont. 4: 88. 1993, Fl. Udupi 631. 2003; M. Mohanan & A.N. Henry, Fl. Thruvananthapuram 3: 474. 1994; S.K. Jain & V. Prakash., Rheedea 5(2): 160. 1995; T.L. Wu & K. Larsen in Z. Wu & P.H. Raven, Fl. China 24: 372. 2000; Press et al., Annot. Checkl. Fl. Pl. Nepal 330. 2000; M. Sabu & Pradeep, Folia Malaysiana 6(1&2): 8. 2005; M. Sabu, Zingiber. Costac. S. India 199. 2006.

Type: Loddiges, Bot. Cab. 8(3): t. 723. 1823.

Hedychium coronarium var. *flavescens* (Lodd.) Baker in J.D. Hooker, Fl. Brit. India 6: 226. 1892; Backer & Bakh. f., Fl. Java 3: 65. 1968.

H. flavum auct. non Roxb.: Sims, Bot. Mag. 50: t. 2378. 1823.

Type: Sims, Bot. Mag. 50: t. 2378. 1823. (*Figure 20; Plate 11. E–H*)

Common Name: Pale yellow Garland Flower, Flavescent Garland Flower.

Terrestrial, perennial rhizomatous herb. *Rhizome* subterranean, 2.2–3.4 cm wide, creamy white internally, slightly aromatic. *Leafy shoot* 116–140 cm high, slightly slanting. *Leaves* 10–12 in number, 6.6–11.2 cm apart, decurved, sessile or very shortly petiolate; petiole *c.* 5 mm long; ligule 4–4.4 cm long, single-lobed, with 4–8 mm deeply clefted at tip, yellowish-green, golden-yellow hairy externally, membranous, closely embracing the stem; lamina 46–50.5 x 7.5–8.7 cm, elliptic, deep glossy green and glabrous above, light green and densely pubescent below, hairs golden-yellow; margin non-ciliate; tip long acuminate, twisting to right; base attenuate; midrib densely hairy below. *Inflorescence* 10–12 cm long, erect, lanceolate, compact with imbricate bracts. *Bracts* 4.5–4.7 x 2.4–2.5 cm, imbricate, obovate, coriaceous, green, yellow tinged towards base golden-yellow hairy externally; margin translucent, membranous, non-ciliate; tip rounded; cincinnus 3-flowered. *Bracteoles* 2.3–2.5 x 1.6–1.8 cm, one on each flower, coriaceous, outer one tubular upto 6–8 mm long, pale green at tip, creamy white towards base, pubescent externally, becomes puberulent towards base; margin membranous, translucent, non-ciliate; tip slightly clefted. *Flower* 15.3–15.6 cm long, sulphur-yellow, slightly fragrant, decurved, 3–many opens at a time. *Calyx* 4.2–4.4 cm long, *c.* 3.5 mm wide at base, tubular, white, green tinged towards base, pubescent externally, 3-toothed, unilaterally split upto 1.3–1.6 cm deep. *Corolla tube* 9–9.1 cm long, sulphur-yellow, whitish towards base, glabrous on both sides, curved. *Corolla lobes* sulphur-yellow, whitish towards base, drooping from flower; dorsal lobe 4.8–4.9 cm long, tip *c.* 4 mm long beaked; lateral lobes 4.3–4.4 cm long, tip

non-beaked. *Lateral staminodes* 5–5.1 x 1.6–1.8 cm, spatulate, sulphur-yellow, tip obtuse, spreading on flower. *Labellum* 5–5.2 x 4–4.2 cm, very widely ovate, gradually clawed at base, sulphur-yellow, deep yellow blotched at center and towards base, spreading on flower; margin reflexed back, sinus 1.4–1.5 cm deep. *Stamen* 5.5–5.8 cm long, straight on flower, more or less right angles with the lip, *Filament* 4.7–4.8 cm long, *c.* 2 mm wide at base, sulphur-yellow, whitish towards base. *Anther* 1.4–1.5 cm long, crescent-shaped, yellowish orange, attached with the filament at *c.* 3.5 mm above from base, thecae at an angle of *c.* 45° with the filament axis; anther suture orange; connective yellowish orange, non-crested. *Ovary* 5–5.5 x 3.4–4 mm, barrel-shaped, pale-green, pubesecent externally. *Style* long, filiform, white, green tinged towards stigma. *Stigma* 2–2.5 mm exserted from anther, stigmatic head flat, slanting with a depression at center, green, hairy; hairs hook-like. *Epigynous glands* two, unequal, 4–4.5 mm long, finger-shaped, yellow. *Fruit* setting not observed.

Notes: It is a closely related species of *H. coronarium*, but can be easily distinguished from it by its golden yellow hairs on ligule and bracts and beneath the lamina, narrower and longer labellum with uniform sulphur yellow colour and stamen exceeding the labellum. Absence of fruit setting makes it reproductively isolated from other species.

It was described by Loddiges in *Botanical Cabinet* (Loddiges 1823b) on the basis of a material sent from India. While describing this species he placed it in a rank between *H. coronarium* and *H. flavum* Roxb. Though the description was very brief he provided an excellent colour plate of the species. Subsequently Roscoe (1825), described the same species based on the material sent by Carey to the Botanical Garden, Liverpool from Serarampore.

As already mentioned in *H. flavum*, there was substantial amount of confusion between these two species. Sims (1823) misidentified a material sent by the Rev. William Herbert from Spofforth near Silhet in Bengal and described as

H. flavum. He also mentioned about another specimen sent by William Herbert to him under the name *H. flavum*. But Sims could not find any sufficient specific difference between his species and Roxburgh's and considered it as the accidental varieties of his species, *i.e., H. flavum*. Subsequently, Hooker in *Curtis's Botanical Magazine* (1831) has corrected the identity of Sims' (*l.c.*) illustration, as *H. flavescens.*

Meanwhile, Lindley wrongly published *H. flavescens* based on a material received from Siebold under the presumption *H. roxburghii* Blume (J. Hort. Soc. London 7: 281. 1852). Lindley and Paxton had reproduced it in Paxton's 'Flower Garden' (Paxton's Fl. Gard. 3: p. 164. 1853). But Wallich (1853) observed it as a distinct species from all the other taxa of *Hedychium* and described it as a new species *H. sieboldii* Wall. (Hooker's J. Bot. Kew Gard. Misc. 5: 371. 1853) and treated the *H. flavescens* Lindl. as its synonym. He also mentioned that the native country is doubtful, perhaps Japan.

Baker (1892) had reduced it as the variety of *H. coronarium* under the section *Gandasulium* Rumph. ex Horan. (stamen never much longer than lip) and stated "stature of the type, flowers sulphour yellow ". None of the workers since Baker followed this view.

As Loddiges (1823b) had validly published *H. flavescens* earlier than Roscoe (1825), the authorship of the species is ascribed to Loddiges.

On critical studies it is revealed that it shows much affinity with *H. flavum* than any other species and it differs only in having golden yellow hairs on lower leaf surface and bracts, larger size of flowers and floral parts (Table 02). These differences are not enough to treat them as separate species. Hence, *H. flavescens* is reduced as a variety of *H. flavum*.

Flowering: August–October.

Distribution: India and Sri Lanka. In India it is widely distributed in North and N.E. India and S. India. In South India it occurs along the Western Ghats and Bison Hill in Andhra Pradesh (Sabu 2006). It is one of the most widely cultivated species of *Hedychium* in the gardens of South India. Besides, it has become a major pest in New Zealand and Hawaii (Csurhes & Hannan-Jones 2008). (*Figure 24. A*)

IUCN Red list Category: Due to the wide geographical range of occurrence in the wild, *H. flavescens* is assessed against the Least Concern (LC) according to the IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA**. **ANDHRA PRADESH**: EAST GODAVARI Dt.: Dummakonda R.F., Addatigala, 425 m., 28 Sep 1980, *G.V. Subba Rao 68626* (MH, CAL); Nalakamaddi, *Narayanaswami 600* (CAL). VISAKAPATNAM Dt.: Cherukanda, 800 m., 29 Aug 1966, *G.V. Subba Rao 28192* (MH); By the sideway Sapparla Gedda, 975 m., 28 Oct 1972, *G.V. Subba Rao 42784* (MH); Way to Gavvala Guda, Lakshmipuram, 650 m., 22 Oct 1986, *N. Rama Rao & P. Narasimhan 84386* (CAL). **JHARKHAND**. EAST SINGHBHUM Dt.: Ligirda Swamp, 1150 ft., 6 Jan 1961, *G.V.S. Rao 23187* (ASSAM, CAL). **KARNATAKA**. CHIKAMANGALUR Dt.: Kigga, *Bhat 1984* (PPCH). KODAGU Dt.: Mercara, 25 May 1976, *M. Sivadasan 17533* (CALI); Way to Thalacauvery, E 075°31'10.1", N 12°29'15.7", 915 m., 25 Mar 2006, *V.P. Thomas 103102, 103103* (CALI); 1 ½ Km. from Jodupala, E 075°39'21.1", N 12°26'16.3", 609 m., 22 Jul 2007, *V.P. Thomas & T. Rajesh Kumar 103129* (CALI). SHIMOGA Dt.: Kudajadri, 1500 m., 12 Feb 2003, *M.G. Prasanth Kumar 86124, 86125* (CALI). **KERALA**: KOZHIKODE Dt.: Calicut, *V.V. Sivarajan 898* (CALI); Chedaleth, 900 m., 13 Aug 1964, *J.L. Ellis 19954* (MH). IDUKKI Dt.: Pambar forest, 16 Sep 1968, 1750 m., *D.B. Deb 30928* (MH); Meenmutty, ± 600 m., 30 May 1982, *C.N. Mohanan 74113* (MH), 2 Aug 1983, *C.N. Mohanan 79808* (MH); Munnar, near bridge, 1600 ft., 20 May 1999, *M. Sabu 78809* (CALI), 2001, *M. Sabu & Jana Skornickova 75264* (CALI), 1500 m., 6 Aug 2002, *M.G. Prasanth Kumar 86381* (CALI); Mannavan Shola, 21 Nov 2002, *M. Ramesh 86114* (CALI); Mattupetti, Gundumalai Tea estate, 2 Mar 2006, *E.A. Babu 86195* (CALI); 2 Km from Mlappara towards Thanikudy, 24 Mar 2009, *V.P.*

Thomas & K.M. Prabhu Kumar 105565 (CALI). MALAPPURAM Dt.: Calicut University Botanic Garden, *J.K. Mangaly 6787* (CALI), 22 Jul 1975, *J.K. Mangaly s.n.* (CALI). THIRUVANANTHAPURAM Dt.: Zoo, *M. Mohanan 52789* (MH, CAL). TRICHUR Dt.: Parambikulam submergible area, 1240 m., 29 Jul 1962, *K. Ramamurthy 14362* (CAL, MH). PALAKKAD Dt.: Anawai, 1000 m., 14 Apr 1978, *N.C. Nair 56799* (MH); on the bank of Bhawani river, Anawai, *J.K. Mangaly 17552* (CALI). WAYANAD Dt.: Edakkal, near Caves, *J.K. Mangaly 7662* (CALI); Chandanathode, 1200 m., 30 Jun 1965, *J.L. Ellis 25262* (MH); Banasuramalai, *M. Sabu 39152* (CALI). **SIKKIM**. Sikkim, 1874, *s.coll. s.n.* (CAL). **TAMIL NADU**: CHENNAI Dt.: Church Cliff Path, Pulueys, 7 Jul 1899, *s.coll. s.n.* (MH). COIMBATORE Dt.: Coimbatore, 8 Jul 1890, 3500 ft., *V. Narayanaswami 3746* (MH); Siruvani, Muthukulam, 950 m., 21 Aug 1960, Apr 425, *A.N. Henry 425* (MH); Muthukulam, Siruvani, *A.N. Henry 425* (MH). DINDIGUL Dt.: Kodaikanal, 6 Km away from Silver cascade, 21 Dec 2004, *A.K. Pradeep 95663* (CALI); Way to Kodaikanal from Palani, 2 Aug 2005, *E. Sanoj 86152* (CALI); Near to entry post at Udagumandalam, N 10°14'43.3", E 077°33'58.1", 1689 m., 3 Aug 2005, *E. Sanoj 86153, 86154* (CALI). MADURAI Dt.: Pumbarai, 21 Jul 1920, *s.coll. 16601* (MH); Pannaikadu, 28 Jul 1965, ± 1700 m., *K.M. Sebastine 25006* (MH); Towards Dolphis hose, 2000 m., 16 Aug 1975, *s.coll. 14818* (E). NILGIRIS Dt.: Neelgherry Hill, 1855, *s.coll. s.n.* (CAL, E); Nilgiris, 1877, *G. Bidia s.n.* (MH); Conoor, 5000 ft., Dec 1885, *J.S. Gamble 16907* (K); Kotagiri, 10 Jul 1886, *s.coll. 188* (E); 2067 m., 28 Aug 1956, *K.M. Sebatine 3936* (MH, CAL); Pakasuramalai, 2067 m., 28 Aug 1957, *K.M. Sebastine 3930* (CAL, MH), *K.M. Sebastine 3990* (MH); Karianshola, 1300 m., 24 Jul 1960, *K. Subramaniyam 10555* (CAL, MH); Killivayal R.F., 800 m., 25 Jul 1972, *E. Vajravelu 41790* (MH); Near Cholady river, 950 m., 27 Nov 1972, *E. Vajravelu 43124* (MH); Avalanchi, 32 km. from Ooty, N 11°18.372", E 076°36.319", 16 Aug 2005, *E. Sanoj 95699* (CALI); Sullikode, R.F., Kotagiri, *E. Vajravelu 35155* (MH); Nilgiris, *G.K. Deka 1877* (MH). SALEM Dt.: Shevaroi Hills, *s.coll. 459* (CAL, CALI). Kollimalai, *s.coll. 12971* (MH). TIRUNELVELI Dt.: Kadayanallur, 25 Sep 1917, *s.coll. 15240* (MH); Way to Inchikuzhi, 750 m, 29 Feb 1963, *A.N. Henry 17362* (MH). **MEGHALAYA**. EAST KHASI HILLS Dt.: Pynursla, 31 miles from Shillong, 25 Aug 1956,

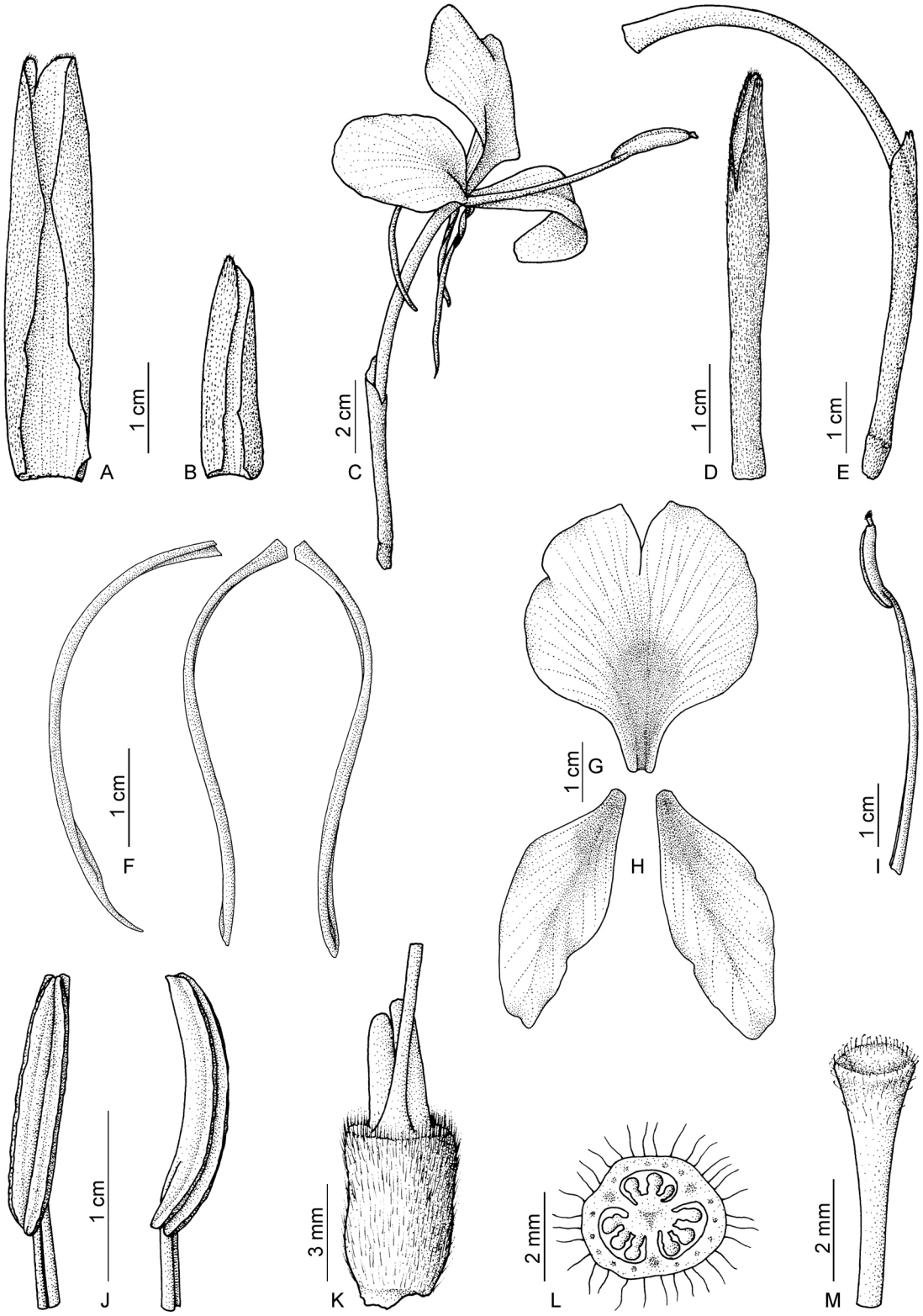

Figure 20. ***H. flavum*** var***. flavescens***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, front view (left) and lateral view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.



Plate 11. **A-D.** ***H. flavum*****: A.** inflorescence; **B.** single flower, bract, bracteole and cincinnus; **C.** labellum**; D.** lateral staminodes. **E-H.** ***H. flavum*** var. ***flavescens*****: E.** inflorescence; **F.** single flower, bract and bracteole; **G.** labellum; **H.** lateral staminodes.

G. Panigrahi 2940 (ASSAM). **NAGALAND**. MOKOKCHUNG Dt.: Naga Hills, Jun 1935, *N.L. Bor 21209* (ASSAM). Tuernang Road, Near Dikku, N 26°17'32", E 094°30'5.3", 107 m., 19 May 2006, *M. Sabu & A.K. Pradeep 103610* (CALI). **UTTARAKHAND**. DEHRADUN Dt. Dehra Dun, Mothronwala, 700 m., 6 Jun 1958, *K.M.M. Dakshini 5510* (BSD); Roberis Cave, 15 Dec 1965, *C.R. Babu 34938* (BSD); Lakshmi Road, 9 Sep 1976, *A.S. Rao 50354*, *50355* (BSD).

Table 02. Main differential characters of *H. flavum* and *H. flavum* var. *flavescens*

Characters	var. ***flavum***	var. ***flavescens***
Lamina	26-37.5 cm long, green or hyaline hairy below	46-50.5 cm long, golden yellow hairy below
Flower length	12.5-13 cm	15.3-15.6 cm
Calyx length	3.3-3.5 cm	4.2-4.4 cm
Corolla tube length	7.9-8 cm	9-9.1 cm
Dorsal corolla lobe length	3.7-3.8 cm	4.8-4.9 cm
Lateral staminodes	3.9-4.1 x 1.4-1.5 cm	5-5.1 x 1.6-1.8 cm
Labellum	3.8-4 x 3.3-3.6 cm	5-5.2 x 4-4.2 cm
Stamen length	4.3-4.5 cm	5.5-5.8 cm
Filament length	3.3-3.4 cm	4.7-4.8 cm

10 Hedychium forrestii

H. forrestii Diels, Notes Roy. Bot. Gard. Edinburgh 5: 304. 1912; T.L. Wu & K. Larsen in Z. Wu & P.H. Raven, Fl. China 24: 375. 2000; Sanoj et. al., J. Bot. Res. Inst. Texas 4(2): 636. 2010.

Type: CHINA. Yunnan: Tali Valley, 25°40' N, *G. Forrest 4812* (E!).

(*Figure 21; Plate 12. A & B*)

Hedychium dekianum A.S. Rao & D.M. Verma, Bull. Bot. Surv. India 11(1&2): 122. 1969, 14(1–4): 129. 1972; N.P. Balakr., Fl. Jowai 2: 527. 1983; S.C. Srivast. in S.K. Jain & R.R. Rao, Threat. Pl. India 236. 1983; Karthik. et al., Fl. Ind. Enum. Monocot. 294. 1989; S.K. Jain & V. Prakash., Rheedea 5(2): 160. 1995.

Type: INDIA. Meghalaya, East Khasi Hills Dt., Shillong, Woodlands (introduced from Khliehriat road from Jowai), 15 Jul 1966, *G.K. Deka 35605* (holo CAL!; iso ASSAM!). (*Plate 12. C & D*)

Terrestrial, perennial rhizomatous herbs. *Rhizome* 3.3–3.6 cm wide, creamy white internally, aromatic. *Leafy shoot* 100–200 cm high, erect, robust. *Leaves* 12–18 in number, 12–16.2 cm apart, sessile, spreading; sheath *c*. 3.5 cm wide, green, margins pink, membranous, translucent, pubescent; ligule 3–5.2 x 2–2.3 cm, oblong, single-lobed, slightly notched at tip, pale green, sericeous externally, membranous, translucent, papery, closely appressed to the stem; lamina 34–55 x 6–13.3 cm, elliptic-lanceolate, dark green and glabrous above (pink tinged in lower leaves), pale green and appressed silky hairy below; margin highly undulate, membranous, translucent, pink tinged, non-ciliate, folded back; tip long caudate, twisted, bend down; base oblique; midrib pink tinged below towards base. *Inflorescence* 15–27.6 cm long, cylindrical, erect, lax. *Bracts* 4.8–5 x 2.5–2.7 cm, obovate, green, pubescent, dense towards tip and margins, leathery, convolute; margin non-ciliate, translucent, membranous, white; tip rounded; cincinnus 2–5 -flowered. *Bracteoles* 3–3.7 x 2.1–2.3 cm, ovate, green, pubescent, outer one tubular, inner ones non-tubular; margin membranous, translucent, non-ciliate. *Flower* 10–12.2 cm long, white, spreading, 10–13 flowers open at a time, ascending, slightly fragrant. *Calyx* 4.2–4.3 cm long, shorter than bracts, 3.5–4 mm wide at mouth, white with pale yellow tinge, pubescent externally, membranous, translucent, upper half inflated, lower half closely appressed to corolla tube, unilaterally split upto 1.2–1.3 cm, 3-toothed at tip. *Corolla tube* 5–7.1 cm long, *c*.

3.5 mm wide at mouth, white, glabrous externally, hairy internally, glabrous towards base, erect or slightly bend towards tip. *Corolla lobes* oblanceolate, white, pale green tinged towards tip, membranous, early decaying at base, drooping from flower, glabrous; dorsal lobe 4.7–4.8 x *c*. 0.6 cm, 5–6 mm long beaked at tip; lateral lobes 4.2–4.3 x *c*. 0.5 cm, non-beaked at tip. *Lateral staminodes* 3.4–3.7 x 0.8–1.4 cm, elliptic-oblanceolate, white, spreading on flower, reflexed back, tip obtuse, margin undulate. *Labellum* 3.5–3.8 x 3.1–3.5 cm, widely ovate-orbicular, white, pale yellow tinge at centre and claw, spreading on flower, reflexed back on upper half, abruptly clawed at base; claw 6–8 mm wide; sinus 1.2–1.7 cm deep; margin undulate; lobes tip obtuse. *Stamen* 5–5.5 cm long, longer than labellum, white. *Filament* 4–4.5 cm long, *c*. 2 mm wide at base, white, erect. *Anther* 1.1–1.3 x *c*. 0.25 cm, oblong, creamy white, split opens from top to bottom, attached with the filament at *c*. 2.5 mm above from base, thecae parallel with the filament axis; connective white, glabrous, non-crested, slightly notched, tip truncate. *Ovary* 4.5–5 x 3–3.5 mm, barrel-shaped, pale green, densely pubescent. *Style* filiform, white, glabrous, pubescent towards tip, green tinged towards stigma. *Stigma* green, cup-shaped, densely pubescent, hairs hook-like, 1–1.5 mm exserted from the anther. *Epigynous glands* two, 3–3.5 mm long, oblong, bright yellow. *Fruits* 4–6 x *c*. 1.5 cm, oblong-cylindrical.

Notes: H. forrestii was originally described by Diels (1912), based on a collection by Forrest (holo *G. Forrest 4812,* E!) from Tali Valley in Western Yunnan. He distinguished this species from *H. coronarium* J. Koenig by its "narrower spreading bracts, the narrower segments of the corolla and broader staminodes." However, he admitted that, he was not able to study some of the floral details of this species. Diels diagnosis of this species was rather short and was based on a specimen with a single upper leaf and an inflorescence. Later, while describing the new variety from Vietnam (*H. forrestii* var. *latebracteatum* K. Larsen), Larsen (1965) elaborated the description of *H. forrestii* based on his studies on specimens at Kew, Paris and Edinburgh.

Meanwhile, Rao and Verma (1969a) apparently being unaware of the description of *H. forrestii*, described yet another species, *Hedychium dekianum* from Jowai, Assam (presently in Meghalaya), based on a collection by Deka (*G.K. Deka 35605 A,* CAL!). The authors compared their new species with *H. coronarium* and distinguished by its "lax spikes; closely convolute bracts; stamen exceeding the lip and oblong-cylindric capsule."

During the course of revision of the genus in India, we were able to collect and study a large number of specimens of *Hedychium* from the entire Northeast India. Our studies on *H. dekianum* based on the type, and live specimens have indicated that Indian specimens differ from *H. forrestii* in the white colour of the filament and creamy white anther, whereas it is salmon pink and crimson respectively in *H. forrestii,* which is mentioned only in one of the collections of *G. Forrest 8478* (K!). As the differences between these taxa are not sufficient to recognize them even as varieties *H. dekianum* is reduced to a synonym of *H. forrestii* and recently published as a new record for India (Sanoj *et al.* 2010).

Flowering & Fruiting: July–October.

Distribution: Distributed in Yunnan and Guizhou provinces of China, India, northern Thailand, Myanmar and Vietnam. In India it is restricted to East Khasi Hills and Jaintia Hills districts of Meghalaya. It is a robust herbaceous plant grows in populations of 3–5 plants in open and moist forest lands. (*Figure 24. B*)

IUCN Red list Category: H. forrestii is having a distribution at geographically wide distant localities with a fewer area of occupancy, and is facing a very high risk of extinction in the wild. Hence we categorize it as Endangered (EN B1ab(i,ii,iv)+2ab(i,ii,iv); E) category as per IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA**. **MEGHALAYA**. EAST KHASI HILLS Dt.: Shillong, Woodlands, 20 Aug 1970, *D.M. Verma 34198* (ASSAM). JAINTIA HILL Dt.: Khliehriat

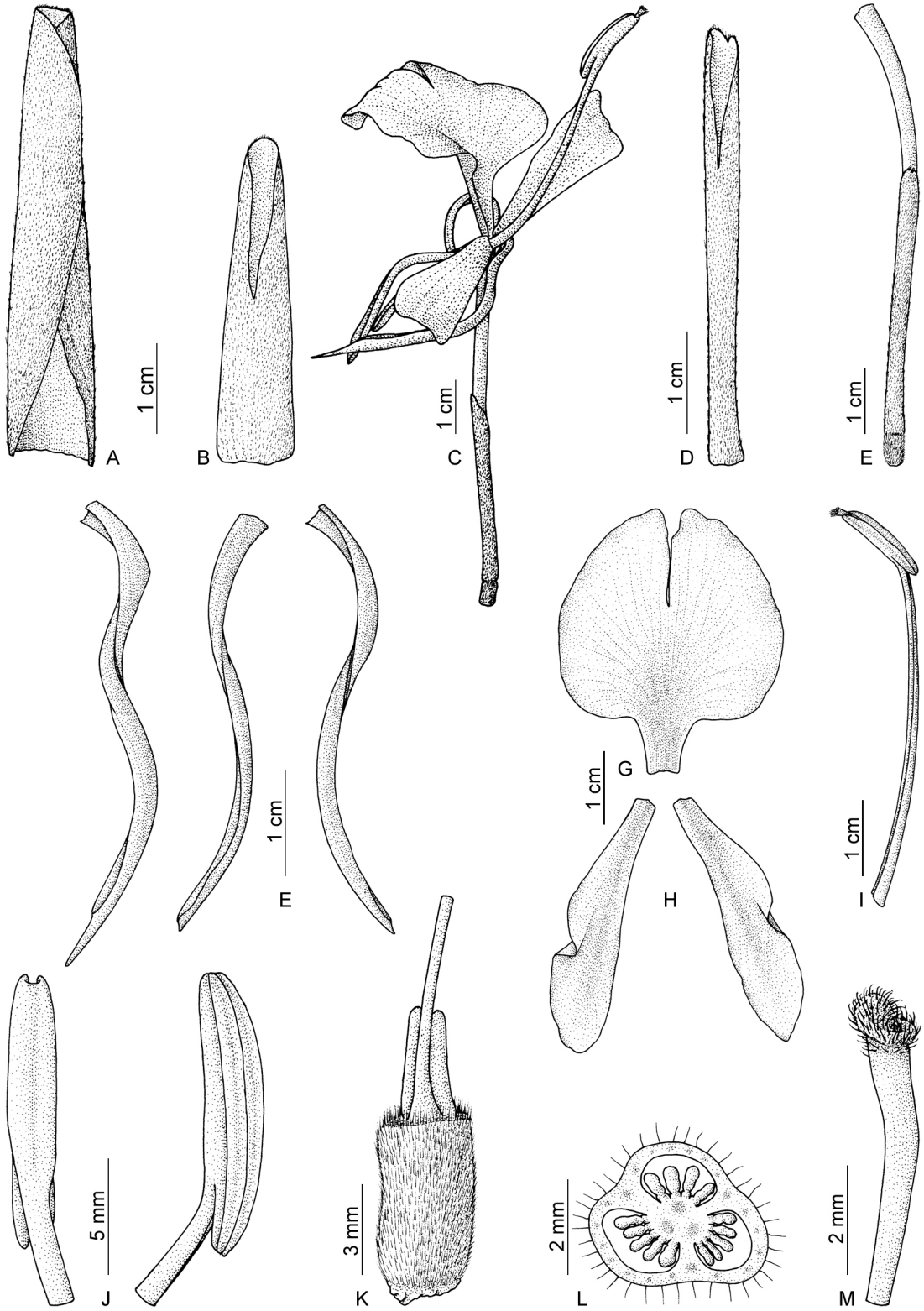

Figure 21. ***H. forrestii***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, back view (left) and lateral view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.



Plate 12. **A&B.** ***H. forrestii:*** **A.** inflorescence; **B.** type specimen (*G. Forrest 4812,* E!). **C&D.** ***H. dekianum*: C.** inflorescence; **D.** type specimen (*G.K. Deka 35605A,* CAL!).

road from Jowai, 23 Oct 1967, *G.K. Deka 37306 A* (ASSAM); Ummlong, 5 miles before Jowai, 16 Aug 1968, *N.P. Balakrishnan 46119 B, D, 46934 E,* (ASSAM); Jowai-Jorain, 20 Aug 1968, *N.P. Balakrishnan 46882* (ASSAM); Way to Dauki from Jowai, N 25°09.769', E 092°23.383', 473 m., 16 Aug 2007, *E. Sanoj & T. Rajesh Kumar 94905* (CALI).

Key to the varieties of *Hedychium forrestii*

1a. Flowers creamy-yellow with yellowish-brown tinge at centre of labellum …….. var. **No. 1**

1b. Flowers white with pale yellow tinge at centre of labellum 2

2a. Flower 10–12.2 cm long; corolla tube 5–7.1 cm long; calyx shorter than bracts..... var. ***forrestii***

2b. Flower 15–15.2 cm long; corolla tube 9.2–9.4 cm long; calyx equal or slightly longer than bracts.....var. ***palaniense***

10a **Hedychium forrestii** var. **palaniense**

H. forrestii var. ***palaniense*** Sanoj & M. Sabu in E. Sanoj et. al., J. Bot. Res. Inst. Texas 4(2): 634. 2010.

Type: INDIA. Tamil Nadu., Dindigul Dt., Perumal Malai, Palani Hills, on the way to Kodaikanal from Palani, 1380 m., 20 Aug 2005, *E. Sanoj 86151* (holo CALI; iso CAL, MH). (*Figure 22; Plate 13. A–D*)

Terrestrial perennial rhizomatous herbs. *Rhizome* 2.7–3 cm wide, creamy yellow internally, slightly aromatic. *Leafy shoot* 108–110 cm high, erect, robust. *Leaves* 10–13 in number, spreading, sessile; sheath margins white, membranous, translucent, sparsely pubescent; ligule 4–4.7 x *c*. 2 cm, ovate, single-lobed, white, pubescent externally, glabrous towards margins, membranous, translucent,

papery, closely appressed to the stem; lamina 38.8–43 x 8.5–7.7 cm, elliptic, dark green and glabrous above, pale green and puberulent below, hairyness increases towards tip; margin undulate, membranous, translucent, white tinged, non-ciliate; tip long caudate, twisted; base cuneate; midrib pubescent below. *Inflorescence* 16.5–23.2 cm long, cylindrical, lax, erect. *Bracts* 4.5–4.7 x 1.8–2 cm, lanceolate, green, glabrous, pubescent towards tip, coriaceous, non-imbricate, convolute; margin non-ciliate, translucent, membranous, white; tip rounded, cincinnus *c*. 3-flowered. *Bracteoles* 2.1–2.8 x 1.2–2 cm, outer one tubular, inner ones non-tubular, translucent, slightly 2 or 3-lobed at tip, pale green, white towards base, glabrous, pubescent towards tip, leathery; margin ciliate at tip. *Flower* 15–15.2 cm long, white, 4–6 -flowers open at a time, ascending, slightly fragrant. *Calyx* 4.8–5.1 cm long, 4.5–5 mm wide at mouth, pale green, pubescent externally, sparse towards base, membranous, translucent, upper half inflated, lower half closely appressed to corolla tube, unilaterally split upto 1.1–1.4 cm, 3-toothed at tip. *Corolla tube* 9.2–9.4 cm long, *c*. 4 mm wide at mouth, white, glabrous externally, hairy internally, bend to one side at centre. *Corolla lobes* oblong, white, pale greenish yellow tinged towards tip, membranous, early decaying at base, drooping from flower, glabrous; dorsal lobe 4.8–5 x *c.* 0.65 cm, 3.5–4 mm long beaked at tip, surface with small raised processes; lateral lobes 4.5–4.7 x *c*. 0.65 cm, non-beaked at tip. *Lateral staminodes* 4.1–4.4 x 1.9–2 cm, elliptic, white, spreading on flower, reflexed back, margin undulate. *Labellum* 4.3–4.6 x 4–4.2 cm, widely depressed ovate, white, pale yellow tinge at centre and towards base, spreading on flower, reflexed back on upper half, base cordate, abruptly clawed at base; claw 6.5–7 mm wide; sinus 1.9–2.1 cm deep; margin undulate, lobes tip rounded at tip. *Stamen* 5.6–6 cm long, longer than labellum, white, bend at tip. *Filament* 4.4–4.5 cm long, *c*. 2 mm wide at base, white, bend to one side at tip. *Anther* 1.3–1.4 x *c*. 3 cm, elliptic, split opens from top to bottom, attached with the filament at 2.5–3 mm above from base, thecae at an angle of *c*. 45° with the filament axis; anther suture pale red; connective white, glabrous, non-crested, tip truncate. *Ovary* 4–4.5 x 3.5–4 mm, barrel-shaped, pale green, pubescent externally. *Style* filiform, white,

glabrous, pubescent towards tip, broadens and yellowish-green tinged towards stigma. *Stigma c*. 2.5 mm wide, yellowish-green, cup-shaped, pubescent, hairs hook-like, *c*. 1.5 mm exserted the anther. *Epigynous glands* two, 2.5–3 mm long, oblong, yellow. *Fruits* 3.5–4 x *c*. 3 cm, ovate, three-angled, glabrous, trilocular, surface smooth; fruit wall green externally, orange internally, completely split and reflexed back on dehiscence. *Seeds c*. 4.5 x 3 mm, red, grey when dry, yellow at base, compactly arranged on column. *Aril* red, yellow when dry, lacerate, basal.

Notes: *H. forrestii* var. *palaniense* is allied to *H. forrestii*, but differs in having longer flower and corolla tube (9.2–9.4 cm) and calyx equal or slightly longer than bracts.

Etymology: The varietal epithet has been derived from the type locality, *i.e.,* 'Palani Hills', from where the variety has been described.

Flowering & Fruiting: July–October.

Distribution: H. forrestii var. *palaniense* is endemic and known only from four localities of Palani Hills, Tamil Nadu at an altitude of 1,300–1,600 m.

(*Figure 24. B*)

IUCN Red list Category: It grows as patches of 15–20 mature individuals in grassy slopes and open rock cliffs, having a very limited extend of occurrence and much fewer area of occupancy, it is assessed here as Critically Endangered (CR B1ab(i,ii,iv,v)+ 2ab(i,ii,iv,v); D; E) according to IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA**. **TAMIL NADU**. NILGIRIS Dt.: Kailas Pillai Estate to Sirur (near Ebanad), 6 Sep 1970, 1450 m., *G.V. Subba Rao 36524* (MH). Dindigul Dt.: Anna, Kodaikanal, Palani Ghat Road between Perumal Malai and Vadakavunchi, 1500 m., 23 Sep 1986, *K.M. Matthew et al. 46992* (E), Palani Ghat Road, below Perumal Peak (Rajamani Estate), 1600 m., 26 Aug 1987, *K.M. Matthew & N. Rajendran 46992* (E).

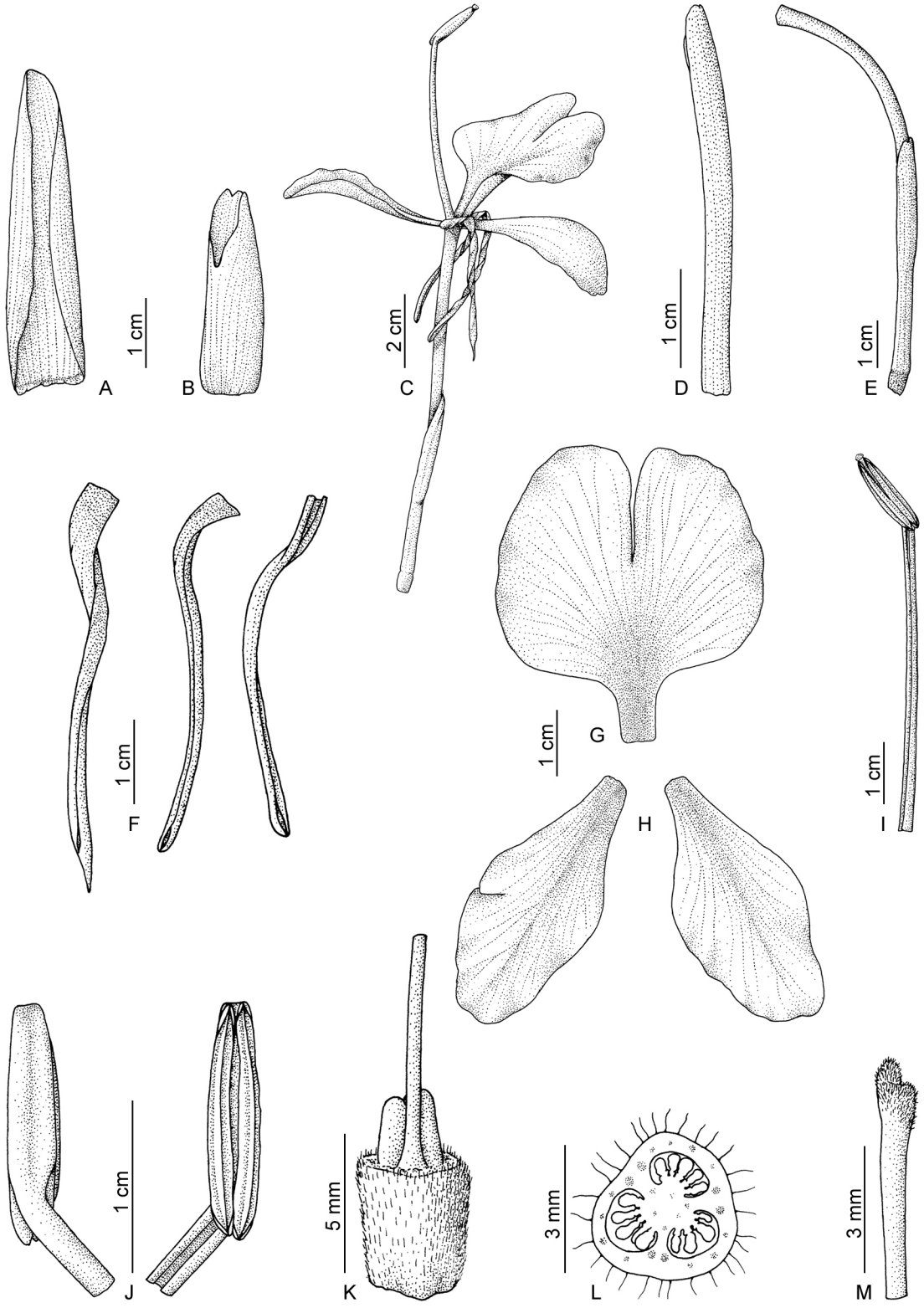

Figure 22. ***H. forrestii*** var. ***palaniense***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, back view (left) and front view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

H. forrestii var. No. 1

Type: INDIA. Mizoram., Champhai Dt., Murlen National Park, on the way to Vapar, 860 m., 25 Aug 2008, *A.V. Prasanth & M.C. Shameer 115418* (CALI).

(*Figure 23; Plate 13. E–H*)

Terrestrial, perennial rhizomatous herbs. *Rhizome* 2.6–3.4 cm wide, creamy white internally, slightly aromatic, covered by brown scales. *Leafy shoot* 100–150 cm high, slanting with erect inflorescence, robust. *Leaves* 10–13 in number, 6.8–10 cm apart, spreading, sessile; sheath *c.* 3 cm wide, margins green, membranous; ligule 3–3.5 x *c.* 2 cm, ovate, single-lobed, obtuse at tip, brown, pubescent externally, membranous, translucent, papery, closely appressed to the stem; lamina 46–58.5 x 8.8–12.7 cm, elliptic, dark green and glabrous above, pale green and sericeous below; margin undulate, membranous, translucent, white tinged, non-ciliate; tip long caudate, twisted; base cuneate; midrib more densely sericeous below. *Inflorescence* 15–20 cm long, cylindrical, moderately dense, erect. *Bracts* 5.7–6 x 2.8–3 cm, obovate, green with brown tinge, pubescent, coriaceous, convolute; margin non-ciliate, translucent, membranous, white, tip acute, cincinnus 2–4 -flowered. *Bracteoles* 2.6–2.7 x 1.9–2.2 cm (outer tubular at base), ovate, translucent, slightly 2 lobed at tip, pale green, white towards base, pubescent, outer one completely encircles the cincinnus. *Flower* 11.2–11.7 cm long, creamy-yellow with yellowish-brown blotch at centre of labellum, 5-many flowers open at a time, ascending. *Calyx* 4.2–4.4 cm long, *c.* 4 mm wide at mouth, pale green, pubescent, membranous, translucent, upper half gradually inflated, lower part closely appressed to corolla tube, unilaterally split upto 1–1.1 cm, 3-toothed at tip. *Corolla tube* 6.8–7 cm long, *c.* 5 mm wide at mouth, creamy-yellow, whitish towards base, hairy internally, bend to one side at centre. *Corolla lobes* oblanceolate, creamy-yellow, pale greenish tinged towards tip, membranous,

drooping from flower, glabrous, margins rolled inside, slightly coiled; dorsal lobe 4.3–4.4 x *c.* 0.6 cm, *c.* 4 mm long beaked at tip; lateral lobes 3.9–4 x *c.* 0.5 cm, very minutely beaked at tip. *Lateral staminodes* 3–3.2 x 0.9–1 cm, elliptic, clawed towards base, creamy-yellow, brown tinged at base, spreading on flower, reflexed back, margin undulate, slightly notched at tip. *Labellum* 3.1–3.2 x 2.6–2.7 cm, widely ovate, creamy-yellow, deep yellowish-brown at centre, spreading on flower, reflexed back on upper half, abruptly clawed at base; claw 3–4 mm wide; sinus 1–1.1 cm deep; margin undulate, lobes obtuse at tip. *Stamen* 4–4.3 cm long, slightly arching. *Filament* 2.9–3 cm long, *c.* 2 mm wide at base, yellowish-brown, slightly arching. *Anther* 1.4–1.5 x *c.* 0.3 cm, oblong, deep yellow, ciliate along thecae margins, split opens from top to bottom, attached with the filament at 3–4 mm above from base, thecae axis parallel with the filament; non-crested, tip slightly notched. *Ovary c.* 5 x 4–5 mm, oblong, yellowish-brown, sericeous externally. *Style* filiform, glabrous, pubescent towards tip, green tinged towards stigma. *Stigma c.* 1.5 mm wide, green, cup-shaped, stigmatic head pubescent, hairs hook-like, *c.* 2 mm exserted from the anther. *Epigynous glands* two, 3–3.5 mm long, oblong, yellow.

Notes: Closely allied to *H. forrestii* var*. latebracteatum* (confined to Vietnam only)*,* but differs from it in having brown tinged bracts with acute tip, longer corolla tube (6.8–7 cm), flowers creamy-yellow with yellowish-brown blotch at the centre of labellum and yellowish-brown filament.

Flowering: August–September.

Distribution: Known only from the type locality. (*Figure 24. B*)

IUCN Red list Category: Due to the extremely lesser area of occupancy and limited number of mature individuals it is assed against Critically Endangered (CR B1ab(i,ii,iv,v)+ 2ab(i,ii,iv,v); D; E) category as per IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

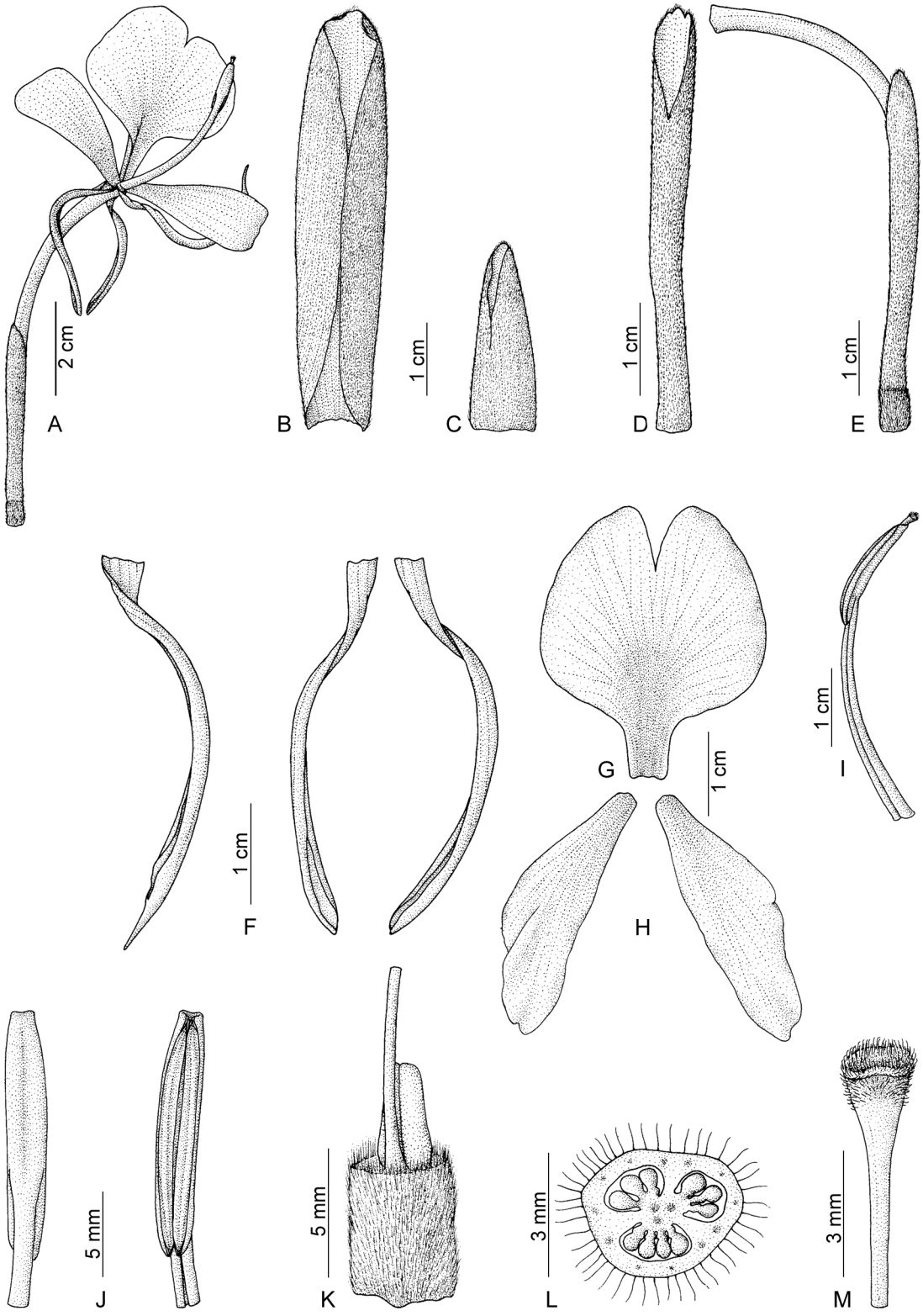

Figure 23. ***H. forrestii*** var. **No. 1**: **A.** single flower; **B.** bract; **C.** bracteole; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, back view (left) and front view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.



Plate 13. **A-D.** ***H. forrestii*** var. ***palaniense*****: A.** inflorescence; **B.** single flower, bract and bracteole; **C.** labellum and lateral staminodes; **D.** stamen. **E-H.** ***H. forrestii*** var. No. 1**: E.** inflorescence; **F.** single flower with bract; **G.** labellum and lateral staminodes; **H.** stamen.

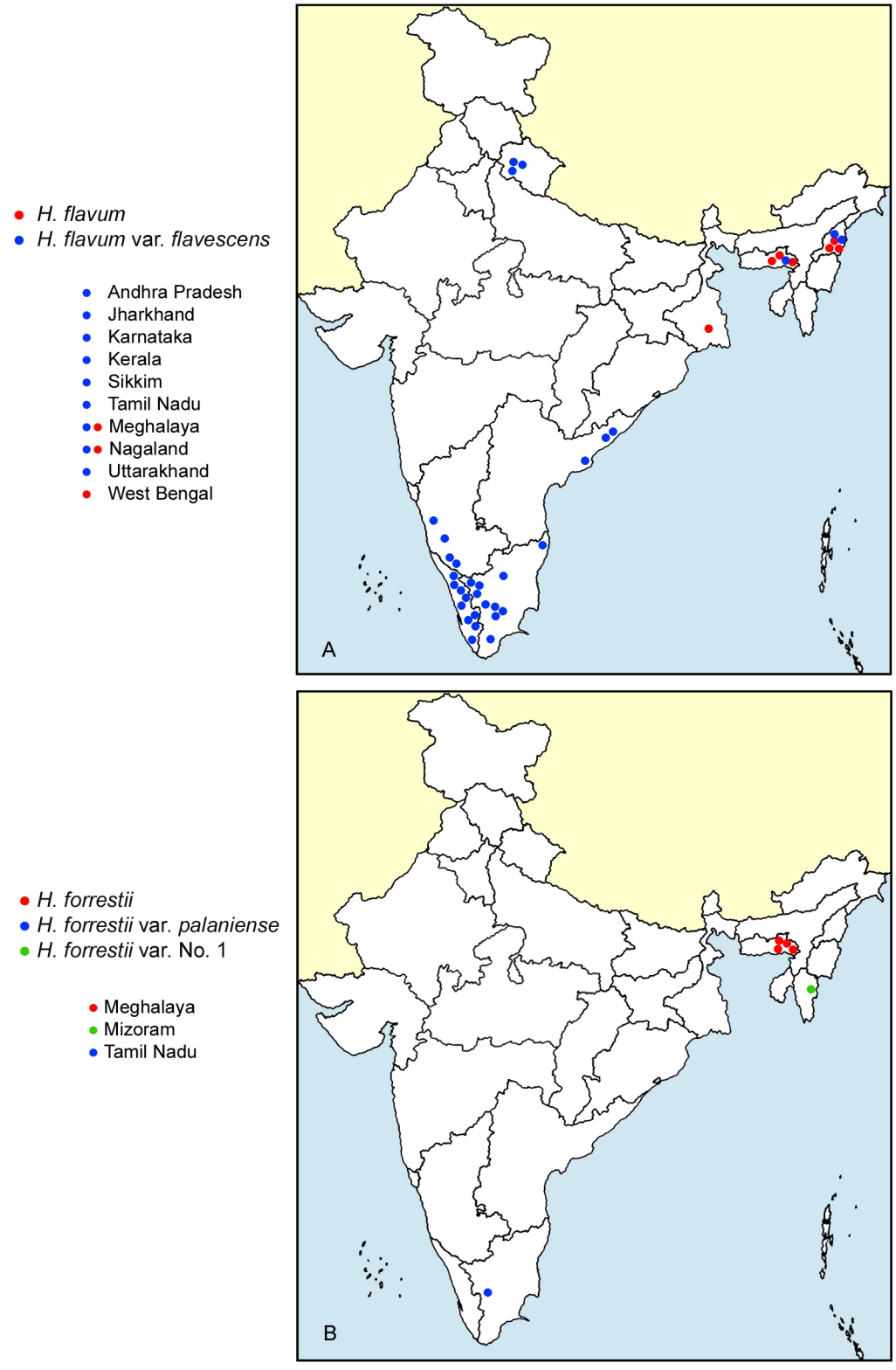

Figure 24. Distribution maps of ***H. flavum, H. flavum*** var. ***flavescens, H. forrestii, H. forrestii*** var. ***palaniense*** and ***H. forrestii*** var. No. 1.

H. gomezianum Wall. in W.J. Hooker, Hooker's J. Bot. Kew Gard. Misc. 5: 368. 1853, J. Hort. Soc. London 9: 20. 1855; C. Muell., Ann. Bot. Syst. 6: 25. 1861; Horan., Prodr. Monogr. Scitam. 25. 1862; Baker in J.D. Hooker, Fl. Brit. India 6: 228. 1892; K. Schum. in A. Engler, Pflanzenr. IV. 46(heft 20): 55. 1904; S.K. Jain & V. Prakash., Rheedea 5(2): 160. 1995.

Type: MYANMAR. Tavoy, 1827, *Gomez 340, Wallich 6543* (holo K!, Microfisch !).

(*Figure 25; Plate 14. A–D*)

Terrestrial, facultative epiphyte, perennial rhizomatous herbs. *Rhizome* 1.6–2.4 cm wide, creamy white internally, slightly aromatic, covered by brown scales. *Leafy shoot* 80–120 cm high, slanting with erect inflorescence. *Leaves* 10–14 in number, 3–6.5 cm apart, spreading, sessile; sheath 1.4–1.5 cm wide, margins white, membranous, translucent, pubescent; ligule 9–10 mm long, ovate, single-lobed, obtuse at tip, pale green, pubescent externally, membranous, translucent, papery, closely appressed to the stem; lamina 34.5–37 x 6.5–7.1 cm, elliptic, recurved back, dark green and glabrous above, pale green and puberulent below; margin undulate, membranous, translucent, white tinged, non-ciliate; tip long caudate, twisted; base cuneate; midrib pubescent below. *Inflorescence* 8–9 cm long, cylindrical, lax, erect. *Bracts* 2.8–3.1 x 0.9–1.1 cm, elliptic, green, strigose, sericeous towards tip margins, convolute; margin non-ciliate, translucent, membranous, white, tip acute, cincinnus 1-flowered. *Bracteoles* 1.1–1.3 x 0.35–0.4 cm, tubular, 0.5–1.3 cm deeply splited, translucent, pale green, glabrous, pubescent towards tip. *Flower* 9.5–9.8 cm long, creamy yellow, 5–7 flowers open at a time, ascending, slightly fragrant. *Calyx* 2.7–3 cm long, *c.* 3 mm wide at mouth, pale green, glabrous, pubescent at tip, membranous, translucent, closely appressed to corolla tube, unilaterally split upto *c.* 5 cm, 3-toothed at tip. *Corolla tube* 4.7–4.8 cm long, *c.* 2.5 mm wide at mouth, creamy yellow, white towards base, glabrous

externally, hairy internally, bend to one side. *Corolla lobes* oblanceolate, creamy yellow, membranous, early decaying at base, drooping from flower, glabrous; dorsal lobe 4.3–4.5 x *c.* 0.45 cm, *c.* 1.5 mm long beaked at tip; lateral lobes 4–4.3 x *c.* 0.4 cm, non-beaked at tip. *Lateral staminodes* 3.1–3.2 x 0.25–0.35 cm, narrow oblanceolate, clawed towards base, creamy yellow, deep creamy tallow towards base, spreading on flower, reflexed back. *Labellum* 2.6–2.7 x *c.* 0.8 cm, oblanceolate, creamy yellow, dark coloured towards base, erect on flower, reflexed back on upper half, base attenuate, gradually clawed at base; claw *c.* 2 mm wide; sinus tip 8–9 mm deep; lobes acute at tip. *Stamen* 4.7–4.9 cm long, slightly arching. *Filament* 3.7–3.8 cm long, *c.* 1.5 mm wide at base, red, pale coloured towards base, slightly arching. *Anther c.* 1.2 x 2 mm, elliptic, red, curved back, split opens from top to bottom, attached with the filament at 2.5–3 mm above from base, thecae axis parallel with the filament; connective red, glabrous, non-crested, tip slightly notched. *Ovary c.* 4 x 3.5 mm, oblong, yellow-green, densely pubescent externally. *Style* filiform, white, glabrous, green tinged towards stigma. *Stigma c.* 1.5 mm wide, green, cup-shaped, slanting with a depression at center, pubescent, hairs hook-like, *c.* 1 mm exserted from the anther. *Epigynous glands* two, *c.* 2.5–3 mm long, oblong, yellow.

Notes: H. gomezianum Wall. is a little known species described by Wallich (1853), in honour of the collector 'Gomez', on the basis of *Wallich 6543* (*Gomez 340,* K!). Gomez collected this specimen from Tavoy, Myanmar in 1827 and denoted as *H. tavoyanum*. While describing the species he was doubtful about the true epiphytic nature of the species, and mentioned that "I have myself at times found decidedly terrestrial species growing both on trees and rocks". It is quite common that epiphytic species grows well on rocks also. Subsequently it appeared in Wallich (1855), Mueller (1861), Horaninow (1862), Baker (1892), Schumann (1904) *etc.*

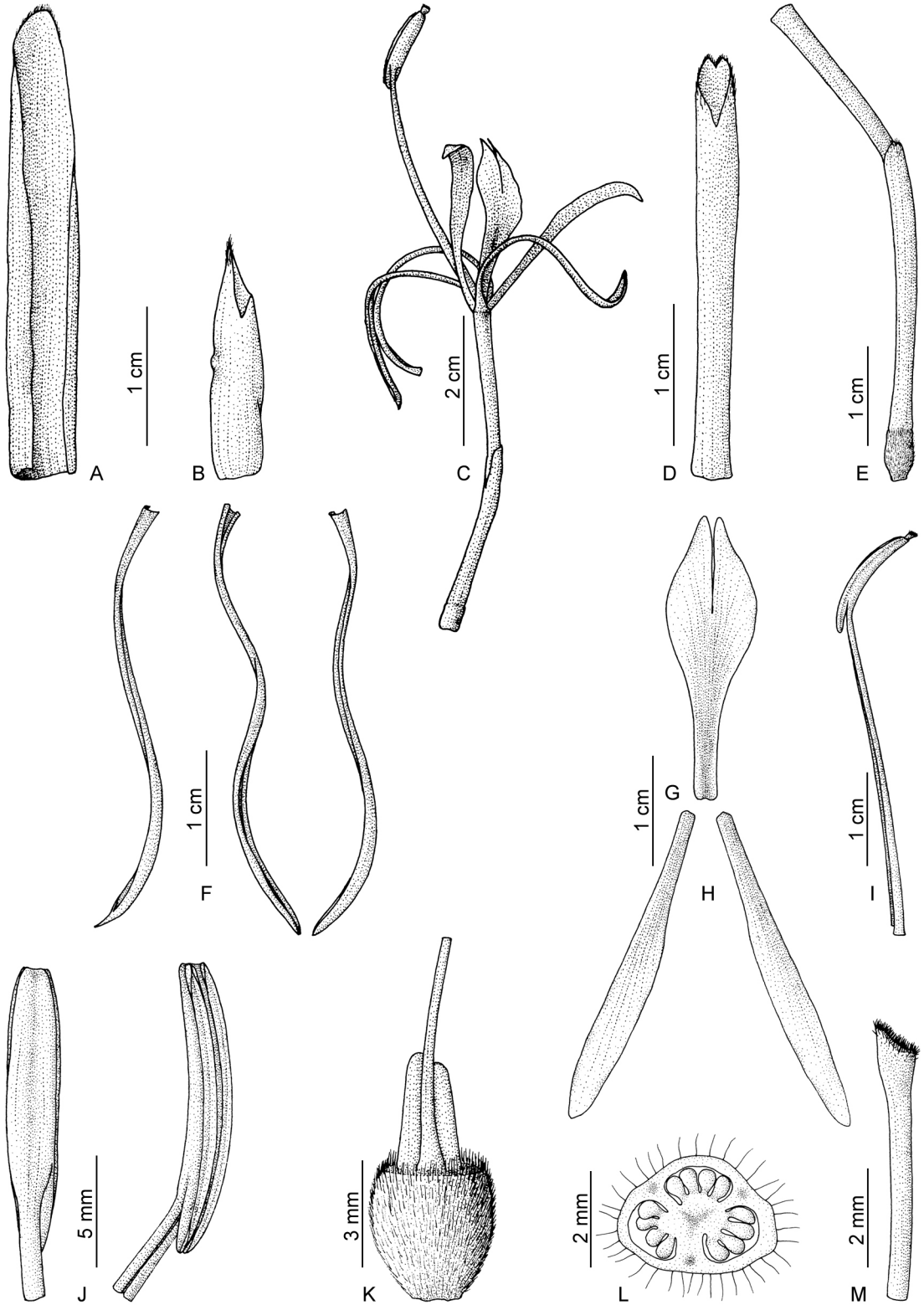

Figure 25. ***H. gomezianum***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, back view (left) and lateral view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

Horaninow (*l.c.*) and Schumann (*l.c.*) interpreted Gomez's epithet, *H. tavoyanum* as *H. javoyanum* and placed under '*Species Indescriptae'* and *'Species Incertae Sedis' respectively*.

Baker (*l.c.*) and Schumann (*l.c.*) described it as an epiphytic species. But our observations in the field revealed that, it shows facultative epiphytic nature.

Flowering: August–November.

Distribution: Mainly distributed in India, Southern Myanmar, Thailand and southern Cambodia. In India it is distributed in Arunachal Pradesh, Manipur and Nagaland. (*Figure 29. A*)

IUCN Red list Category: This species has been distributed very sparsely with geographically well separated subpopulations and having a very lesser area of occupancy, hence it is categorized as Critically Endangered (CR B1b(i,ii,iv)+ 2b(i,ii,iv); E) as per IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA**. **ARUNACHAL PRADESH**. LOHIT Dt.: Dreyi to Shoeliang, 1200–1625 m., 13 Nov 1957, *R.S. Rao 10487* (ASSAM). **MANIPUR**. IMPHAL Dt.: Imphal, Nongmeigin 4000 ft., 2 Aug 1853, *D.B. Deb 819* (CAL). **NAGALAND**. KOHIMA Dt.: Jotsoma, 31 Aug 2006, *E. Sanoj & V.P. Thomas 105572* (CALI).

12 Hedychium gracile

H. gracile Roxb., [Hort. Beng. 1814, *nom. nud*.] Pl. Coromandel 3: 48. 1820, Fl. Ind. ed. Carey, 1: 12. 1820 (rep. 1: 14. 1832); Roem. & Schult., Mant. Syst. Veg. 15. 1822; Spreng., Syst. Veg. 1: 9. 1825; Roscoe, Monandr. Pl. Scitam. 1828; A. Dietr., Sp. Pl. 1: 33. 1831; Paxton, Paxton's Mag. Bot. 4: 203. 1838; D. Dietr., Syn. Pl. 1: 9. 1839; Wall. in W.J. Hooker, Hooker's J. Bot. Kew Gard.

Misc. 5: 367. 1853, J. Hort. Soc. London 9: 19. 1855; C. Muell., Ann. Bot. Syst. 6: 24. 1861; Horan., Prodr. Monogr. Scitam. 25. 1862; Hook. f., Bot. Mag. 108: t. 6638. 1882; Baker in J.D. Hooker, Fl. Brit. India 6: 229. 1892; K. Schum. in A. Engler, Pflanzenr. IV. 46(heft 20): 56. 1904; Weathers, Bulb Book 269. 1911; J.N. Mitra, Monocot. E. India 1: 242. 1958; Naik & Panigrahi, Bull. Bot. Surv. India 3(1): 72. 1961; A.S. Rao & D.M. Verma, Bull. Bot. Surv. India 11(1&2): 123. 1969, 14(1-4): 132. 1972; N.P. Balakr., Fl. Jowai 2: 529. 1983; Karthik. et al., Fl. Ind. Enum. Monocot. 295. 1989; S.K. Jain & V. Prakash., Rheedea 5(2): 160. 1995; S. Kumar, Zingber. Sikkim 53. 2001; M. Sabu & Pradeep, Folia Malaysiana 6(1&2): 8. 2005.

Lectotype & Epitype (designated here): Roxburgh, Pl. Coromandel 3: t. 251. 1820 *pro parte* (drawing of a single flower and leaf at lower right bottom corner of *H. angustifolium*) (lecto). Silhet, E.I.C*., Wallich 6546 A* (epi E!).

H. glaucum Roscoe, Monandr. Pl. Scitam. 1/2: t. 53. 1824; Paxton, Paxton's Mag. Bot. 4: 204. 1838; K. Schum. in A. Engler, Pflanzenr. IV. 46(heft 20): 57. 1904; Naik & Panigrahi, Bull. Bot. Surv. India 3(1): 72. 1961; R.M. Sm. in A.J.C. Grierson & D.G. Long, Fl. Bhutan 2: 203. 1991; Press et al., Annot. Checkl. Fl. Pl. Nepal 330. 2000.

Type: Roscoe, Monandr. Pl. Scitam. 1/2: t. 53. 1824.

H. gracile var*. glaucum* (Roscoe) Horan., Prodr. Monogr. Scitam. 25. 1862; Baker in J.D. Hooker, Fl. Brit. India 6: 229. 1892;

H. viridiflorum C.B. Clarke, Gard. Chron. 2: 406. 1881.

Lectotype (designated here)*:* Hook. f., Bot. Mag. 108: t. 6638. 1882.

(*Figure 26; Plate 14. E–H*)

Terrestrial, perennial rhizomatous herbs. *Rhizome* 1.3–2.4 cm wide, creamy white internally, slightly aromatic. *Leafy shoot* 50–93 cm high, slanting or erect with erect inflorescence, slender. *Leaves* 10–14 in number, 5–8.4 cm apart, spreading, sessile; sheath 1.4–2 cm wide, margins green, membranous, translucent; ligule 2–2.5 mm long, ovate, single-lobed, truncate at tip, pink, pubescent towards tip, membranous, translucent, papery, closely appressed to the stem; lamina 19–28.3 x 4–7 cm, elliptic, bright green above, pale green below, glabrous; margin undulate, membranous, translucent, white tinged, non-ciliate; tip long caudate, twisted; base cuneate, slightly oblique. *Inflorescence* 13–21.5 cm long, lax, erect; rachis glabrous. *Bracts* 1.2–2 x 0.4–0.5 cm, lanceolate-oblanceolate, green, glabrous, puberulent towards base, convolute; margin non-ciliate, ciliate at tip, hyaline, membranous, white, tip obtuse, cincinnus 1-flowered. *Bracteoles* 0.8–1.1 x 4–5.5 cm, tubular, hyaline, tip obtuse, pale green, glabrous, membranous. *Flower* 5.3–7.3 cm long, white with reddish-pink stamen, many flowers open at a time, ascending, slightly fragrant. *Calyx* 1.4–2 cm long, *c.* 2 mm wide at mouth, pale greenish yellow, glabrous, sparsely pubescent at base, membranous, translucent, closely appressed to corolla tube, unilaterally split upto 1.2–1.4 cm, obscurely 3-toothed at tip. *Corolla tube* 1.5–2.3 cm long, *c.* 2 mm wide at mouth, white, creamy towards tip, hairy internally, more or less straight. *Corolla lobes* 3.2–3.4 cm long, narrow oblanceolate, creamy-white, membranous, early decaying at base, drooping from flower, glabrous; dorsal lobe *c.* 1 mm long beaked at tip; lateral lobes non-beaked at tip. *Lateral staminodes* 1.9–2.5 x 0.2–0.3 cm, narrow elliptic, white, spreading on flower, reflexed back, outer margin undulate, tip acute. *Labellum* 1.7–2.4 x 0.7–0.9 cm, elliptic, white, spreading on flower, reflexed back on upper half, gradually clawed at base; claw *c.* 3 mm wide; sinus 1.2–1.5 cm deep; outer margin undulate, lobes acute at tip. *Stamen* 3.5–4.5 cm long, slightly arching. *Filament* 2.9–3.6 cm long, *c.* 1 mm wide at base, reddish-pink, paler towards base, slightly arching. *Anther* 0.9–1 x 0.1–0.2 cm, oblong, split opens from top to bottom, attached with the filament at 1.5–2 mm above from base, thecae axis at parallel with the filament; connective reddish-pink, glabrous, non-crested, tip truncate.

Ovary 2–2.5 x 1.5–2 mm, oblong, pale green, pubescent externally. *Style* filiform, white, glabrous, green tinged towards stigma. *Stigma c.* 1 mm wide, green, cup-shaped, slanting with a depression at center, ciliate, hairs hook-like, *c.* 1 mm exserted from the anther. *Epigynous glands* two, 2–2.5 mm long, oblong, creamy yellow.

Notes: The name *H. gracile* was first applied by Roxburgh in his *Hortus Bengalensis* (1. 1814) to a plant called by natives as *'Kattea laffear',* which was collected by M.R. Smith in 1811 from Silhet, NE Bangladesh. Subsequently, it was described in *Plants of the Coast of Coromandel* (Roxburgh 1820) by providing a description and a figure of a single leaf and dissected flower. In *Flora Indica* (1820), he mentioned it as a slender species with about three feet high and the native of Garo Hills ("*Garrow*").

The type of this species in the *Coromandel Plants* (Roxburgh 1820) is an outline of a single leaf and a dissected flower, in the right bottom corner of the illustration of *H. angustifolium* (t. 251). It shows a very short stamen, which is equal to the corolla lobes and lateral staminodes, and the labellum is half the length of stamen. The type description by Roxburgh did not mention the stamen length.

Subsequently, Roscoe (1824) described a similar plant with rather longer stamen as *H. glaucum*. But he has also mentioned that "diversities too striking to permit us to consider them as the same species". He distinguished this species from *H. gracile* on the size of the stamen as shown in the illustration.

Later, Wallich (1853), who knows well about the Roxburgh's *H. gracile*, kept *H. glaucum* as the synonym of the former. It is evident from Wallich's statement ("I have before me a large number of specimens in all stages, particularly those collected by Dr. Hooker and Thomson; which, although differing apparently among themselves, I am unable to distinguish even as varieties") that, there is a great variation within the species.

Baker (1892) considered *H. glaucum* as the variety of *H. gracile,* whereas Schumann (1904) followed Roscoe (*l.c.*) and treated them as distinct species. Baker (*l.c.*) and Schumann (*l.c.*) distinguished *H. glaucum* from *H. gracile* in having more robust and larger in all floral parts. Our experience with a large number of live and herbarium specimens throughout its distributional range, agree with Wallich's observations and treat them as conspecific.

Another new species, *H. viridiflorum* was published by Clarke in *Gardeners' Chronicle* (16: 406. 1881) based on a plant introduced from Sikkim to Kew. He had also mentioned that it will soon appear in the *Botanical Magazine*. Whereas J.D. Hooker identified this species as *H. gracile* and described in *Botanical Magazine* (Bot. Mag. 108. 6638. 1882) with *H. glaucum* and *H. viridiflorum* as its synonyms. He also concurred with Wallich (*l.c.*) in the reduction of *H. glaucum* and he also provided description and an excellent colour drawing of the species.

Typification: We could not trace out the specimens of M.R. Smith in any of the herbaria like BM, CAL, E and K. In this context, we selected the illustration of Roxburgh (*l.c.*), *i.e.,* the outline of a single leaf and a dissected flower in the right bottom corner of the illustration of *H. angustifolium* (t. 251. 1820) in the Coromandel Plants, as lectotype. Since this figure does not fit the protologue well, another specimen, *Wallich 6546 A* (E!) is selected here as an epitype to support the interpretation of the lectotype.

Flowering & Fruiting: July–September.

Distribution: Distributed in India, Nepal, Bhutan, Myanmar and Bangladesh. In India it is widely reported from Arunachal Pradesh, Meghalaya, Sikkim and West Bengal at an altitude of 1,200–2,500 m. (*Figure 29. B*)

IUCN Red list Category: Due to wider geographical range of occurrence and fairy good population size, this species will not face any risk of extinction in the wild in the immediate future. Hence it is assessed against Least Concern (LC) category as

per IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA**. **ARUNACHAL PRADESH**. EAST KAMENG Dt.: 5 Km. from Seppa towards Bomdila, 11 Aug 2003, *M. Sabu & A.K. Pradeeep 92547* (CALI). DIBANG VALLEY Dt.: Mayudya, 2500 m., 14 Aug 2000, *M. Bhaumik 2841* (CAL); Hunli, 1800 m., 21 Aug 2000, *M. Bhaumik 2985* (CAL). KAMENG Dt.: Sissini, 13 Oct 1955, *R.S. Rao 1247* (ASSAM, CAL). WEST KAMENG Dt.: Bomdila, 6 km towards Tenga Valley, 14 Oct 1964, *J. Joseph 39929* (ASSAM). **ASSAM**. NORTH CACHAR HILLS Dt.: Garampani to Raliang Road, 1200 m., 21 Aug 1968. *N.P. Balakrishnan 46932* (ASSAM). **MEGHALAYA**. Khasia, *J.D. Hoker & J. Thomson s.n.* (MH, CAL); 5-6000 ft., *J.D. Hooker & J. Thomson s.n.* (right side material only) (K); *s.loc., Native collectors of Bot. Garden Calcutta s.n.* (E). EAST KHASI HILLS Dt.: Cherrapunji, 4000 ft., 2 Jun 1911, *I.H. Burkill & S.C. Banerjee 35124* (CAL); Behind the Circuit House, Cherrapunji, 27 Oct 1956, *G. Panigrahi 3453* (ASSAM); Bishops Falls, 11 Sep 1970, *P.K. Hajra 38663* (CAL). RI-BHOI Dt.: Umsaw, 4000 ft., 20 Sep 1959, *G.K. Deka 19067 B* (ASSAM), *G.K. Deka 19067* (CAL, ASSAM). JAINTIA HILLS Dt.: Jorain, 30 May 1965, *N.P. Balakrishnan 42271* (ASSAM). **SIKKIM**. EAST SIKKIM Dt.: Waldern, 1000-1600 m., *Griffith 5672* (CAL); 10 km from Gangtok towards Mangan, 22 Aug 2004, *M. Sabu & A.K. Pradeep 92717* (CALI); 4 Km. towards Gangtok from Ranipool, 21 Aug 2004, *M. Sabu & A.K. Pradeeep 92710* (CALI). NORTH SIKKIM Dt.: Lachung Valley, 1000 ft., 19 Aug 1909, *Smith & Cave 2580* (CAL). **WEST BENGAL**. DARJEELING Dt.: Darjeeling, 11 Aug 1893, *J.M. Cowan s.n.* (E), 4500 ft., 30 Aug 1875, *C.B. Clarke 27281* (CAL); Mungpoo, 3500 ft., Sep 1875, *J.S. Gamble s.n.* (CAL); Below Darjeeling, 6000 ft., *S. Kurz s.n.* (CAL); Teesta Valley, 1355 m., N 27°03.826", E 88°22.956", 25 Aug 2004, *M. Sabu & A.K. Pradeeep 92746* (CALI); Great Rangeet, 2500 ft., 16 Aug 1862, *T. Anderson 1278* (CAL); Kalimpong 4-5000 ft., 22 Sep 1914, *Thornton Riply 95* (CAL); Labdah, 5000 ft., 30 Jul 1884, *G.A. Gammie s.n.* (CAL); Rungbee, 5000 ft., 25 Aug 1870, *C.B. Clarke 12479* (CAL). *Locality unknown. Shepherd s.n.* (K); *Griffith 5675* (CAL); 21 Aug 1857, *Cole s.n.* (CAL); 3500 ft., Aug 1874, *s.coll., s.n.* (CAL); 1875-6, *G. King s.n.* (CAL); 4-6000 ft., *J.D. Hooker & J. Thomson s.n.* (CAL); 1876, *s.coll. s.n.* (CAL); 5000 ft., 31 Aug 1974, *G. King s.n.* (CAL).

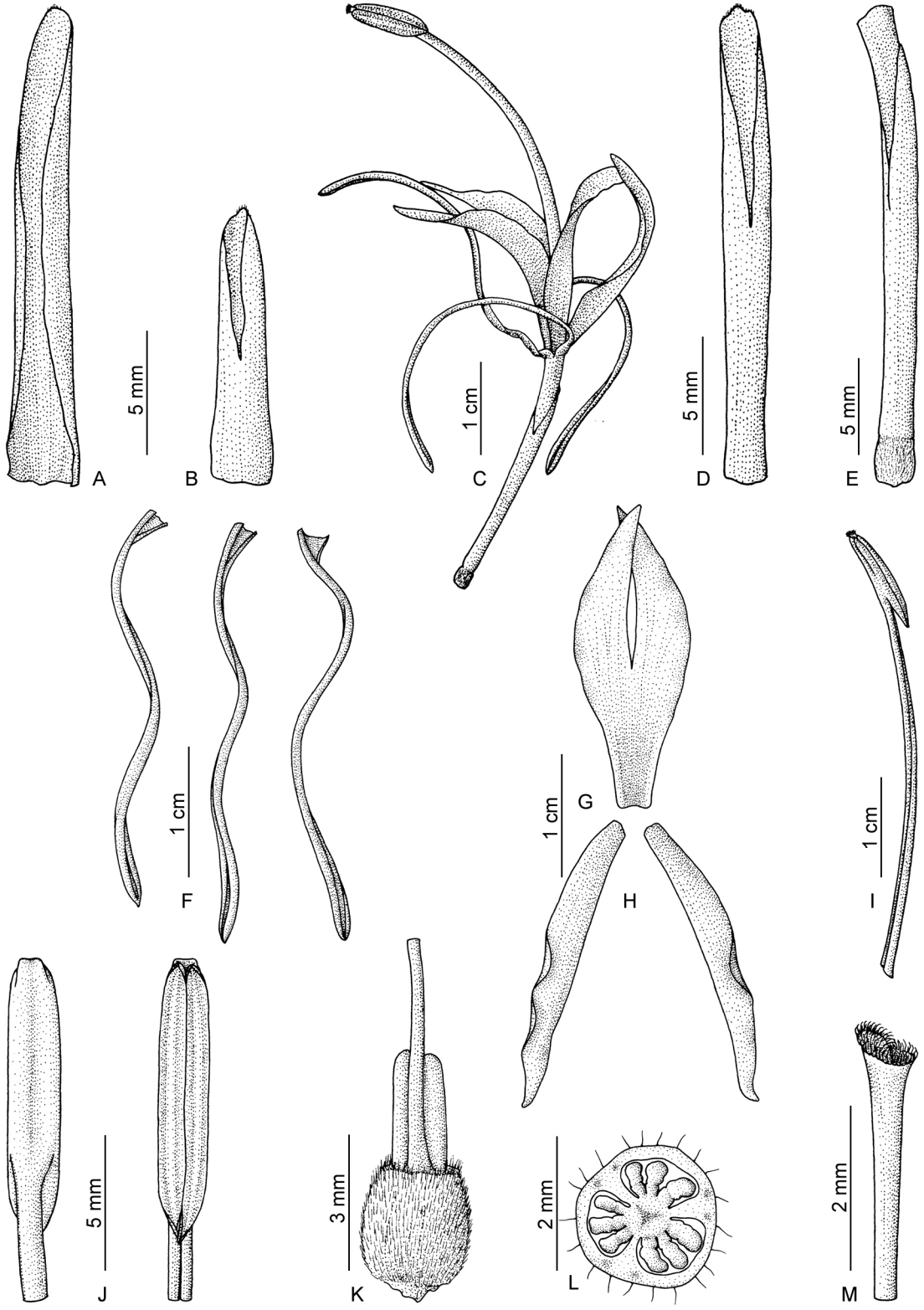

Figure 26. ***H. gracile***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, back view (left) and front view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

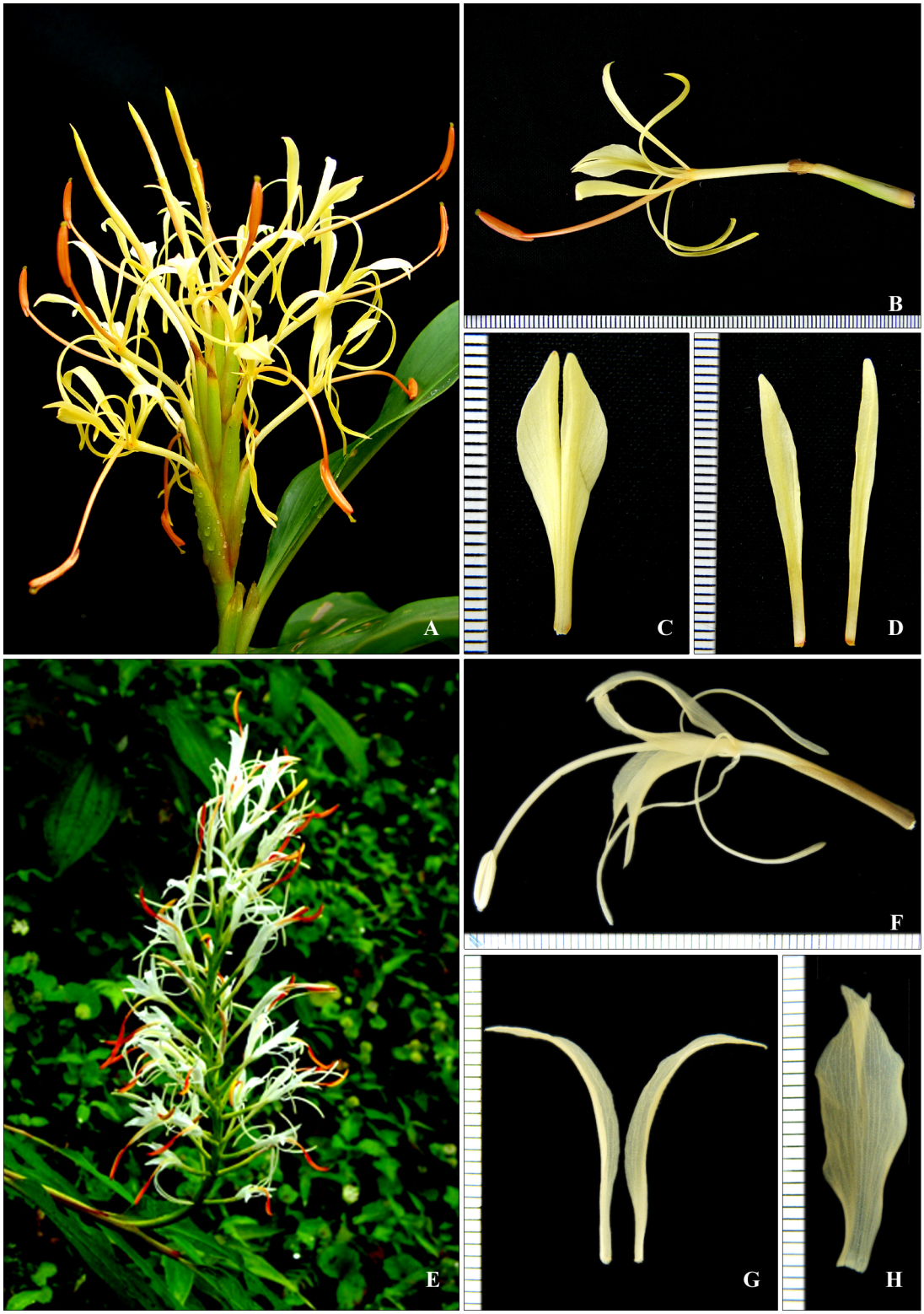

Plate 14. **A-D.** ***H. gomezianum*****: A.** inflorescence; **B.** single flower with bract; **C.** labellum; **D.** lateral staminodes. **E-H.** ***H. gracile*****: E.** inflorescence; **F.** single flower with bract; **G.** lateral staminodes; **H.** labellum (**F-H** -from pickled specimens).

Key to the varieties of *H. gracile*

1a. Rachis densely pubescent; flowers and filament creamy-yellow……. var. No. **1**

1b. Rachis glabrous; flowers white; filament reddish-pink…….…… 2

2a. Corolla tube 3–5 mm longer than bracts…….. var. ***gracile***

2b. Corolla tube 1–1.9 cm longer than bracts……. var. ***calcaratum***

12a **Hedychium gracile** var. **calcaratum**

H. gracile var. ***calcaratum*** (A.S. Rao & D.M. Verma) Sanoj & M. Sabu, *stat. nov.*

H. calcaratum A.S. Rao & D.M. Verma, Bull. Bot. Surv. India 11(1&2): 120. 1969; 14(1-4): 133. 1972; N.P. Balakr., Fl. Jowai 2: 530. 1983; S.C. Srivast. in S.K. Jain & R.R. Rao, Threat. Pl. India 236. 1983; Karthik. et al., Fl. Ind. Enum. Monocot. 294. 1989; S.K. Jain & V. Prakash., Rheedea 5(2): 160. 1995.

Type: INDIA. Meghalaya. Jowai-Bodarpur Road, 96 km from Shillong, 22 Jul 1957, *G.K. Deka 10134* (holo CAL!; iso ASSAM!).

H. gracillimum A.S. Rao & D.M. Verma, Bull. Bot. Surv. India 11(1&2): 124. 1969, *syn. nov.,* 14(1-4): 132. 1972; S.C. Srivast. in S.K. Jain & R.R. Rao, Threat. Pl. India 236. 1983; Karthik. et al., Fl. Ind. Enum. Monocot. 295. 1989; S.K. Jain & V. Prakash., Rheedea 5(2): 160. 1995.

*Type***:** INDIA. Meghalaya., East Khasi Hills Dt., From cultivated plant in garden of Eastern Circle, Botanical Survey of India, Shillong, original plant collected in Pynursla, 1 Jul 1967, *D.M. Verma 35650* (holo CAL!).

(*Figure 27; Plate 15. A–E*)

Terrestrial, perennial rhizomatous herbs. *Rhizome* 2–2.9 cm wide, creamy whitish internally, slightly aromatic. *Leafy shoot* 50–80 cm high, erect or slanting

with erect inflorescence. *Leaves* 6–9 in number, 4.9–6 cm apart, spreading; petiole 6–9 mm long; sheath 0.8–1 cm wide, margins red, glabrous; ligule 2–4 x *c.* 1 cm long, 2-lobed or deeply notched at tip, green, pale red tinged, glabrous; lamina 18.5–29.5 x 4.3–5.3 cm, elliptic, dark green above, pale green, glabrous; margin undulate, membranous, translucent, white tinged, non-ciliate; tip long caudate, twisted; base long cuneate; midrib glabrous. *Inflorescence* 7–12 cm long, cylindrical, lax, erect, rachis glabrous. *Bracts* 1.3–2.1 x 0.55–0.75 cm, elliptic, green, glabrous, convolute, non-imbricatie; margin non-ciliate, translucent, membranous, white, tip obtuse or slightly notched, cincinnus 1-flowered. *Bracteoles* 0.6–1.1 x 0.2–0.3 cm, tubular, membranous, translucent, closely appressed to tube, pale green, glabrous, margins non-ciliate, unilaterally split upto 4–6 mm deep. *Flower* 6.5–7.4 cm long, white with pinkish red stamen, many flowers open at a time, ascending. *Calyx* 2.1–2.6 cm long, *c.* 2 mm wide at mouth, white, pale yellowish towards tip, glabrous, membranous, translucent, closely appressed to corolla tube, unilaterally split upto 1.1–1.2 cm, 3-toothed at tip. *Corolla tube* 2.7–3.4 cm long, *c.* 2.5 mm wide at mouth, white, pale yellowish towards tip, glabrous, hairy internally, slightly arching. *Corolla lobes* narrowly oblanceolate, pale yellow, whitish towards base, membranous, drooping from flower, glabrous; dorsal lobe 2.8–3.2 x *c.* 0.4 cm, *c.* 1 mm long beaked at tip; lateral lobes 2.6–2.7 x *c.* 0.3 cm, non-beaked at tip. *Lateral staminodes* 2–2.6 x 0.2–0.3 cm, oblique, narrowly elliptic, white, spreading on flower. *Labellum* 2–2.4 x 0.8–1.2 cm, elliptic, white, spreading on flower, upper half reflexed back, base long cuneate, gradually clawed at base; claw c. 2.5 mm wide; sinus 1.1–1.6 cm deep; lobes tip acute. *Stamen* 3.2–3.7 cm long. *Filament* 2.5–3 cm long, *c.* 1.5 mm wide at base, reddish-pink, slightly curved back. *Anther c.* 0.9–1.1 x 0.2 cm, oblong, oblong, base attenuate, creamy white at openings, split opens from top to bottom, attached with the filament at *c.* 3 mm above from base, thecae axis parallel with the filament; connective pink, glabrous-pubescent, non-crested, tip slightly notched; connective pinkish red; thecae orange. *Ovary c.* 2.5–3 x 2–2.5 mm, oblong, pale green, glabrous, angular. *Style* filiform, white, glabrous, yellow-greenish towards stigma. *Stigma c.* 1 mm wide, yellow-green, cup-shaped,

slanting with a depression at center, pubescent, hairs hook-like, *c.* 1 mm exserted from the anther. *Epigynous glands* two, 2–3.5 mm long, oblong, yellow.

*Note*s: *H. calcaratum* was described by Rao and Verma (*l.c.*) based on solitary collection of Deka from Jowai-Bodorpur Road, Meghalaya (*G.K. Deka 10134,* CAL, ASSAM). While describing the species, original authors compared it with *H. stenopetalum* and distinguished from it in having shorter spikes, 1-flowered bracts, much longer corolla tube than the bracts, smaller lip and stamen, smaller and broader staminodes. While examining the types at CAL and ASSAM we found that, flowers are very badly preserved in the types, making the study impossible. The comparison of types, protologue and the illustration of *H. calcaratum* with large number of live and herbarium specimens of *H. gracile* revealed that, the differences are not sufficient to distinguish it as a species, and hence *H. calcaratum* is reduced as a variety of the *H. gracile*.

H. gracillimum was described by Rao and Verma (1969a), along with *H. calcaratum*, based on a cultivated material at experimental garden at Woodlands introduced from Pynursla, Meghalaya. It is closely allied to the well known species, *H. gracile,* but differs from it, in having rather longer corolla tube, which is much exserted from the bracts and calyx. Detailed studies on large number of live specimens and herbarium specimens at herbaria like ASSAM, BM, CAL, CALI and E revealed that, *H. calcaratum* and *H. gracillimum* are conspecific, but differ in having slightly longer flowers with shorter bract, bracteoles and corolla tube. It is considered only as mere accidental variant and is reduced as a new synonym of *H. gracile* var. *calcaratum*.

Flowering: June–September.

Distribution: Occurs in Sothern Bhutan and India. In India, distributed in Meghalaya and Arunachal Pradesh at an altitude of 1,100-2,400 m. (*Figure 29. B*)

IUCN Red list Category: In India it is distributed in Meghalaya and Arunachal Pradesh and in wild it is facing a very high risk of extinction in the immediate

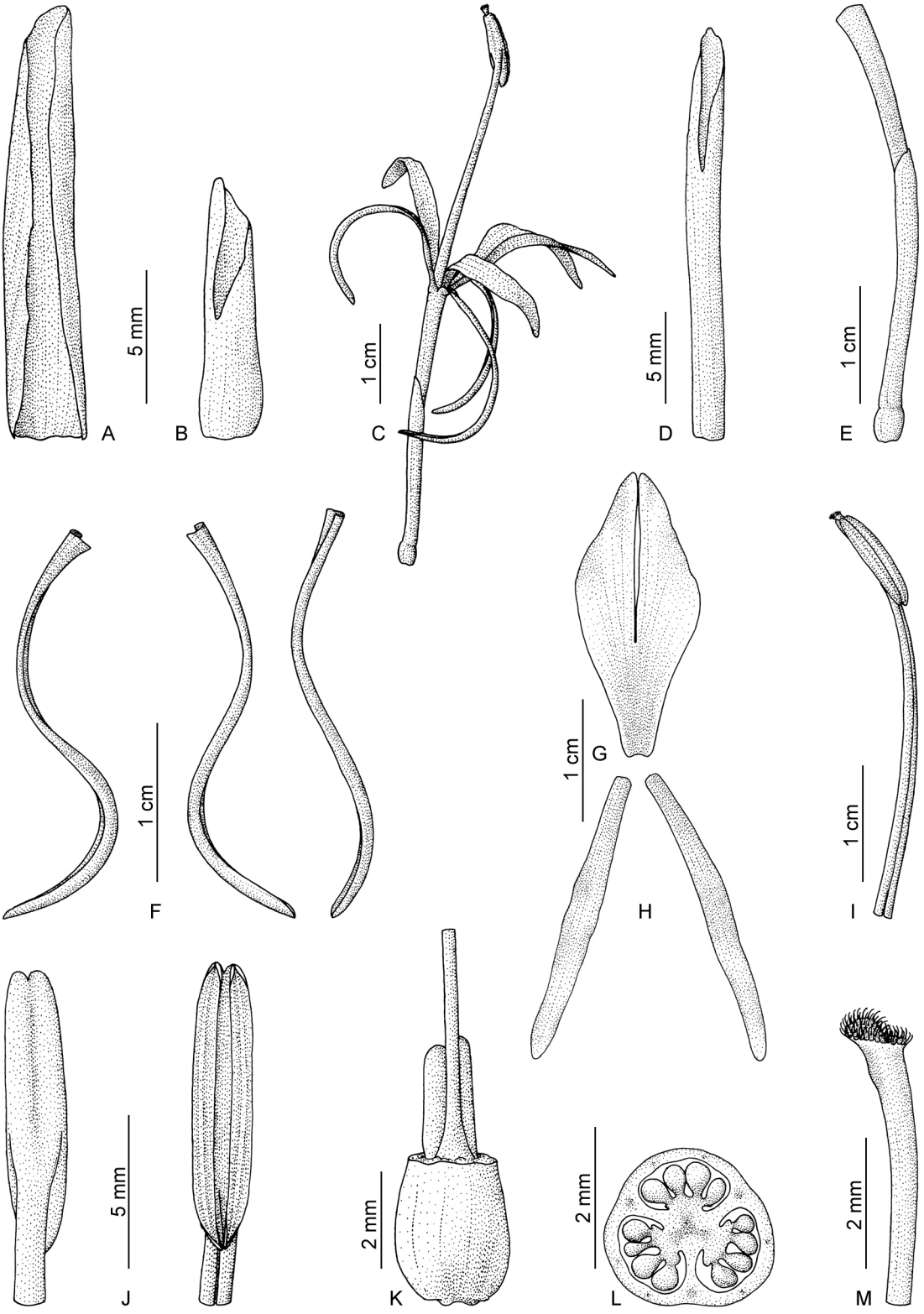

Figure 27. ***H. gracile*** var. ***calcaratum***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, back view (left) and front view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

future. Hence it is assessed against Endangered (EN A2a; B1b(i,ii)+2b(i,ii); E) category as per IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA**. **ARUNACHAL PRADESH**. DIBANG VALLEY Dt.: Brango, Nera Mipi, 1500 m., 23 Jun 2002, *M. Bhaumik 3986* (ASSAM). **MEGHALAYA**. Khasia, 4-5000 ft., *J.D. Hooker & J. Thomson s.n.* (K); Khasia, Kullong, 23 Aug 1885, *C.B. Clarke 40006* (BM). EAST KHASI HILLS Dt.: Cherrapunji, near Circuit House, 7 Jun 1956, *G.K. Deka 170* (ASSAM); Cherrapunji, 16 May 1950, *G.K. Deka 23085* (ASSAM); Woodlands, Shillong, introduced from Pynursla, 12 Jul 1966, *D.M. Verma 35603* (ASSAM), 21 Aug 1967, *D.M. Verma 35672* (ASSAM), 13 Jun 1968, *D.M. Verma 35687 C* (CAL, ASSAM); Shillong, BSI Surroundings, 1470 m., 12 Aug 2004, *E. Sanoj 95601* (CALI); Forest round about Mawmluh village near Cherrapunji, 3 Jun 1956, *R.S. Rao 2688* (ASSAM, CAL). JAINTIA HILLS Dt.: Way to Ladrymbai, Jowai, 1338 m., N 25°25.576', E 092°17.614', 16 Aug 2007, *E. Sanoj & T. Rajesh Kumar 95191* (CALI); Jowai, Muthlong, way to Garampani, 1374 m., N 25°28.414', E 092°19.135', 12 Aug 2007, *E. Sanoj & T. Rajesh Kumar 95171* (CALI); Jowai, Way to Dawki, 1280 m., N 25°26.241', E 092°11.329', 17 Aug 2007, *E. Sanoj & T. Rajesh Kumar 94910* (CALI); Jowai-Jorain, 1580 m., *E. Sanoj 95616* (CALI). *Locality unknown. Wallich 6546 B* (BM).

12b **Hedychium gracile** var. No. 1

H. gracile var. No. 1

Type: INDIA. Arunachal Pradesh, East Kameng Dt., 5 Km. from Seppa towards Bomdila, 1600 m., 11 Aug 2003, *M. Sabu & A.K. Pradeeep 92550* (holo CAL; iso CALI, MH). (*Figure 28; Plate 15. F & G*)

Terrestrial, perennial rhizomatous herbs. *Rhizome* 1.5–1.8 cm wide, creamy white internally, slightly aromatic, covered by brown scales. *Leafy shoot* 45–55 cm

high, slanting with erect inflorescence. *Leaves* 8–13 in number, 4–5 cm apart, spreading; shortly petiolate, petiole 6–10 mm long; sheath 6–8 mm wide, margins purple, membranous, glabrous; ligule 3 x *c.* 5 mm, truncate or notched at tip, pink red, glabrous, membranous, translucent, papery, closely appressed to the stem; lamina 14–17.5 x *c.* 8.3 cm, oblong-lanceolate, dark green above, purple or green below, glabrous; margin undulate, membranous, translucent, purple tinged, non-ciliate; tip long caudate, twisted; base cuneate. *Inflorescence* 12–15 cm long, cylindrical, lax, erect; rachis densely pubescent. *Bracts* 0.8–1.2 x c. 0.5 cm, ovate, green, glabrous, pubescent towards tip margins, coriaceous, convolute; margin scabrous, non-ciliate, translucent, membranous, tip obtuse, cincinnus 1-flowered. *Bracteoles* 6–7 x 2–3 mm, tubular, translucent, acute at tip, pale green, white towards base, glabrous, membranous. *Flower* 5–5.4 cm long, creamy yellow, many flowers open at a time, ascending, slightly fragrant. *Calyx* 1–1.2 cm long, *c.* 2.5 mm wide at mouth, white, glabrous, membranous, translucent, closely appressed to corolla tube, unilaterally split upto 3–4 mm, 2-toothed at tip. *Corolla tube* 1.3–1.4 cm long, *c.* 3 mm wide at mouth, creamy-yellow, hairy internally, bend to one side at centre. *Corolla lobes* oblong, white, membranous, drooping from flower, glabrous; dorsal lobe 2.4–2.5 x *c.* 0.3 cm, *c.* 1 mm long beaked at tip; lateral lobes *c.* 2.5 x 0.3 cm, non-beaked at tip. *Lateral staminodes c.* 2 x 0.3 cm, linear, creamy-yellow, spreading on flower, reflexed back, outer margins undulate. *Labellum* 1.8–2 x 0.3–0.4 cm, elliptic, creamy-yellow, spreading on flower, reflexed back on upper half, gradually clawed at base; claw *c.* 2.5 mm wide; sinus *c.* 1.5 cm deep; outer margin undulate, acute at tip. *Stamen* 3.2–3.4 cm long, straight. *Filament c.* 2.8 cm long, *c.* 1.5 mm wide at base, creamy-yellow, straight. *Anther* 7–8 x *c.* 2 mm, oblong, yellow, ciliate in thecae margins, split opens from top to bottom, attached with the filament at *c.* 3 mm above from base, thecae axis parallel with the filament; connective yellow, glabrous, non-crested, tip slightly notched. *Ovary c.* 3 x 2 mm, oblong, pale green, densely pubescent externally. *Style* filiform, white, glabrous, pale green tinged towards stigma. *Stigma c.* 1 mm wide, pale green, cup-shaped, slanting with a depression at center, pubescent, hairs hook-like, *c.* 1 mm exserted from the anther. *Epigynous glands* two, 1–2 mm long, oblong, yellow. *Fruits* 0.7–0.8 x 0.5–0.6 cm, trigonous, loculicidal capsule, ovate, densely

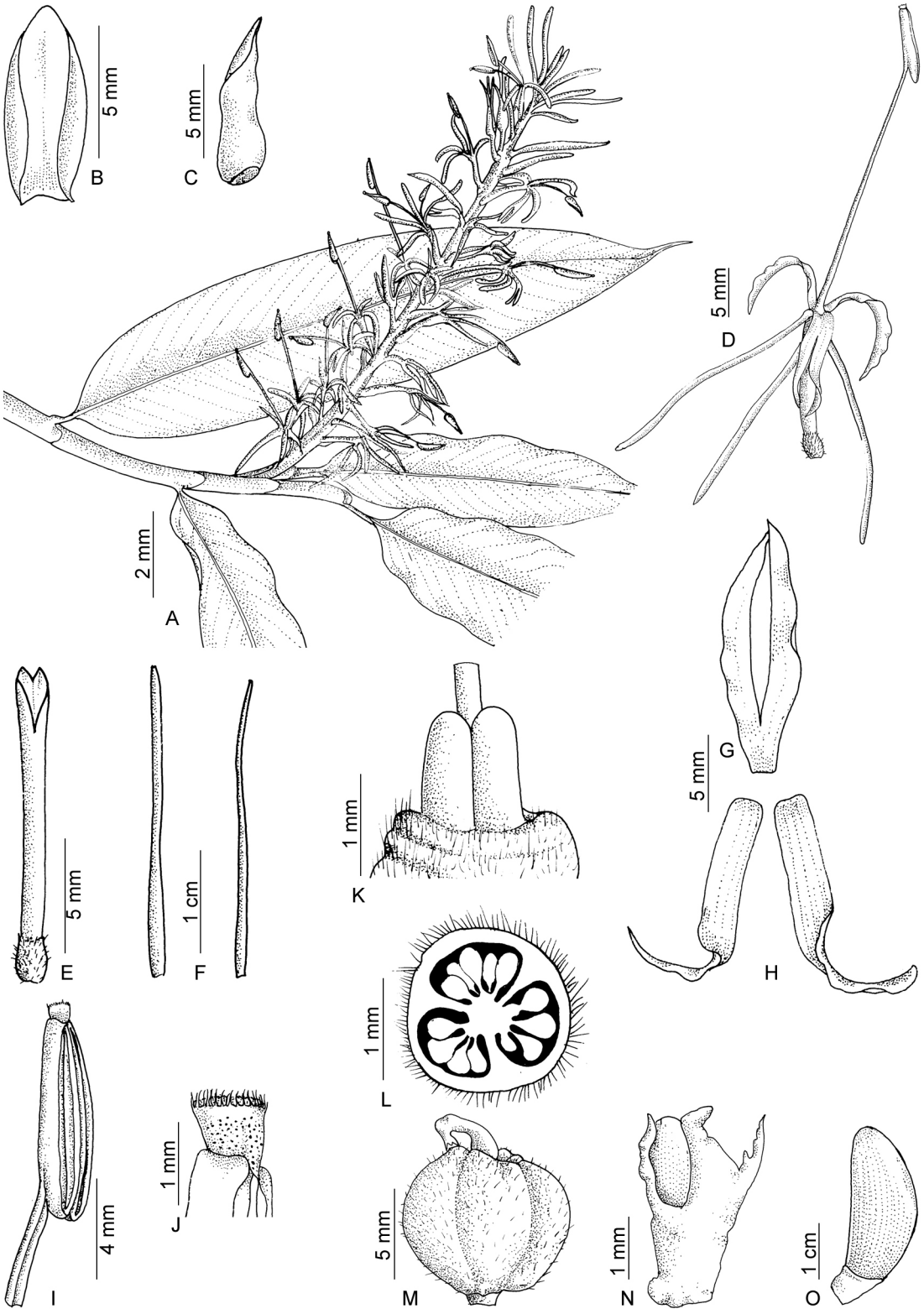

Figure 28. ***H. gracile*** var. **No. 1**: **A.** habit; **B.** bract; **C.** bracteole; **D.** single flower; **E.** calyx with ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** anther (lateral view) with a part of filament; **J.** anther tip with stigma; **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** fruit; **N.** seed with aril; **O.** seed.

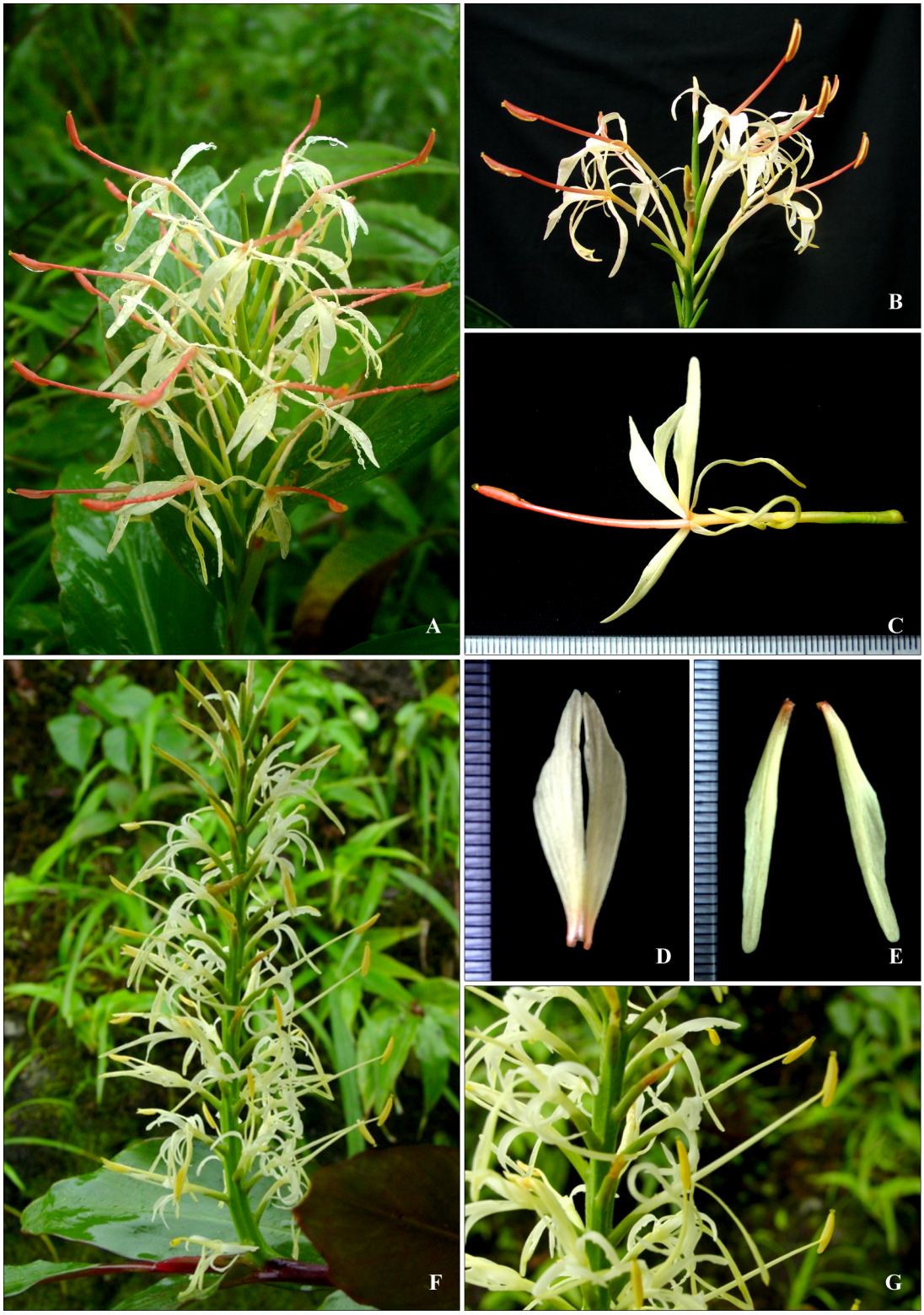

Plate 15. **A-E.** ***H. gracile*** var. ***calcaratum*****: A & B.** inflorescences showing variations in colour and nature; **C.** single flower with bract; **D.** labellum; **E.** lateral staminodes. **F & G.** ***H. gracile*** var. **No. 1**: **F.** inflorescence; **G.** flower close-up**.**

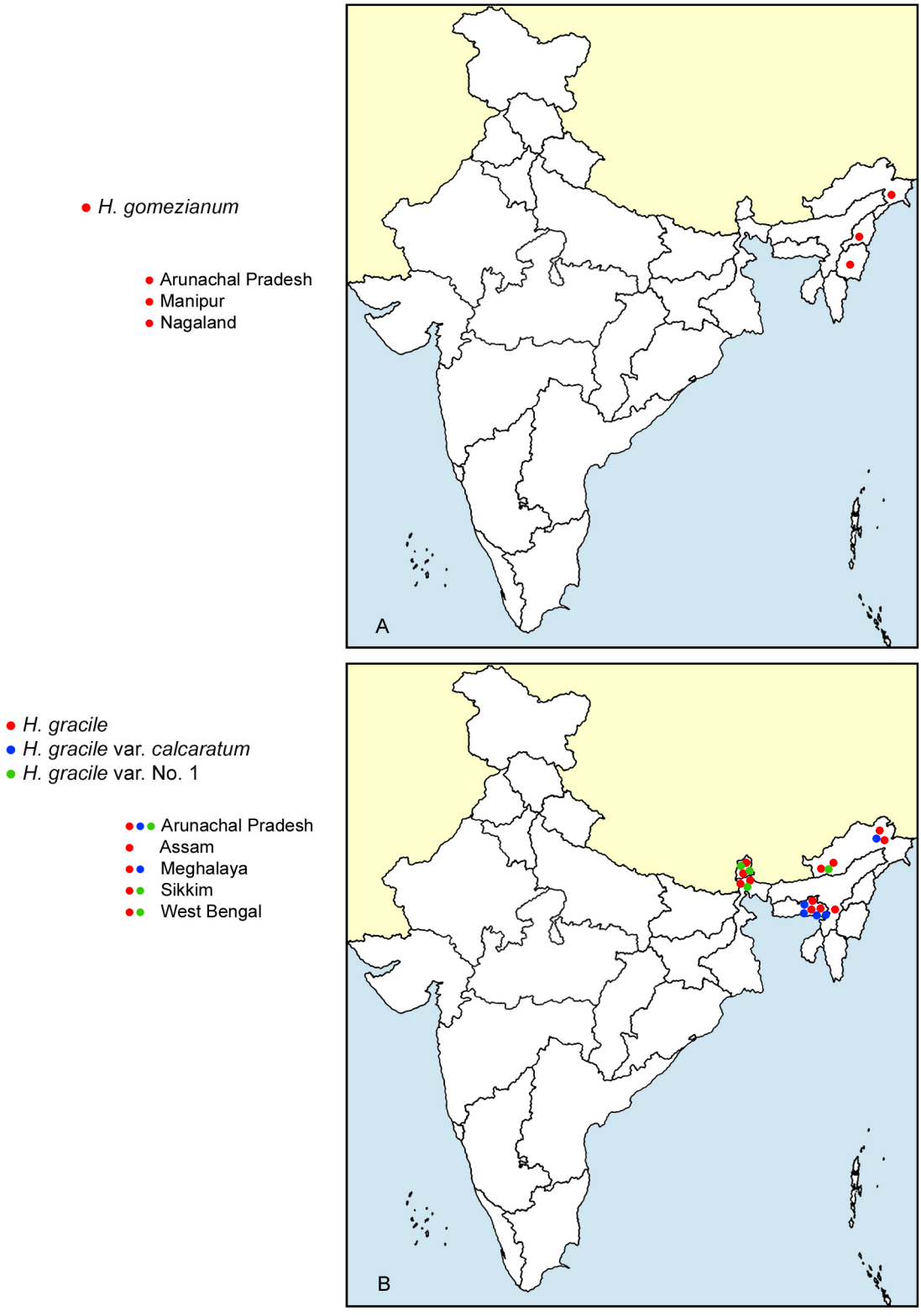

Figure 29. Distribution maps of ***H. gomezianum, H. gracile,*** ***H. gracile*** var. ***calcaratum,*** and ***H. gracile*** var. No.1.

pubescent, trilocular. *Seeds c.* 3 x 1 mm, reddish purple, compactly arranged on column. *Aril* red, lacerate, cup-shaped at base.

Notes: Closely allied to *H. gracile*, but differs from it in having densely pubescent rachis, creamy-yellow flowers with yellow anthers. During the herbarium studies at E and CAL we could locate few earlier collections of this taxon from North and East Districts of Sikkim and Darjiling District of West Bengal.

Flowering & Fruiting: July–September.

Distribution: Endemic to Northeast India. Distributed only in Sikkim, northern West Bengal and Western Arunachal Pradesh. (*Figure 29. B*)

IUCN Red list Category: It could be located only from four localities of northeastern border of India and due to its restricted population size and smaller geographical range of occurrence we assessed it as Critically Endangered (CR B1b(i,ii,iv,v)+ 2b(i,ii,iv,v) as per IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined. **INDIA. SIKKIM**. EAST SIKKIM Dt.: South bank of Rate Chhu, north of Gangtok, 27°23' N, 88°37' E, 1670 m., 31 Jul 1992, *D.G. Long et al., 957* (E). NORTH SIKKIM Dt.: North of Myang Chu, south side of Tista Valley, 1615 m., 27°31' N, 88°36' E, 11 Jul 1996, *D.G. Long & H.J. Noltiee 109* (E). **WEST BENGAL**. DARJILING Dt.: Rungbee, 5000 ft., 20 Aug 1974, *G. King s.n.* (CAL).

13 Hedychium gratum

H. gratum Voigt, Hort. Suburb. Calcutt. 570. 1845; Baker in J.D. Hooker, Fl. Brit. India 6: 232. 1892; K. Schum. in A. Engler, Pflanzenr. IV. 46(heft 20): 54. 1904; J.N. Mitra, Monocot. E. India 1: 244. 1958; Naik & Panigrahi, Bull. Bot. Surv. India 3(1): 72. 1961; S.C. Srivast. in S.K. Jain & R.R. Rao, Threat. Pl. India 235. 1983; Karthik. et al., Fl. Ind. Enum. Monocot. 295. 1989; S.K. Jain & V. Prakash., Rheedea 5(2): 161. 1995.

Neotype (designated here): Illustration at Calcutta, 57 (CNH!).

(*Figure 30; Plate 16. A–D*)

Terrestrial, perennial rhizomatous herbs. *Rhizome* 2.7–3.2 cm wide, white internally, slightly aromatic. *Leafy shoot* 81–92 cm high, erect. *Leaves* 8–9 in number, 5.5–10 cm apart, sessile, spreading; sheath 1.8–2 cm wide, green, margins white, membranous, translucent, sericeous; ligule 2.7–3.3 x 1.5–1.7 cm long, ovate, single-lobed, slightly notched at tip, pale green, sericeous externally, membranous, translucent, papery, closely appressed to the stem; lamina 31–35 x 7.5–9 cm, elliptic, dark green and glabrous above, pale green and densely pubescent below; margin highly undulate, membranous, translucent, white, non-ciliate, folded back; tip long caudate, slightly twisted, bend down; base obtuse; midrib densely sericeous below. *Inflorescence* 6–10 cm long, elliptic, erect, compact with imbricate bracts. *Bracts* 3–3.2 x 2.1–2.5 cm, ovate, green, glabrous, pubescent towards tip, coriaceous, imbricate; margin non-ciliate, translucent, membranous, white; tip rounded; cincinnus 2–3 -flowered. *Bracteoles* 2–2.1 x 1–1.3 cm, pale green, white towards base, puberulent, pubescent towards tip, outer one tubular, membranous, translucent except at midrib, margin non-ciliate. *Flower* 11–11.3 cm long, white, 3–5 flowers open at a time, drooping, slightly fragrant. *Calyx* 3.1–3.6 cm long, 3.5–4 mm wide at mouth, pale green, white towards base, pubescent externally, sparsely pubescent towards base, membranous, translucent, upper half inflated, unilaterally split upto 1.3–1.6 cm, obscurely 3-toothed at tip. *Corolla tube* 6.9–7 cm long, *c*. 3 mm wide at mouth, white, glabrous externally, hairy internally, bend to one side at centre (90° or more). *Corolla lobes* oblanceolate, white, pale green tinged towards tip, membranous, early decaying at base, drooping from flower, glabrous; dorsal lobe *c.* 4.3 x 0.6 cm, 5–6 mm long beaked at tip; lateral lobes *c.* 3.9 x 0.5 cm, non-beaked at tip. *Lateral staminodes* 2.9–3.1 x 1.4–1.5 cm, spatulate, white, spreading on flower, reflexed back, tip obtuse, margin undulate. *Labellum* 4–4.2 x 3.8–3.9 cm,

widely depressed ovate, white, pale yellow tinge at centre and towards base, spreading on flower, reflexed back on upper half, base cordate, abruptly clawed at base; claw 4–5 mm wide; sinus 0.7–1 cm deep; margin undulate; lobes tip rounded. *Stamen* 5–5.1 cm long, longer than labellum, erect. *Filament* 3.9–4 cm long, *c.* 1.5 mm wide at base, white with pale fleshy tinge, erect. *Anther* 1.2–1.3 cm x 0.3–0.35 cm, oblong, creamy white, split opens from top to bottom, attached with the filament at 2.5–3 mm above from base, thecae parallel with the filament axis; anther suture creamy yellow; connective white, glabrous, non-crested, tip truncate. *Ovary* 4–5 x 2.5–3 mm, barrel-shaped, pale green, densely pubescent externally. *Style* filiform, white, glabrous, pubescent towards tip, broadens and green tinged towards stigma. *Stigma* green, cup-shaped, slanting with a depression at center, pubescent, hairs hook-like, *c.* 1 mm exserted from the anther. *Epigynous glands* two, *c.* 3.5 mm long, oblong, yellow.

Notes: *H. gratum* was described by Voigt (1845) in *Hortus Suburbanus Calcuttensis,* based on an introduced material from 'Khassya', Meghalaya. While describing the species he provided the diagnosis of the species only as "Very near *flavescens*, but smaller" by referring to *H. flavescens* Carey ex Roscoe, which is also discussed on the previous page of *Hortus Suburbanus Calcuttensis*. Later Baker (1892) also described it in Hooker's *Flora of British India* with a more detailed description. He compared it with *H. coccineum* and mentioned that "it differs in its whitish flower and shorter stamens". And stated it has been described based a drawing in the Calcutta collection.

It is closely allied to *H. coronarium* in having dense spike with imbricate bracts and flowers white with yellow blotch at the centre. But it can be easily distinguished from *H. coronarium* in having wider lamina, smaller flowers and floral parts, and longer stamen which exceeds the labellum.

Typification: We could not locate the specimen mentioned by Voigt (*l.c.*) in any of the herbaria in India and abroad. However, we could locate one drawing at CAL, supposed to be used by Baker (*l.c.*) for describing the species. Since no lectotype could be located, this is selected here as the neotype. The writing on the drawing is illegible, but can be presumed as *"Hedychium* from Mr. Smith Silhet''. The present detailed description is based on a live collection from Shangpung, Meghalaya, for the first time after Baker (*l.c.*).

Flowering & Fruiting: July–September.

Distribution: It occurs in India and Northern Bangladesh, in India it is distributed in Khasia and Jaintia Hills of Meghalaya and Phek District of Nagaland.

(*Figure 32. A*)

IUCN Red list Category: As the species shows very narrow distribution in Meghalaya, Nagaland and Northern Bangladesh and could be located only once during this revision it is assessed as the Critically Endangered (CR A3(i); B1ab(i,ii,iv,v)+ 2ab(i,ii,iv,v); D; E) as per IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA**. **MEGHALAYA**. EAST KHASI HILLS Dt.: Shillong, Sep 1890, *H. Collett 93* (CAL). JAINTIA HILLS Dt.: Shangpung, way to Garampani, 1374 m., 12 Aug 2007, N 25°28.414", E 092°19.135", *E. Sanoj & T. Rajesh Kumar 95177* (CALI). WEST KHASI HILLS Dt.: 14th mile from Markara to Nongstoin, 19 Jan 1958, *G. Panigrahi 16446* (CAL, ASSAM). **NAGALAND**. PHEK Dt.: Jotsoma, Jul 1886, *D. Prain 17* (CAL).

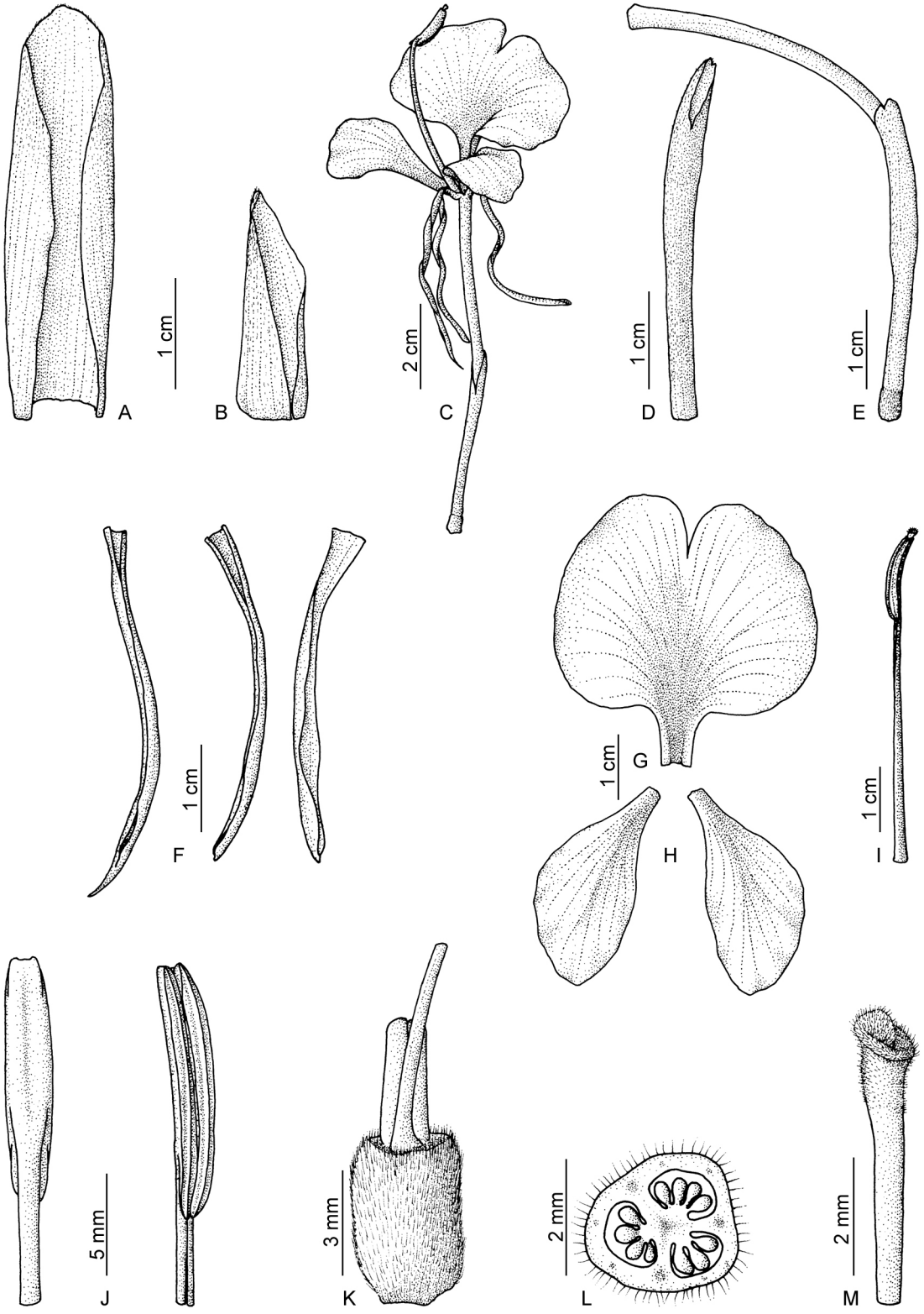

Figure 30. ***H. gratum***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, back view (left) and lateral view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

H. greenii W.W. Sm., Rec. Bot. Surv. India 4: 272. 1911, *non* N.E. Br. 1922; Naik & Panigrahi, Bull. Bot. Surv. India 3(1): 72. 1961; A.S. Rao & D.M. Verma, Bull. Bot. Surv. India 14(1-4): 130. 1972; S.C. Srivast. in S.K. Jain & R.R. Rao, Threat. Pl. India 236. 1983; Karthik. et al., Fl. Ind. Enum. Monocot. 295. 1989; R.M. Sm. in A.J.C. Grierson & D.G. Long, Fl. Bhutan 2: 201. 1991; S.K. Jain & V. Prakash., Rheedea 5(2): 161. 1995 ; S. Kumar, Zingiber. Sikkim 53. 2001; M. Sabu & Pradeep, Folia Malaysiana 6(1&2): 13. 2005; Chaturv. & Moaakum, Folia Malaysiana 9(2): 133. 2008.

Lectotype (designated here)**:** BHUTAN, Jul 1908, *H.F. Green s.n.* (lecto CAL!, Acc. No. CAL0000000948; isolecto CAL!, Acc. No. CAL0000000949).

Common Name: Red Butterfly Lily, Scarlet Ginger. (*Figure 31; Plate 16. E–G*)

Terrestrial, perennial rhizomatous herbs. *Rhizome* 1.8–2.6 cm wide, monopodial branching, found above soil level, pale brown at centre, pale green towards margin. *Leafy shoot* 88–116 cm high, slanting. *Leaves* 13–14 in number, 6–8 cm apart, spreading on plant; sheath 1.4–1.6 cm wide, green, margins translucent, membranous, purple-red tinged, pubescent; sessile; ligule 6–8 mm long, ovate, single-lobed, truncate at tip, purple-red tinged, ovate, pubescent externally; lamina 16.2–19.5 x 6.2–7.5 cm, elliptic, dark and glossy green above, persistent purple-red below, glabrous on both sides; margins translucent, non-ciliate, hairy below; tip long acuminate, twisted; base cuneate-obtuse; midrib pale green above, sparsely pubescent below. *Inflorescence* 5.5–10.3 cm long, conical. *Bulbils* 1.6–2.3 X 1.2–2.2 cm, produced in the axils of lower bracts, ovate, pale green, glabrous, covered by brown scale sheaths. *Bracts* 4.1–4.3 x 2–2.2 cm, ovate, reflexed back at tip, green, glabrous on both sides, moderately coriaceous, reflexed back, imbricate or loosely imbricate; margin non-ciliate, membranous, translucent, red-tinged, glabrous; tip acute; cincinnus 1 or 2 -flowered. *Bracteoles* 2–2.3 x 1.4–1.5 cm, ovate, green with white towards base, glabrous, non-tubular. *Flower* 8.1–

8.3 cm long, erect, brick-red, 1–4 flowers open at a time, non-fragrant. *Calyx* 3.1–3.2 cm long, 6–7 mm wide at mouth, pale green with white towards base, puberulent on lower half, membranous, translucent, upper 2/3 half inflated, lower part closely appressed to corolla tube, tubular, unilaterally split upto 1.5–1.9 cm, 3-toothed at tip, lobes equal, tip rounded. *Corolla tube* 3.9–4 cm long, *c*. 4.5 mm wide at mouth, erect, pale brick-red, yellowish towards base, glabrous externally, hairy internally. *Corolla lobes* elliptic, pale brick-red, yellow tinged at tip, membranous, drooping from flower, glabrous; dorsal lobe 3.3–3.4 x *c.* 0.9 cm, *c.* 2 mm long beaked at tip; lateral lobes 3.3–3.4 x 1–1.1 cm, non-beaked at tip. *Lateral staminodes* 3.5–3.6 x 0.9–1 cm, spatulate, brick-red, crumpled on upper half, erect, more or less right angles with labellum, reflexed back towards tip; margin undulate, crumpled, tip truncate or slightly lobed. *Labellum* 3.9–4 x 4.4–4.5 cm, depressed ovate, fan-shaped, brick-red with yellowish at centre, erect, highly crumpled, reflexed back on margins, obscurely clawed, cuneate at base; claw *c*. 9 mm wide; sinus 1.5–1.7 mm deep; margins undulate. *Stamen* 4–4.3 cm long, deep red, slightly arching. *Filament* 3.3–3.4 cm long, *c.* 3 mm wide at base, deep red, slightly arching. *Anther* 1–1.1 x *c.* 0.3 cm, oblong, deep red, lobes parallel, split opens from top to bottom, attachment at 3–4 mm above from base; connective deep red, glabrous, non-crested and truncate at tip. *Ovary* 3.5–4 x *c.* 3.5 mm, barrel-shaped, white, glabrous externally. *Style* filiform, white, glabrous, yellow tinged towards stigma. *Stigma* yellow, stigmatic head slanting with a depression at center, hairy, 1.5–2 mm exserted the anther. *Epigynous glands* two, 2–2.5 mm long, oblong, finger-shaped, yellow.

Notes: H. greenii was described by Smith (1911) to honor Mr. H.F. Green based on a specimen from the lower hills of W. Bhutan, and flowered in cultivation at the residence of H.F. Green. It is the only species of *Hedychium* which produces bulbils. Bulbils are produced from the axils of lower sterile bracts, and which also act as a mode of propagation. The fruit setting is also not observed in this species. This species can be easily distinguished by its persistent purple-red colour at lower side of leaves, fan-shaped labellum with ceneate (wedge-shaped) base and

crumpled nature of labellum and lateral staminodes. Naturally it grows as large populations on mountain slopes or wet rocky cliffs. The large brick-red coloured flowers attract attention even from a far distance. It is also cultivated as an ornamental plant.

Typification: During the herbarium studies at CAL, we could locate two collections by H.F. Green of this species, both are from Bhutan, collected in July 1908. Among them *H.F. Green s.n.* (Acc. No. CAL0000000948, CAL!) and it's duplicate (Acc. No. CAL0000000949, CAL!) are selected here as the lectotype and isolectotype respectively.

Etymology: Commemorates H.F. Green, who distinguished it as a new species of *Hedychium* for the first time.

Flowering: July–October.

Distribution: Distributed in Northeastern India and Bhutan. Naturalized in cultivation with restricted occurrence in SW Bhutan, and in Meghalaya, Nagaland and West Bengal in India at an altitude of 600–1,800 m. (*Figure 32. B*)

IUCN Red list Category: Even though it is widely cultivated as an ornamental, in wild it is having a very sparse distribution in northeast India and Bhutan. Over exploration from the wild is one of the reasons for the disappearance of the species in the wild. Hence it is assessed against Endangered (EN A2ad; B1b(i,ii,iv)+2b(i,ii,iv); E) as per IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Uses: Because of its much attractive red flowered inflorescence with fan shaped and crumbled labellum, it is cultivated as an ornamental plant in gardens by rhizome cuttings and bulbils. It is also used in flower arrangements.

Specimens examined: **INDIA**. **ARNACHAL PRADESH**. EAST KAMENG Dt.: 5 Km from Seppa towards Bomdila, 1 Aug 2003, *M. Sabu & A.K. Pradeep 92552* (CALI). LOHIT Dt.: Hawa Pass, 1068 m., N 27°55'0.9", E 096°20'01.5", 6 Aug 2009, *E. Sanoj & T. Rajesh Kumar 105634.* **NAGALAND**. PHEK Dt.: Jotsoma Village, 2 Km from

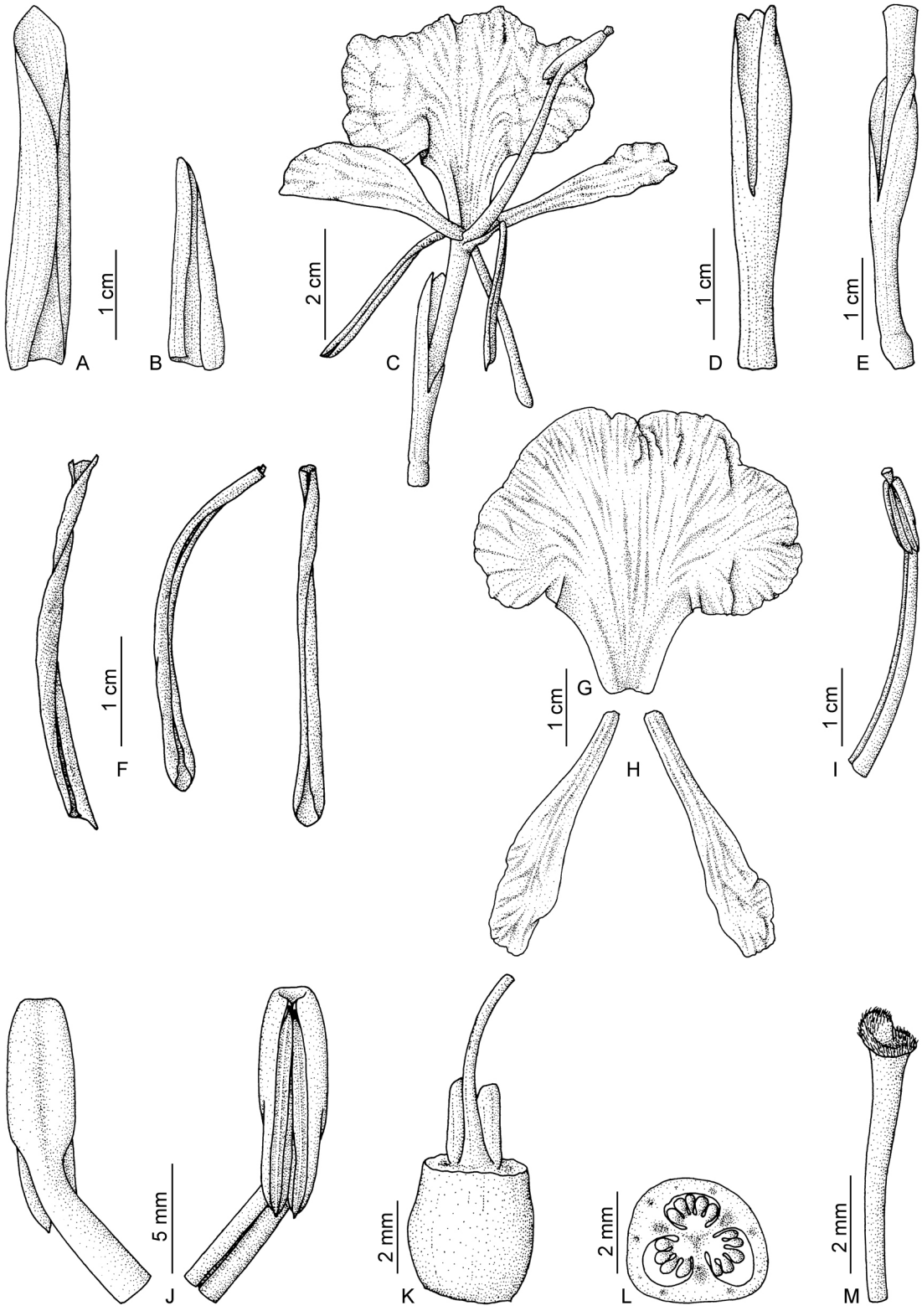

Figure 31. ***H. greenii***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, back view (left) and front view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

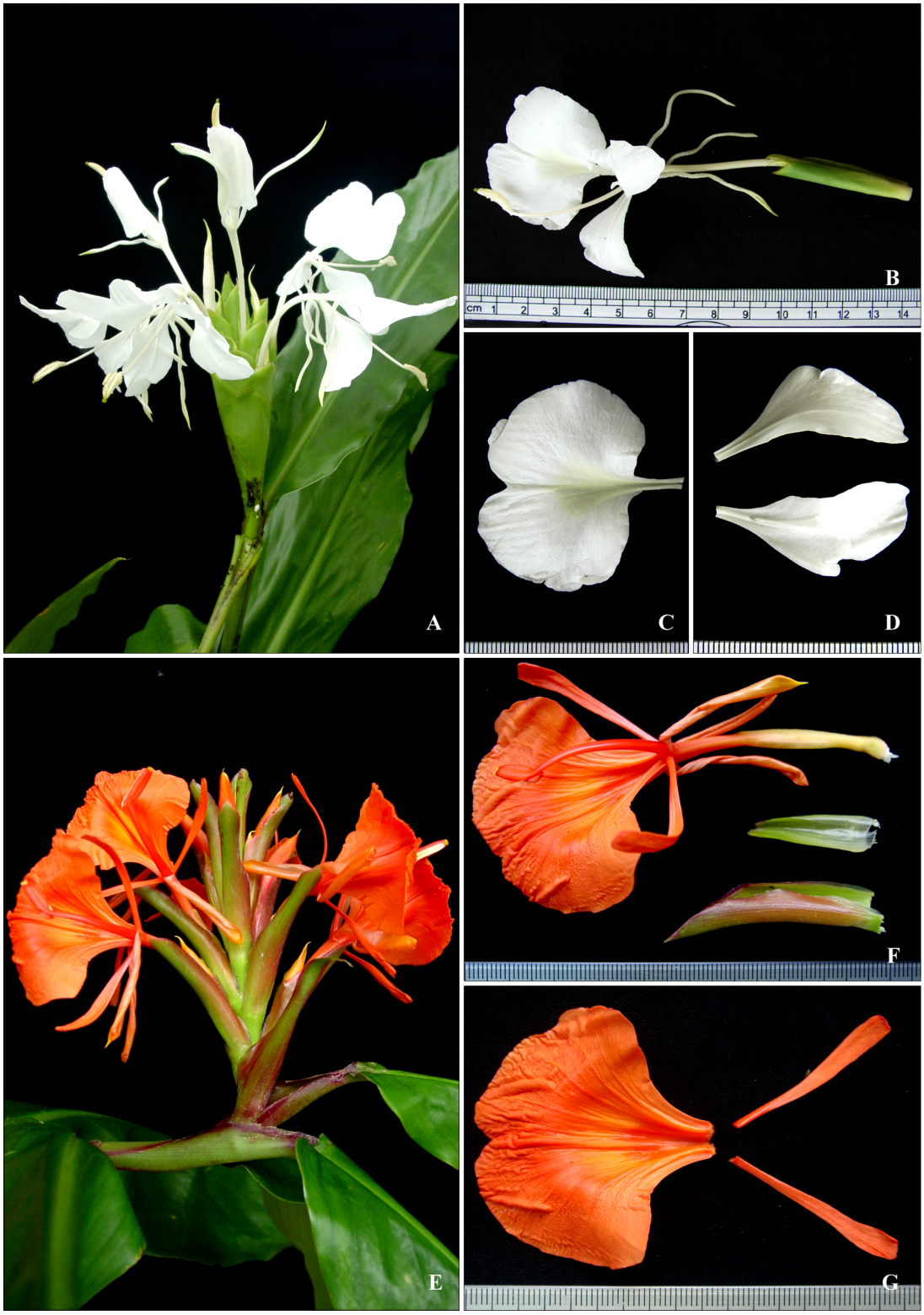

Plate 16. **A-D.** ***H. gratum*****: A.** inflorescence; **B.** single flower with bract; **C.** labellum; **D.** lateral staminodes. **E-G.** ***H. greenii*****: E.** inflorescence; **F.** single flower, bract and bracteole; **G.** labellum and lateral staminodes.

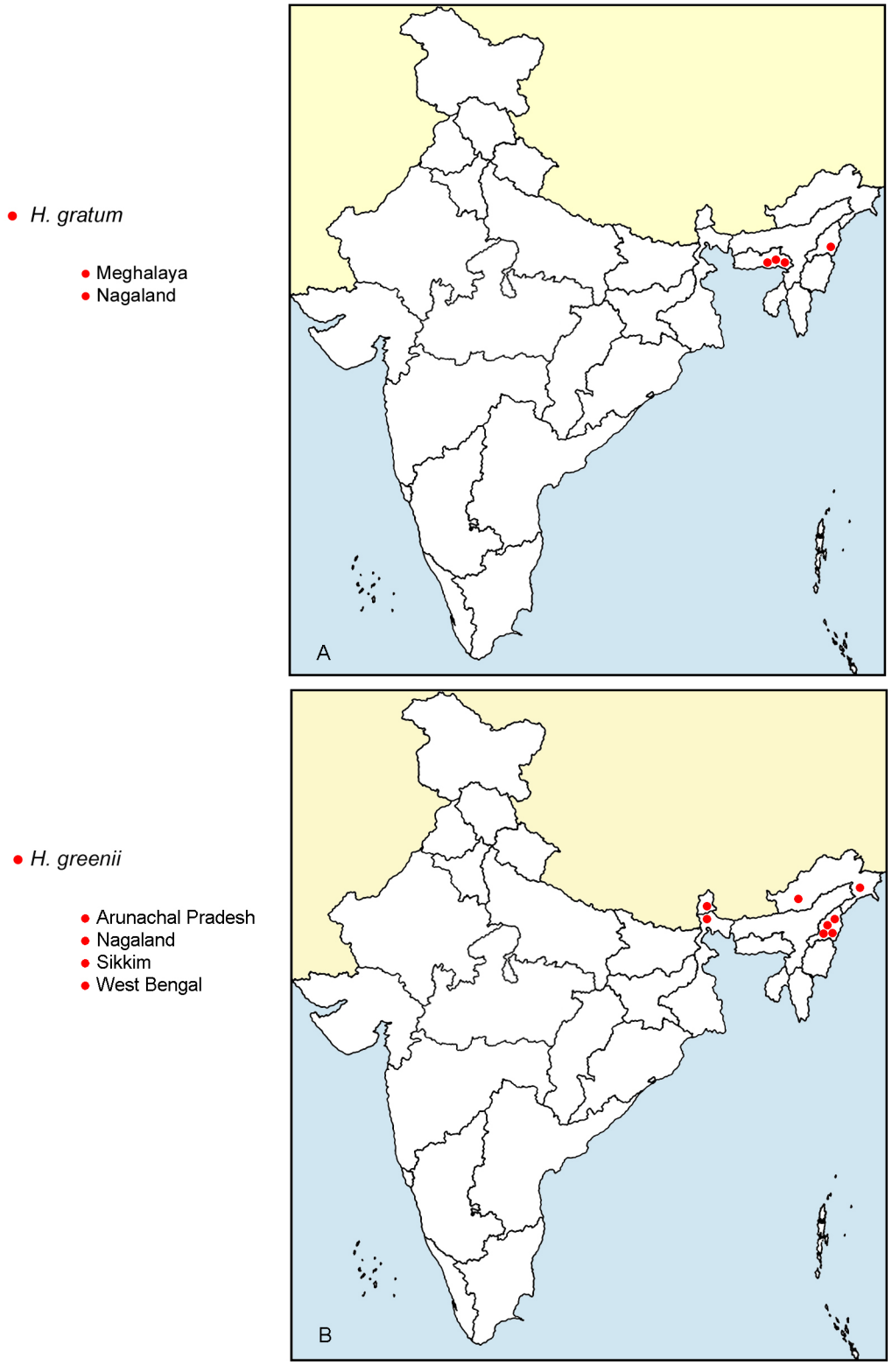

Figure 32. Distribution maps of
H. gratum and ***H. greenii.***

Kohima city, 1400 m., 23 May 2006, *M. Sabu & A.K. Pradeep 103640* (CALI); Jotsoma, Jul 1886, *D. Prain 8* (CAL), Nov 1886, *D. Prain 6* (CAL); 1578 m., N 25°40'03.2", E 094°03'48.2", 31 Aug 2006, *E. Sanoj & V.P. Thomas 105568* (CALI); Phek, Muchojho, way to Surhoba, 5 Sep 2006, *E. Sanoj & V.P. Thomas 105593* (CALI). MOKOKCHUNG Dt.: Longhum village area, 28 Aug 2006, *E. Sanoj & V.P. Thomas 105555* (CALI). **SIKKIM**. EAST SIKKIM Dt.: BSI Gangtok Campus, 1736 m., E 088°36'77.5" N 27°20'38.7", 22 Aug 2004, *M. Sabu & A.K. Pradeep 92712* (CALI); Pangthang, 22 Aug 2006, *V.P. Thomas 105513* (CALI). **WEST BENGAL**. DARJILING Dt.: Kalingpong, Jul 1922, *U. Kanjilal 7734* (ASSAM).

15 Hedychium griffithianum

H. griffithianum Wall. in W.J. Hooker, Hooker's J. Bot. Kew Gard. Misc. 5: 369. 1853, J. Hort. Soc. London 9: 20. 1855; C. Muell., Ann. Bot. Syst. 6: 25. 1861; Horan., Prodr. Monogr. Scitam. 25. 1862; Baker in J.D. Hooker, Fl. Brit. India 6: 229. 1892; K. Schum. in A. Engler, Pflanzenr. IV. 46(heft 20): 58. 1904; J.N. Mitra, Monocot. E. India 1: 243. 1958; A.S. Rao & D.M. Verma, Bull. Bot. Surv. India 11(1&2): 125. 1969; 14(1-4): 132. 1972; N.P. Balakr., Fl. Jowai 2: 529. 1983; S.K. Jain & V. Prakash., Rheedea 5(2): 161. 1995 ; Chaturv. & Moaakum, Folia Malaysiana 9(2): 133. 2008.

Lectotypes (designated here): INDIA. Meghalaya. Khasia, *Griffith s.n.* (lecto K!, Acc. No. K000640483; isolecto K!, Accc. No. K000640484).

H. griffithianum var. *glanduligerum* C.B. Clarke ex Baker in J.D. Hooker, Fl. Brit. India 6: 230. 1892; J.N. Mitra, Monocot. E. India 1: 243. 1958.

Type: Not known. (*Figure 33; Plate 17. A–D*)

Terrestrial, perennial rhizomatous herbs. *Rhizome* 1.6–2.3 cm wide, pale brown outside, creamy white internally. *Leafy shoot* 50–100 cm high, slanting.

Leaves 8–12 in number, 5–7 cm apart; petiole 0.7–1 cm, pale green below, green above; ligule 3–4 mm long, deeply notched at centre (nearly as two lobed), pink, sparsely pubescent externally; lamina 27–33.5 x 5.5–7 cm, elliptic-oblanceolate, dark green and glabrous above, pale green and puberulent below; margin non-ciliate, sparsely pubescent below; tip caudate; base attenuate; midrib sparsely pubescent below. *Inflorescence* 11–20.5 cm long, elliptic, erect, lax; peduncle 2–3 mm thick, glabrous, green. *Bracts* 2.6–2.7 x 0.8–0.9 cm, elliptic, green, glabrous, moderately coriaceous, non-imbricate, convolute, persistent; margin non-ciliate, translucent; tip obtuse; cincinnus 1-flowered. *Bracteoles* 12–13 x 2–2.5 mm, pale green, glabrous, tubular, minutely crested at tip, hairy on crest, membranous, translucent, closely appressed to calyx, persistent; margin non-ciliate. *Flower* 8.2–8.4 cm long, white (turn to pale creamy-yellow on second day) with red stamen and pinkish red tinged at mouth, spreading, many flowers open at a time. *Calyx* 2.9–3 cm long, *c.* 3.5 mm wide at mouth, pale green, glabrous, membranous, translucent, slightly exceeding bracts, slightly inflated at upper half, unilaterally split upto 5–4.5 mm deep, obscurely 3-toothed at tip, lobes minutely crested and hairy externally at tip, margins ciliate at lobes, persistent. *Corolla tube* 4–4.1 cm long, *c.* 2.5 mm wide at mouth, white, pale pinkish red towards tip, glabrous externally, hairy internally, tube slightly curved towards tip. *Corolla lobes* yellow, whitish towards base, membranous, drooping from flower, glabrous; dorsal lobe 3.4–3.5 x *c.* 0.4 cm, *c.* 1.5 mm long beaked at tip; lateral lobes 3.3–3.4 x *c.* 0.4 cm, non-beaked at tip. *Lateral staminodes* 3.4–3.6 x 0.35–0.4 cm, very narrowly elliptic, sword-shaped, white, brown tinged at base, spreading on flower, reflexed back, margin undulate, tip acute. *Labellum* 3.2–3.3 x 1.1–1.2 cm, elliptic, white, brown tinged at base, spreading on flower, reflexed back on upper half, gradually clawed at base; claw c. 4 mm wide; sinus 1.5–1.7 mm deep; margin undulate. *Stamen* 3.9–4.1 cm long, arching over labellum. *Filament* 3.1–3.2 cm long, *c.* 1.5 mm wide at base, red, pinkish red towards base, arching. *Anther* 10.5–11 x *c.* 2 mm, oblong, brownish yellow, lobes parallel, split opens from top to bottom, attached with the filament at 2.5–3 mm above from base; thecae parallel with the filament; connective red,

glabrous, non-crested and truncate at tip, minutely spurred at base. *Ovary* 2–2.5 x *c.* 2.5 mm, barrel-shaped, pale green, red tinged towards base, sparsely pubescent externally. *Style* filiform, white, glabrous, green tinged towards stigma. *Stigma* green, stigmatic head flat, slanting with a depression at center, hairy, hairs hook-like, 1–1.5 mm exserted from the anther. *Epigynous glands* two, 2–2.5 mm long, oblong, finger-shaped, brownish yellow. *Fruits* 0.9–1 x 0.9–1.1 cm, ovoid, three-angled, glabrous. *Seeds* 3.5–4 x 2–2.5 mm, elliptic, grey (when dry), surface longitudinally grooved, transversely constricted. *Aril* 4–5 mm long, yellow (when dry), membranous, completely covers the seed.

Notes: It was described by Wallich (1853) on the basis of Griffith's collections from Khasia. He also distinguished it in having lamina with parallel glandular lines on the ventral surface and long grey hairs on dorsal surface, globular gland dotted floral parts and exceedingly slender divisions of the limb. While describing the species Wallich (*l.c.* & 1855) stated that, "The nearest affinity is certainly with the immediately preceding species (*i.e., H. gomezianum*), of which I can imagine it possible that it may hereafter prove only a variety".

Later it appeared in Horaninow (1862), Baker (1892) and Schumann (1904). Baker (*l.c.*) also erected a variety, *H. griffithianum* var. *glanduligerum* from Khasia, it differs from the species only in glabrous leaves and much glandular plants and flowers. Since the variation in vestiture is a common trait found in *Hedychium* or in the family Zingiberaceae as a whole, this variety is synonymised under *H. griffithianum*.

Naik and Panigrahi (1961) merged *H. griffithianum* with the species *H. venustum* Wight. The reduction was based on their earlier expressed view in discussion part that "the relative length of the stamen and the lip is a variable character within a species, particularly in *H. venustum*, which shows the stamen as shorter than, as long as or slightly longer than the lip". But based on the re-examination of the cited specimens of Naik and Panigrahi (*l.c.*), *i.e., G.K. Deka*

13188 (ASSAM!), *R.N. De & D.C. Forests 21092* (ASSAM!), *G.K. Deka 19651* (ASSAM!), Rao and Verma (1969a) stated that, "the material at their disposal did not belong to either *H. venustum* or *H. griffithianum* but is *H. spicatum*, and the observations of live plants from some of their collection localities", and reinstated these as two separate species. We also recognized it as a separate species from *H. venustum* and treated without any varietal taxa.

Typification: We could locate two specimens at Kew, which was collected by 'Griffith' from Khasia (K000640483, K! & K000640484, K!). They are selected as lectotype and isolectotype respectively and are designated here.

Flowering & Fruiting: August–October.

Distribution: Endemic to Meghalaya and Northern West Bengal of India, at an altitude of 1,000–2,000 m. (*Figure 34. A*)

IUCN Red list Category: As it has a very restricted distribution at northeast India with a very widely distributed subpopulations and lesser area of occupancy it has been categorized under Critically Endangered (CR B1b(i,ii,iv)+ 2ab(i,ii,iv); E) category as per IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA**. **MEGHALAYA**. Khasia, *Griffith s.n.* (K); *J.D. Hooker & J. Thomson s.n.* (K). EAST KHASI HILLS Dt.: Near Mawlai Bridge, 3 Aug 1963, *G.K. Deka 35799* (ASSAM); Shillong, 6000 ft., 21 Aug 1886, *C.B. Clarke 44609* (CAL). JAINTIA HILLS Dt.: Jarain forest, on way to Wah Umngot, ± 1300 m., 19 Aug 1968, *N.P. Balakrishnan 46816* (ASSAM); Jorain–Jowai, 20 Aug 1968, *N.P. Balakrishnan 46883* (ASSAM); Garampani–Raliang Road, 21 Aug 1968, *N.P. Balakrishnan 46931, 46933* (ASSAM); Shangpung, 14 Aug 2007, *E. Sanoj & T. Rajesh Kumar 95173* (CALI); Way to Dauki, Jowai, 1280 m., N 25°26.241", E 092°11.329", 17 Aug 2007, *E. Sanoj & T. Rajesh Kumar 94911 & 94912* (CALI). **WEST BENGAL**. DARJEELING Dt.: Darjeeling, 6000 ft., Aug 1873, *J.S. Gamble 8135* (K); Mungpoo, 25 Aug 1885, *C.B. Clarke 40119 B* (K).

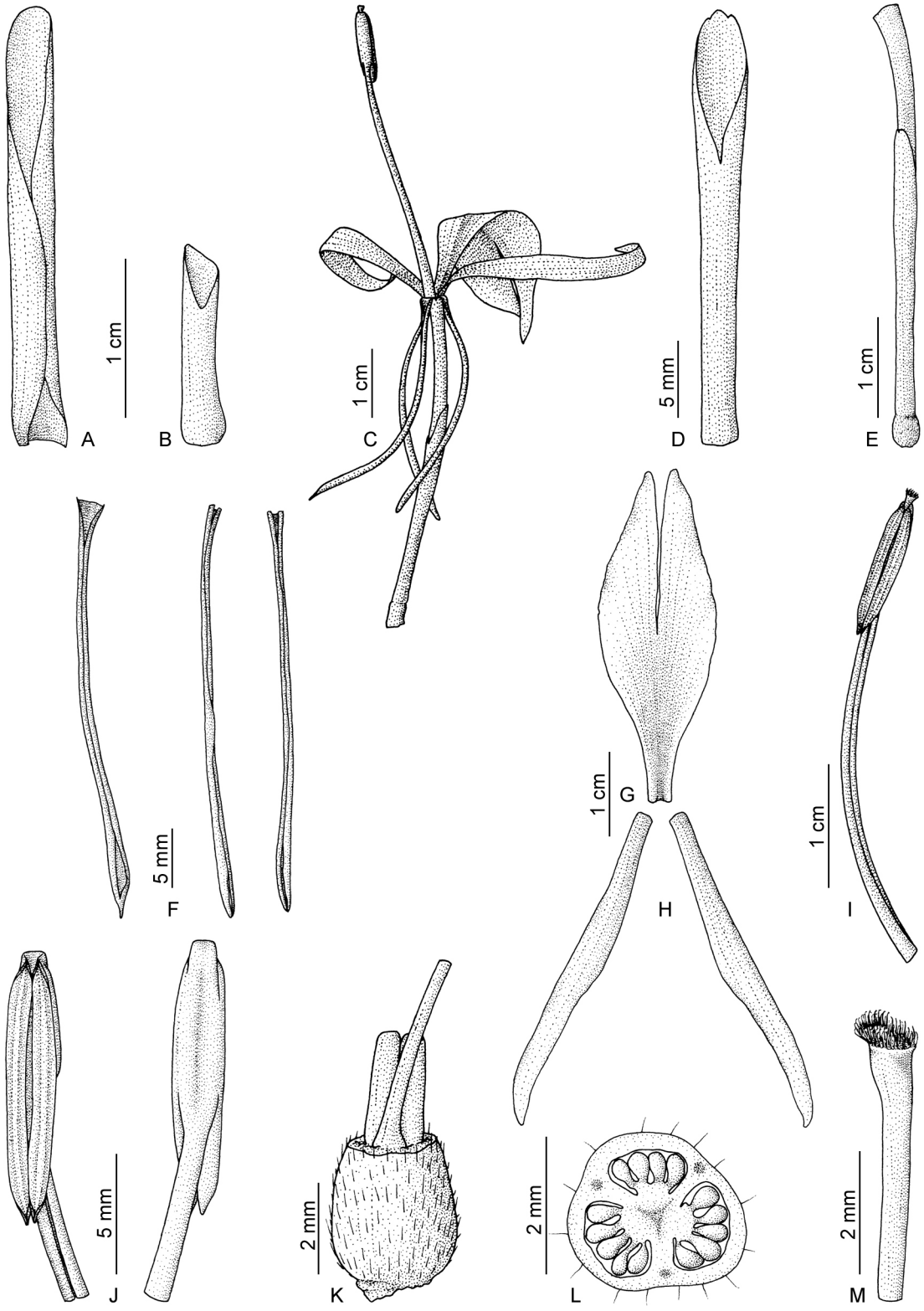

Figure 33. ***H. griffithianum***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, front view (left) and back view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

H. hookeri C.B. Clarke ex Baker in J.D. Hooker, Fl. Brit. India 6: 230. 1892; K. Schum. in A. Engler, Pflanzenr. IV. 46(heft 20): 49. 1904; J.N. Mitra, Monocot. E. India 1: 243. 1958; A.S. Rao & D.M. Verma, Bull. Bot. Surv. India 14(1-4): 132. 1972; S.C. Srivast. in S.K. Jain & R.R. Rao, Threat. Pl. India 235. 1983; S.K. Jain & V. Prakash., Rheedea 5(2): 161. 1995.

Lectotypes (designated here)**:** INDIA. Meghalaya. Khasia, Kala Panee, 27 Jun 1830, *J.D. Hooker & Thomson 1350* (lecto K!, Acc. No. K000640478; isolecto K!, Acc. No. K000640479). (*Plate 17. E–G*)

Lithophytic or epiphytic, perennial rhizomatous herbs. *Rhizome* 1.4–2.6 cm wide, creamy white internally, slightly aromatic, covered by brown scales. *Leafy shoot* 30–45 cm high, slanting with erect inflorescence. *Leaves* 8–10 in number, 5.3–7.5 cm apart, spreading, sub-sessile; petiole 0.8–1.8 cm long, glabrous; sheath 1–1.3 cm wide, margins green, membranous, translucent, glabrous; ligule 1.3–2 x *c.* 1 cm, oblong, single-lobed, slightly notched at tip, pale pink, glabrous, membranous, translucent, papery, closely appressed to the stem; lamina 13–20 x 4–6 cm, broadly elliptic, dark green above, pale green below, glabrous; margin undulate, membranous, translucent, white tinged, non-ciliate; tip caudate, twisted; base cuneate. *Inflorescence* 2.5–6.5 cm long, cylindical, lax, erect. *Bracts* 1.2–1.3 x 0.5–0.6 cm, ovate, green, glabrous, convolute; margin non-ciliate, translucent, membranous, white, tip acute, cincinnus 1-flowered. *Flower* 2.7–2.8 cm long, sulphur-yellow, ascending. *Calyx* 8–9 mm long, glabrous, membranous, translucent, inflated, unilaterally split upto 1.9–2 cm, truncate at tip. *Corolla tube c.* 8–9 mm long, slightly longer than calyx, hairy internally, erect. *Corolla lobes* 8–9 mm long, linear, sulphur yellow, membranous, glabrous. *Lateral staminodes* 8–9 x *c.* 2 mm long, spatulate, clawed towards base, sulphur yellow, spreading on flower, slightly reflexed back, tip obtuse. *Labellum* 8–9 x 3.5–4 mm long, spatulate, sulphur-yellow,

spreading on flower, slightly reflexed back on upper half, gradually clawed at base; claw 1–1.2 mm wide; bifid at tip; sinus *c.* 2 mm; margin undulate. *Stamen* 1.6–1.8 cm long, erect. *Filament* 8–12 mm long, erect. *Anther* 4.5–5 mm long, oblong, split opens from top to bottom, attached with the filament at 1–1.5 mm above from base, thecae axis parallel with the filament; connective not prolonged. *Ovary c.* 1.5 mm long, globose. *Style* filiform, white, glabrous. *Stigma* cup-shaped, slanting with a depression at center. *Fruits c.* 8 mm diameter, globose, glabrous, trilocular, surface smooth; fruit wall fleshy, yellow externally, orange internally, completely splitted and refexed back on dehiscence. *Seeds c.* 2.5 x 1.5 mm, black, aggregate as a globose mass. *Aril* black, lacerate, basal.

Notes: H. hookeri was established by Baker in Hooker's *Flora of British India* (1892) on the basis of a collection of J.D. Hooker and Thomson from Khasia. As per the description provided by him, it is a dwarf species (30-60 cm high) with 2.5-5.2 cm long spike and very small sulphur-yellow flowers; corolla lobes, labellum and lateral staminodes below *c.* 8 mm, stamen twice as long as the lip and globose capsules. He also mentioned that, the spike of this species resembles with *Globba bulbifera* Roxb. in appearance.

We could collect one dwarf species of *Hedychium* in fruiting condition from Tezu, Arunachal Pradesh. On comparing it with the type specimens at Kew and the description provided by Baker, we recognized it as *H. hookeri*. It can be easily identified from other species of *Hedychium* in having a *G. bulbifera* -like inflorescence with prominent bracts and small flowers, globose fruits (below 1 cm diam.) with black seeds with black aril and they are aggregate as a globose mass on each locule. The description provided here is based on Baker (1892), Schumann (1904) and type materials at Kew.

Typification: At Kew Herbarium we could locate two specimens of *J.D. Hooker & Thomson 1350* (K!) collected from Kalapanee, Khasia (Acc. No. K000640478 & K000640479) which has been originally designated as *H. gracile*

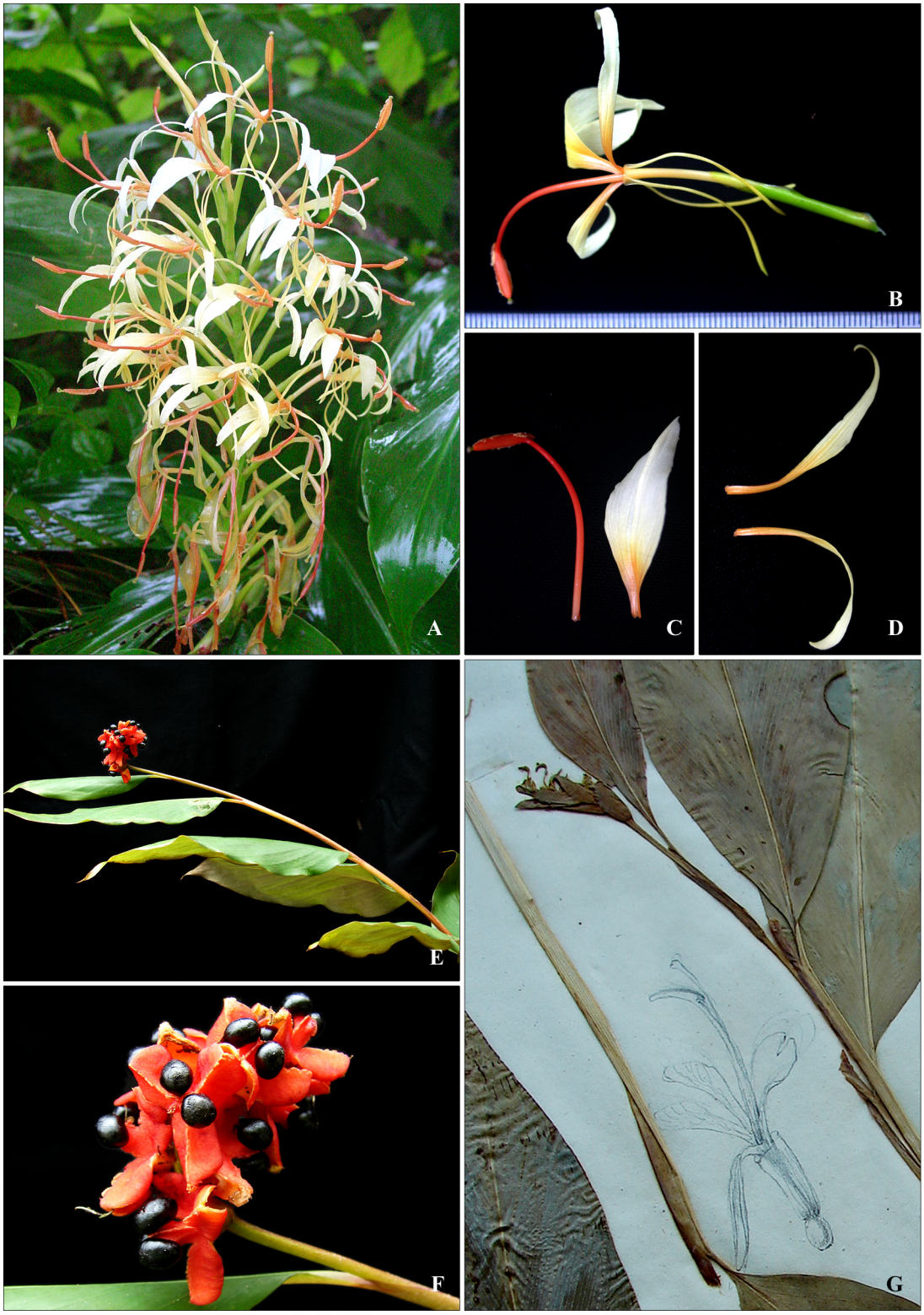

Plate 17. **A-D. *H. griffithianum*: A.** inflorescence; **B.** single flower with bract; **C. l**abellum and stamen; **D.** lateral staminodes. **E-G. *H. hookeri*: E.** habit; **F.** infructescence close-up with seeds; **G.** inflorescence and illustration of flower from the type specimen (*J.D. Hooker & Thomson 1350,* K!).

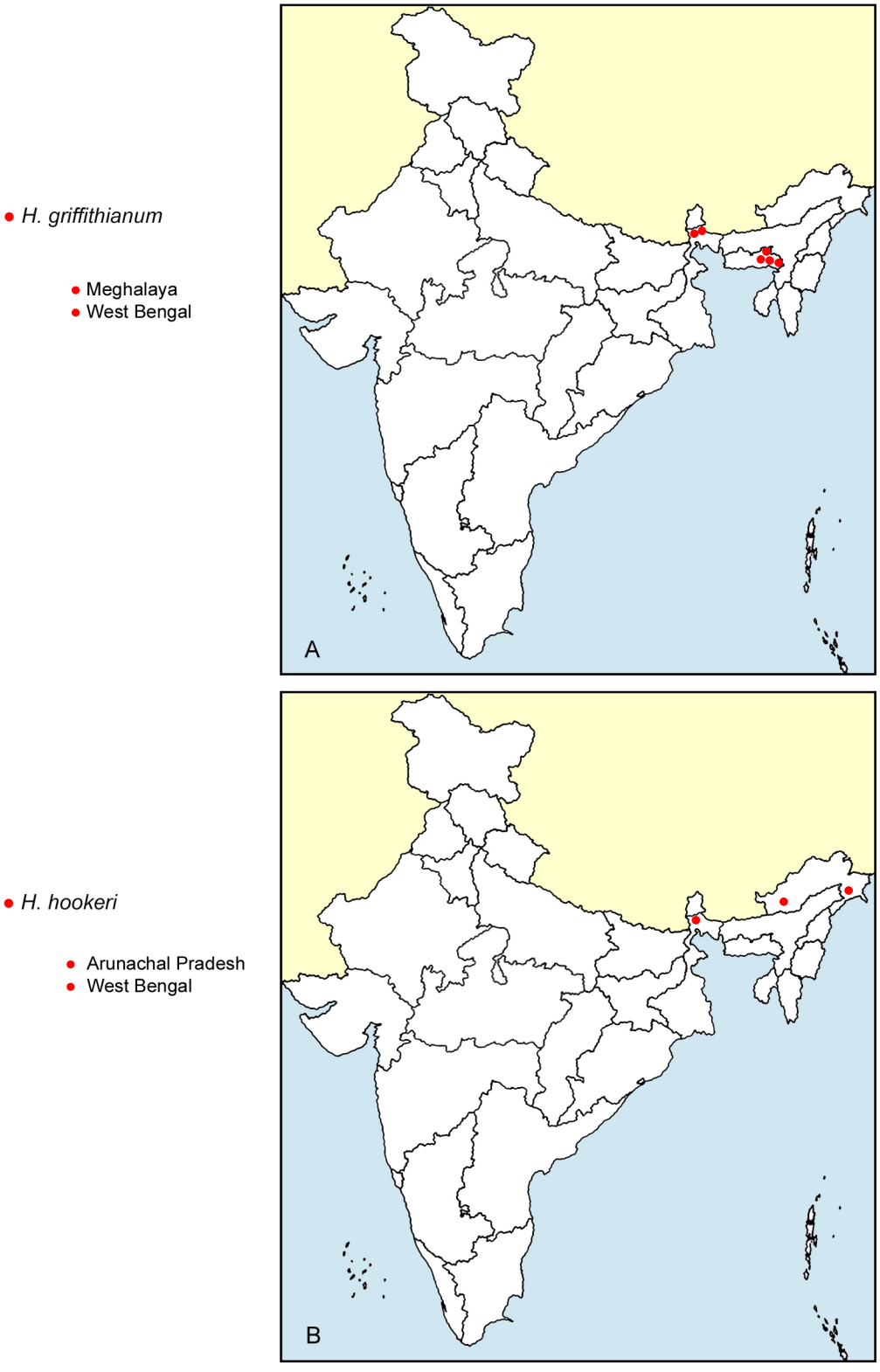

Figure 34. Distribution maps of
H. griffithianum and ***H. hookeri***.

Roxb. and annotated by C.B. Clarke as a new species, *H. hookeri*. Among them we selected and designated the former as the lectotype and latter as the isolectotype.

Flowering & Fruiting: June–October.

Distribution: Endemic to Northeast India. In India it is distributed in Northern West Bengal, Ri-Bhoi District of Meghalaya and East Kameng District and Lohit District of Arunachal Pradesh, at an altitude of 1,000–1,500 m. (*Figure 34. B*)

IUCN Red list Category: Due to the endemic distribution with very lesser area of occupancy and geographically distant sub-populations, it is assessed against the Critically Endangered (CR A2a; B1b(i,ii,iv)+ 2b(i,ii,iv); E) category as per IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA**. **ARUNACHAL PRADESH**. EAST KAMENG Dt.: 5 Km. from Seppa towards Bomdila, 11 Aug 2003, *M. Sabu & A.K. Pradeeep 92556* (CALI). LOHIT Dt.: Lalpani, 1068 m., N 27°55'12.3", E 096°20'43.0", 6 Aug 2009, *E. Sanoj & T. Rajesh Kumar 105635* (CALI). **WEST BENGAL**. DARJILING Dt.: Rangbee, 4500 ft., Oct 1972, *J.S. Gamble 8133* (K).

17 Hedychium larsenii

H. larsenii M. Dan & Sathish, Nordic J. Bot. 19(3): 333. 1999.

Types: INDIA. Manipur., Propagule originally brought from Kasom Khullen, 1427 m., 20 Aug 1996, *M. Dan 22668* (holo TBGT). (*Figure 35; Plate 18. A–D*)

Terrestrial, perennial rhizomatous herbs. *Rhizome* 4–5 cm wide, creamy white internally, slightly aromatic, covered by brown scales. *Leafy shoot* 60–160 cm high, erect, robust. *Leaves* 13–15 in number, 9.5–11.5 cm apart, spreading, sessile; sheath 5.5–5.8 cm wide, margins green, membranous, translucent, pubescent;

ligule 2–5.5 x 4–4.5 cm long, ovate, single-lobed, obtuse at tip, pale green, densely strigose externally, membranous, translucent, papery, early dried off, closely appressed to the stem; lamina 45–62.5 x 10–17.3 cm, broadly lanceolate, dark green and glabrous above, pale green and densely pilose below; margin undulate, membranous, translucent, white tinged, non-ciliate; tip long acuminate, twisted; base cuneate; midrib densely pubescent below. *Inflorescence* 13–35 cm long, conical, dense, erect. *Bracts* 4–6.1 x 2.3–3.7 cm, ovate, green, glabrous, pubescent towards tip margins, coriaceous, convolute; margin non-ciliate, translucent, membranous, white, tip acute, cincinnus 2–8 -flowered. *Bracteoles* 2.1–4.5 x 1.5–2.3 cm (outer tubular), translucent, pale green, white towards base, glabrous, pubescent towards tip, outer one completely encircles the cincinnus, leathery. *Flower* 11.2–12 cm long, white with creamy yellow blotch at centre of labellum, many flowers open at a time, ascending, slightly fragrant. *Calyx* 3.6–5.7 cm long, *c.* 7 mm wide at mouth, pale green, pubescent, membranous, translucent, closely appressed with corolla tube, inflated towards tip only, unilaterally split upto 1.6–1.9 cm, 3-toothed at tip. *Corolla tube* 4–5.7 cm long, *c.* 3 mm wide at mouth, white, glabrous externally, hairy internally. *Corolla lobes* elliptic, white, pale greenish tinged towards tip, membranous, early decaying at base, drooping from flower, glabrous; dorsal lobe 4.5–6.1 x 0.6–0.7 cm, 6–9 mm long beaked at tip; lateral lobes 4–5.5 x *c*. 0.5 cm, 0.5–1 cm long beaked at tip. *Lateral staminodes* 3–3.3 x 0.3–0.7 cm, sword-shaped, white, spreading on flower, reflexed back, margin undulate, tip obtuse. *Labellum* 2.5–3.1 x 1.5–2.4 cm, orbicular, white, creamy yellow at centre, spreading on flower, reflexed back on upper half, base cordate, gradually clawed towards base; claw 2–2.5 mm wide; sinus 1–1.1 cm deep; margin undulate, lobes rounded at tip. *Stamen* 6.4–6.7 cm long, slightly arching, white. *Filament* 5.9–6 cm long, *c.* 2 mm wide at base, white, slightly arching. *Anther* 12.5–13 x 0.3–0.35 cm, elliptic, ciliate in the thecae margins, split opens from top to bottom, attached with the filament at 3–3.5 mm above from base, thecae right angles to the filament; connective white, glabrous, minutely crested, *c.* 0.5 mm long, tip truncate. *Ovary* 4–5 x 2.5–3.5 mm, oblong, pale green, densely pubescent externally. *Style* filiform,

white, glabrous, pubescent towards tip, green tinged towards stigma. *Stigma c.* 1 mm wide, green, cup-shaped, slanting with a depression at center, pubescent, hairs hook-like, 1.5–2 mm exserted from the anther. *Epigynous glands* two, 2.5–3 mm long, oblong, pale yellow, rounded at tip. *Fruits c.* 2.5 x 1.5 cm, loculicidal capsule, ovate-elliptic, three-angled, subtrigonous; fruit wall yellow externally (when mature), orange internally, completely splitted and refexed back on dehiscence. *Seeds c.* 5 x 3 mm, angular, red, yellow at base, compactly arranged on column. *Aril* red, lacerate, basal.

Notes: The species was described based on a material brought from Kasom Khullen, Manipur and flowered in Tropical Botanical Garden, Palode. While describing the species the authors compared it with *H. forrestii*, and distinguished it in having "elliptic-oblong, acuminate leaves, dense inflorescence, oblong apicualte bracts, linear staminodes, ovate labellum and twice longer stamens". But, our studies based on the live specimens revealed that, it is closely allied to *H. stenopetalum* than *H. forrestii,* but differs from it in having shorter, dense and conical inflorescence, orbicular labellum and sword-shaped lateral staminodes. Like *H. stenopetalum, H. larsenii* also shows a wide range of variation in the size of habit, size of inflorescence and number of flowers per cincinnus depending on the age of rhizome and habitat.

Etymology: The specific epithet honours Prof. Kai Larsen, Denmark for his valuable contributions to the family Zingiberaceae of the world.

Flowering & Fruiting: July–September.

Distribution: Endemic to Northeast India. Known only from the type locality and Mizoram, India. (*Figure 36. A*)

IUCN Red list Category: Known only from the type locality and adjacent areas of Mizoram. As having very restricted, sparse distribution and facing high risk of extinction in wild, the species is assessed against Critically Endangered (CR B1b(i,ii)+ 2b(i,ii); E) category as per IUCN Guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

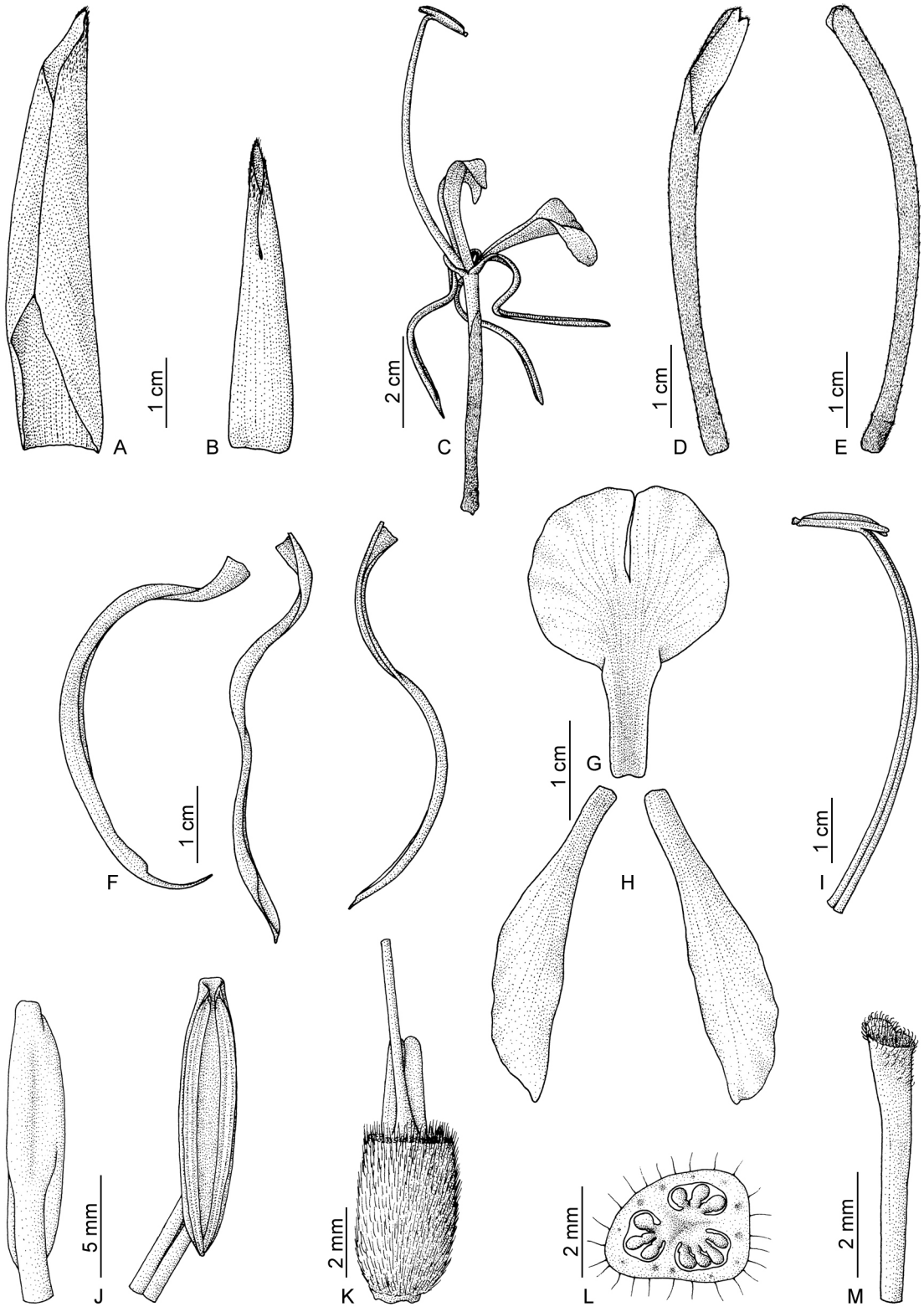

Figure 35. ***H. larsenii***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, back view (left) and front view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

Specimens examined: **INDIA. KERALA**. THIRUVANANTHAPURAM Dt.: Tropical Botanical Garden and Research Institute (Originally introduced from Kasom Khullen, Thoubal Dt., Manipur), 23 Sep 1997, *M. Dan 22698 A-C* (TBGT), 22 Jul 1998, *M. Dan 36219 b* (TBGT), *M. Sabu 86572* (CALI). **MIZORAM**. MAMIT Dt.: 17 Km from Mamit to Aizwal, 3 Jun 2008, *V.P. Thomas & A.V. Prasanth 113425* (CALI). LAWNGTLAI Dt.: Mampui, 307 m., N 22°22'55.0", E 092°45'55.9", 12 Sep 2002, *M.G. Prasanth Kumar & Jana Skornickova 86250* (CALI).

18 Hedychium longipedunculatum

H. longipedunculatum Sastry & D.M. Verma, J. Bombay Nat. Hist. Soc. 6: 293. 1968; A.S. Rao & D.M. Verma, Bull. Bot. Surv. India 14(1-4): 130. 1972; S.C. Srivast. in S.K. Jain & R.R. Rao, Threat. Pl. India 236. 1983; S.K. Jain & V. Prakash., Rheedea 5(2): 161. 1995.

Type: INDIA. Arunachal Pradesh, Subansiri Dt., Amjee, 1220 m., 22 May 1966, *A.R.K. Sastry 45509* (holo CAL!; iso ASSAM!). (*Plate 18. E–G*)

Epiphytic, perennial rhizomatous herbs. *Rhizome* 1.8-2.3 cm wide, pale greenish-yellow internally, light greyish-green externally, slightly aromatic. *Leafy shoot* 25–40 cm high, slanting with erect inflorescence. *Leaves* 4–6 in number, spreading, sessile, upper petioled; petiole 3–16 mm long; ligule *c.* 1.5–2 cm long, single-lobed, notched at tip, glabrous, membranous, translucent, papery, closely appressed to the stem; lamina 15–23 x 6–10 cm, broadly elliptic, dark green above, light pinkish-purple below, glabrous; margin undulate, membranous, translucent, pink tinged, non-ciliate; tip abruptly caudate-acuminate, twisted; base acute. *Inflorescence* 9–20 cm long, cylindrical, erect; rachis hairy. *Bracts c.* 11 x 7 mm, triangular, pinkish-red, glabrous, convolute; margin non-ciliate, translucent, membranous, tip acute, cincinnus 1-flowered. *Bracteoles c.* 6 x 4 cm, membranous, acute at tip, red, glabrous, completely encircles the flower. *Flower* 3–3.3 cm long,

creamy yellow, 8–13 flowers open at a time, ascending, fragrant. *Calyx c.* 11 mm long, pale yellow, densely villous, membranous, tufted hairs at tip, unilaterally split at tip. *Corolla tube c.* 11 mm long, creamy yellow with pale red, glabrous externally, hairy internally, erect. *Corolla lobes c.* 1.6 x 0.3 cm, linear-lanceolate, creamy yellow, pale red tinged towards tip, 3-nerved, membranous, glabrous. *Lateral staminodes c.* 1.7 x 0.7 cm, spatulate, clawed towards base, creamy-yellow, spreading on flower, slightly reflexed back. *Labellum c.* 1.5 x 0.6 cm, spatulate, creamy yellow, spreading on flower, slightly reflexed back on upper half, distinctly clawed at base; claw *c.* 2 mm wide; sinus *c.* 1 cm deep; lobes oblong, obtuse at tip. *Stamen c.* 2.2 cm long, erect. *Filament c.* 1.5 cm long, *c.* 2 mm wide at base, yellow, erect. *Anther c.* 7 mm long, oblong, bright-yellow, split opens from top to bottom, attached with the filament at 2–3 mm above from base, thecae axis at an angle of parallel with the filament; anther cells diverging at base; connective bright-yellow, glabrous. *Ovary c.* 3 mm diameter, sub-globose, densely villous, obscurely three-angled. *Style* filiform, white, glabrous, green tinged towards stigma. *Stigma c.* 1 mm wide, green, cup-shaped, slanting with a depression at center, pubescent, hairs hook-like. *Fruits c.* 1.5 cm diameter, sub-globose, three-angled, hairy, trilocular; fruit wall fleshy, orange internally, completely splitted and refexed back on dehiscence. *Seeds c.* 3 x 1 mm, ellipsoid, smooth. *Aril* red, lacerate, fleshy.

Notes: The species *H. longipedunculatum* was described by Sastry and Verma (1968) from Subansiri District of Arunachal Pradesh. While describing the species, they compared it with *H. densiflorum*, and separated from it in having elliptic leaves, very long peduncle with much short flowering spike, bracts shorter than corolla tube, spatulate lateral staminodes, densely villous ovary and anther cells divergent at base. We could locate the plant from Arunachal Pradesh with our co-workers, but unable to collect live or herbarium specimens. The description provided here is based on Sastry and Verma (*l.c.*), Rao & Verma (1972) and types at CAL and ASSAM.



Plate 18. **A-D.** ***H. larsenii*****: A.** inflorescence; **B.** single flower, bract, bracteole and bud; **C.** labellum; **D.** lateral staminodes. **E-G.** ***H. longipedunculatum*****: E.** habit; **F.** inflorescence close-up; **G.** single flower (*G. Watt 11609,* CAL!).

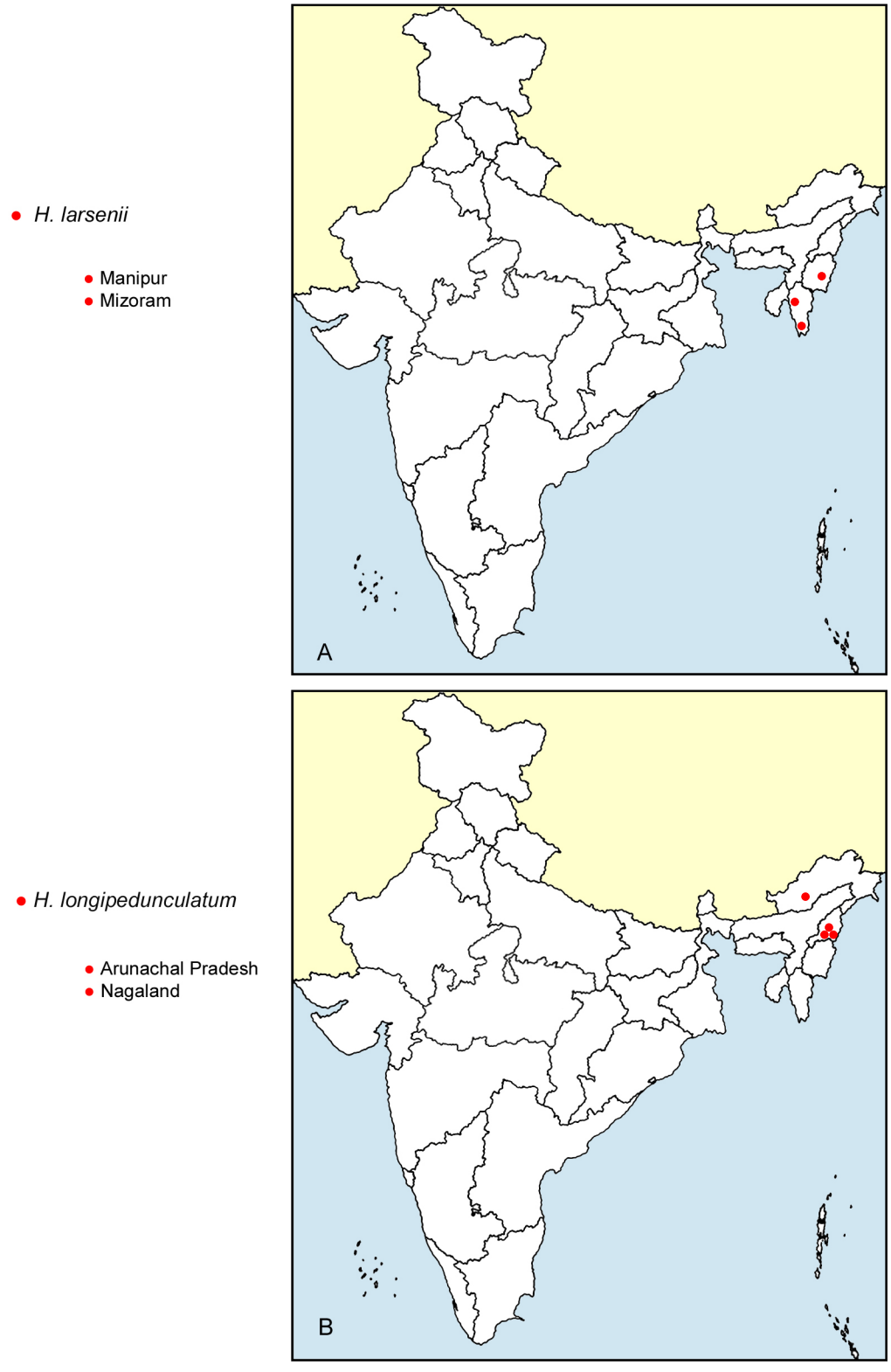

Figure 36. Distribution maps of
H. larsenii and ***H. longipedunculatum.***

Distribution: Endemic to Arunachal Pradesh and Konoma Hills of Nagaland, India, at an altitude of 1,200–2,000 m. (*Plate 36. B*)

Flowering & Fruiting: May–July.

IUCN Red list Category: Due to the endemism with very restricted area of occupancy of the species, it is assessed against the Critically Endangered (CR A2a; B1b(i,ii)+ 2ab(i,ii); E) category as per IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA. ARUNACHAL PRADESH.** LOWER SUBANSIRI Dt.: Hapoli Vicinity, 28 May 1966, *A.R.K. Sastry 45584* (ASSAM); Begi to Amjee, 12 May 1966, *A.R.K. Sastry 45222* (ASSAM). **NAGALAND.** Naga Hills, Namung, Feb 1844, *s.coll. s.n.* (CAL); Naga Hills, Jun 1935, *N.L. Bor 21210* (ASSAM). KOHIMA Dt.: Khonoma Hill, 7500 ft., 19 May 1895, *G. Watt 11609* (CAL). PHEK Dt.: Kilomi, 5900 ft., 26 Jun 1935, *N.L. Bor 4480* (K).

19 Hedychium marginatum

H. marginatum C.B. Clarke, J. Linn. Soc. 25: 75. t. 31. 1890; Baker in J.D. Hooker, Fl. Brit. India 6: 226. 1892; K. Schum. in A. Engler, Pflanzenr. IV. 46(heft 20): 46. 1904; J.N. Mitra, Monocot. E. India 1: 242. 1958; Naik & Panigrahi, Bull. Bot. Surv. India 3(1): 72. 1961; A.S. Rao & D.M. Verma, Bull. Bot. Surv. India 11(1&2): 126. 1969, 14(1-4): 129. 1972; Deb, Fl. Tripura 2: 377. 1983; S.C. Srivast. in S.K. Jain & R.R. Rao, Threat. Pl. India 235. 1983; Karthik. et al., Fl. Ind. Enum. Monocot. 295. 1989; S.K. Jain & V. Prakash., Rheedea 5(2): 161. 1995 ; Chaturv. & Moaakum, Folia Malaysiana 9(2): 134. 2008.

Type: INDIA. Nagaland. Kohima, 4500 ft., 3 Nov 1885, *C.B. Clarke 41513* (holo K!; iso BM!, CAL!). (*Figure 37; Plate 19. A–F*)

Hedychium luteum Baker in J.D. Hooker, Fl. Brit. India 6: 232. 1892, *syn. nov*.; King & Prain, Ann. Roy. Bot. Gard. Calcutta 9(1): 70. t. 86. 1898. K. Schum. in A. Engler, Pflanzenr. IV. 46(heft 20): 53. 1904; J.N. Mitra, Monocot. E. India 1: 242. 1958; S.C. Srivast. in S.K. Jain & R.R. Rao, Threat. Pl. India 235. 1983; Karthik. et al., Fl. Ind. Enum. Monocot. 295. 1989; S.K. Jain & V. Prakash., Rheedea 5(2): 161. 1995.

Type: T. Thomson, illustration at Calcutta Herbarium, Nov 1854, *s.n.* (Icono CAL!).

(*Plate 19. G*)

H. aurantiacum auct. non Roscoe: Chaturv. & Moaakum, Folia Malaysiana 9(2): 130. 2008.

H. flavescens auct. non Lodd.: Chaturv. & Moaakum, Folia Malaysiana 9(2): 133. 2008.

Terrestrial, perennial rhizomatous herbs. *Rhizome* 2.2–3 cm wide, monopodial branching, creamy white internally, aromatic. *Leafy shoot* 105–150 cm high, slanting. *Leaves* 15–22 in number, 5.7–10 cm apart, spreading on plant, sessile; ligule 2.6–3.6 × 1.1–1.8 cm, lanceolate, single-lobed, pale green, sericeous, externally membranous, closely appressed to stem, tip obtuse; lamina 24.2–30.6 × 6–6.5 cm, elliptic-oblanceolate, dark green and glabrous above, pale green (pale pink tinged towards base on lower leaves) and sericeous below; margin non-ciliate, translucent, pale pink tinged; tip twisted, long acuminate; base obtuse; midrib pale green above. *Inflorescence* 6.5–10 cm long, elliptic, dense. *Bracts c.* 3.9 × 1.6 cm, spatulate, boat-shaped, green with red tinge, sparsely pubescent externally, moderately coriaceous, imbricate; margin non-ciliate, translucent; tip rounded, tuft of hairs at tip, hairs brown; cincinnus 2–4 -lowered. *Bracteoles c.* 1.6 × 1 cm, white with red tinge, pubescent externally, membranous, translucent, non-tubular; margins non-ciliate. *Flower* 9.8–10.2 cm long, lemon-yellow (turn to much dark yellow on second day), spreading, 4–8 flowers open at a time. *Calyx* 3.4–3.5 cm

long, *c.* 2.5 mm wide at mouth, pale greenish-yellow with red tinge, pubescent externally, membranous, translucent, upper half slightly inflated, lower half closely appressed to corolla tube, unilaterally split upto 1.1 cm deep, obscurely 3-toothed at tip, unequal. *Corolla tube* 6.5–6.6 cm long, *c.* 3 mm wide at mouth, lemon-yellow, whitish towards base, slightly arching, glabrous externally, hairy internally along the margins of filament groove. *Corolla lobes* lemon-yellow, membranous, drooping from flower, glabrous; dorsal lobe 3.5–3.6 × *c.* 0.4 cm, 1.5–2 mm long beaked at tip; lateral lobes 3.1–3.3 × *c.* 0.4 cm, non-beaked at tip. *Lateral staminodes* 2.8–3 × 0.4–0.45 cm, oblanceolate, lemon-yellow, upper half reflexed back, outer margin undulate, tip obtuse. *Labellum* 2.6–2.7 × *c.* 1.7 cm, obovate, lemon-yellow, upper half reflexed back spreading on flower, gradually clawed at base; claw *c.* 5 mm wide; sinus 8–9 mm deep; lobes obtuse at tip; outer margin undulate. *Stamen* 3.7–3.8 cm long. *Filament* 2.6–2.7 cm long, *c.* 1.5 mm wide at base, lemon-yellow, slightly arching. *Anther c.* 1.2 × 0.25 cm, oblong, lemon-yellow, oblong, lobes parallel, split opens from top to bottom, attached with the filament at *c.* 1.5 mm above from base, anther parallel with the filament axis; connective yellow, glabrous, prolonged in to a very minute crest (*c.* 0.5 mm long), truncate at tip. *Ovary c.* 2.5 × 2.5 mm, barrel-shaped, pale red, densely pubescent externally. *Style* filiform, white, glabrous, green tinged towards stigma. *Stigma c.* 1.5 mm wide, green, stigmatic head flat, slanting with a depression at center, hairy, hairs hook-like. *Epigynous glands* two, *c.* 2.5 mm long, oblong, oblong, yellow.

Notes: H. marginatum was described for the first time by Clarke (1890) based on a specimen collected from Kohima (*C.B. Clarke 41513*). He described it as a distinct species mainly because of the villous nature of the tips of bracts and yellow labellum. The plate number XXXI associated with the protologue does not match with the type material mainly on the winged filaments, bifid ligule, cylindrical inflorescence and single flowered bracts. It is assumed that the drawing was made using an abnormal specimen.

Subsequently, Baker (1892) described another species *H. luteum* based on a colour plate made at Calcutta Herbarium under the supervision of T. Thomson, the then Superintendant of Royal Botanical Garden in November 1854. However, H.F. Link mentioned the same epithet *H. luteum* long back in 1821 in 1st volume of his '*Enumeratio Plantarum Beroliensis'* (p. 443) under *"Addenda et Emendanda"* as "*H. coccineum et angustifolium Bot. Mag. non differre videntur. Accepimus quoque H. luteum ex hort. Angl. Quod nondum floruit"* (translated as – *H. coccineum* and *H. angustifolium* of the *Botanical Magazine* do not differ. We have also received *H. luteum* of English gardener which has not yet flowered). Link's species is invalid as there is not a descriptive word or a reference. In horticultural circles a lot of names float about without any nomenclatural status. While describing *H. luteum,* Baker did not refer to Link and he described the species only on the basis of the drawing of Thomson at CAL. Code (McNeill *et al.* 2006) has no restrictions for a later use of "*luteum*" in the genus, and so it is quite acceptable when it was used in the *Flora of British India*. Hence it is also difficult to say whether *H. luteum* of Baker and that of Link are one and the same. Later, the drawing of Thomson was reproduced by King and Prain (1898) and described as *H. luteum*, and we could also locate Thomson's original illustration from Calcutta Herbarium.

Baker (1892) placed *H. marginatum* under the subgenus: *Gandasulium* (Stamen never much longer than lip) and *H. luteum* under the subgenus: *Macrostemium* (Stamen much longer than lip). However, in both cases stamen longer than the lip (stamen rather longer than lip, and stamen half as long again as lip respectively), as evidenced by types. While describing *H. luteum* Baker mentioned the "labellum orbicular, bifid and distinctly clawed". This statement is a mistake made by Baker while interpreting Thomson's drawing. Based on the many live specimens from Kohima, Mokokchung, Phek Districts of Nagaland and Champhai District of Mizoram revealed that, the labellum is obovate, bifid up to 8–9 mm deep and gradually clawed. Moreover it is one of the species which shows a wide range of variation in labellum size, shape and length of nature of claw.

Schumann (1904) also treated *H. marginatum* and *H. luteum* under two subgenera, *viz.*, *Gandasulium* and *Euosmianthus* respectively. But, based on the detailed protologue and type studies we concluded that, both are conspecific. Hence *H. luteum* is reduced as a new synonym of the latter.

Recently, Rao and Verma (1972) also treated *H. marginatum* and *H. luteum* as separate species. But they misidentified and described another taxon as *H. luteum.* The detailed studies on the possible material used by them (*D.M. Verma 34646* ASSAM!) and the description provided it turnout to be a new species. During the revisionary work of Indian *Hedychium* we could also collect live plants of this species from Nagaland and is described elsewhere.

Flowering: August–September, so far no fruiting has been observed.

Distribution: Endemic to Northeast India. Known only from solitary collections from Meghalaya, Mizoram and Tripura, and common in Kohima, Phek and Mokokchung Districts of Nagaland at an altitude of 900-1,200 m.

(*Figure 39. A*)

IUCN Red list Category: The species is common at Kohima, Mokokchung and Phek Districts of Nagaland (about 6,750 sq. km) and sparse at Mizoram and Tripura, and is facing high risk of threat in the wild. Hence the species is assessed as Vulnerable (VU A2a; B1b(i,ii)+2b(i,ii); C1; D2) as per IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA**. **MANIPUR**. IMPHAL Dt.: Imphal, 17 Aug 1951, *D.B. Deb 290* (CAL), 16 Aug 1951, *D.B. Deb 337* (CAL). **MIZORAM**. CHAMPHAI Dt.: 2 Km from Murlin Village towards Vapar, 24 Aug 2008, *A.V. Prasanth & M.C. Shameer 115412* (CALI). **NAGALAND**. *s.loc., D.M. Verma 34649* (CAL). KOHIMA Dt.: Piffinsa,

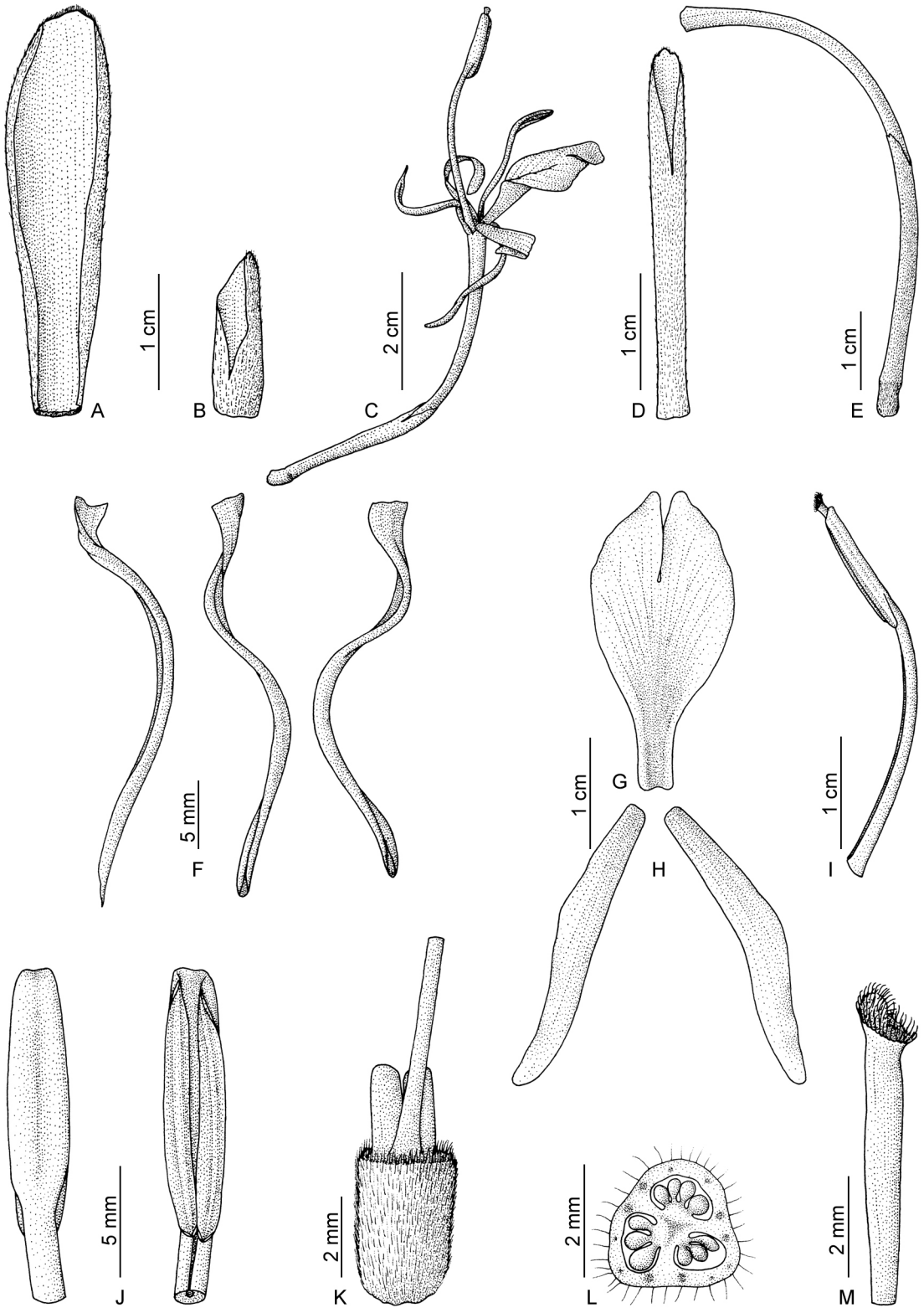

Figure 37. ***H. marginatum***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, back view (left) and front view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

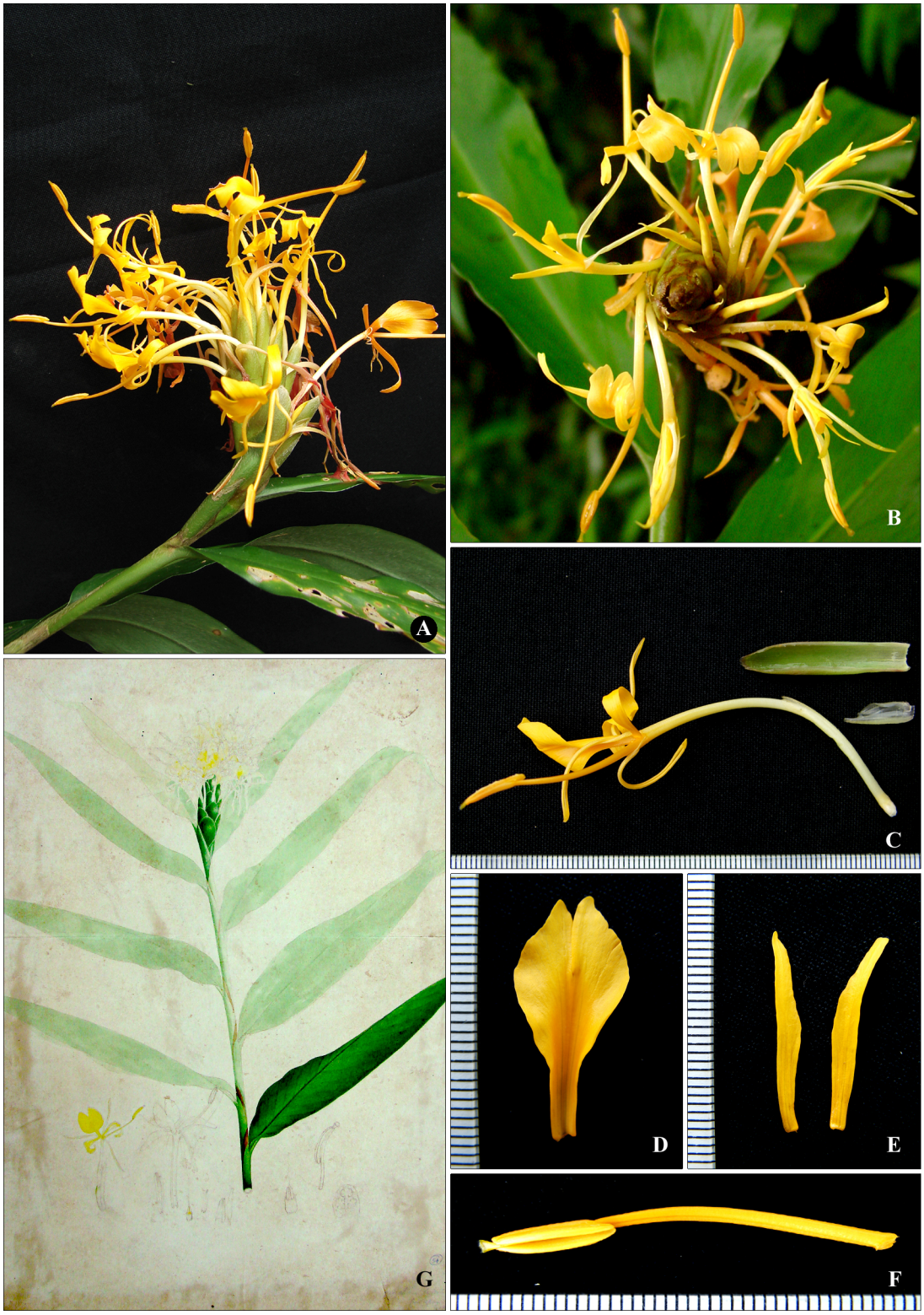

Plate 19. **A-F.** ***H. marginatum*****: A.** inflorescence; **B.** inflorescence showing spiral arrangement of flowers; **C.** single flower, bract and bracteole; **D.** labellum; **E.** lateral staminodes; **F.** stamen. **G.** ***H. luteum*****,** Iconotype at CAL.

3000 ft., 18 Oct 1885*, C.B. Clarke 42094* (CAL); Kohima, 19 Oct 1885, 4000 ft., *C.B. Clarke 40926* (CAL), 4 Sep 1937, *G.K. Deka 19654* (ASSAM). MOKOKCHUNG Dt.: Meinkiong, 1400 m., N 26°21'40", E 094°33'56", 20 May 2006, *M. Sabu & A.K. Pradeep 103621* (CALI), 27 Aug 2006, *E. Sanoj & V.P. Thomas 105536, 105539* (CALI); 5 Km from Phek to Kutsepo, 6 Sep 2006, *E. Sanoj & V.P. Thomas 105611, 105615* (CALI). PHEK Dt.: Jotsoma, Jul 1886, *D. Prain 9, 16, 18* (CAL), 2 Km from Kohima city, 1400 m., 23 May 2006, *M. Sabu & A.K. Pradeep 103629* (CALI), 31 Aug 2006, *E. Sanoj & V.P. Thomas 105569* (CALI). TUENSANG Dt.: Phalong, Naga Hills, 4000 ft., Dec 1907, *A. Meebold 7086* (CAL). **TRIPURA**. Sardukchira, *D.B. Deb 1460* (CAL).

20 Hedychium maximum

H. maximum Roscoe, Monandr. Pl. Scitam. 3/4: t. 52. 1824; Ker Gawler, Bot. Reg. 12: t. 1022. 1826; A. Dietr., Sp. Pl. 1: 32. 1831; Paxton, Paxton's Mag. Bot. 4: 204. 1838; D. Dietr., Syn. Pl. 1: 9. 1839; Horan., Prodr. Monogr. Scitam. 24. 1862; K. Schum. in A. Engler, Pflanzenr. IV. 46(heft 20): 45. 1904; Turrill, Bull. Misc. Inform. Kew 1914(10): 368. 1914; Karthik. et al., Fl. Ind. Enum. Monocot. 295. 1989.

Type: Roscoe, Monandr. Pl. Scitam. 3/4: t. 52. 1824.

H. coronarium var. *δ* Wall. in W.J. Hooker, Hooker's J. Bot. Kew Gard. Misc. 5: 325. 1853, J. Hort. Soc. London 9: 15. 1855; C. Muell., Ann. Bot. Syst. 6: 23. 1861.

H. coronarium var. *maximum* (Roscoe) Baker in J.D. Hooker, Fl. Brit. India 6: 226. 1892; Naik & Panigrahi, Bull. Bot. Surv. India 3(1): 71. 1961; A.S. Rao & D.M. Verma, Bull. Bot. Surv. India 14: 129. 1972. (*Figure 38; Plate 20. A–E*)

H. coronarium auct. non J. Koenig: Chaturv. & Moaakum, Folia Malaysiana 9(2): 133. 2008.

Common Name: Large White *Hedychium.*

Terrestrial perennial rhizomatous herbs. *Rhizome* 2.6–3 cm wide, creamy white internally, pale pink externally, slightly aromatic, covered by brown scales. *Leafy shoot* 100–120 cm high, slanting with erect inflorescence, robust. *Leaves* 12–16 in number, 6.3–10.4 cm apart, spreading, sessile; sheath 3.8–4.2 cm wide, margins green, membranous, translucent, pubescent; ligule 6.5–7 x *c.* 1.4 cm long, ovate, single-lobed, obtuse at tip, pale green, pubescent externally, membranous, translucent, papery, closely appressed to the stem; lamina 44–50.5 x 7–8.3 cm, elliptic, dark green and puberulent above, pale green and pubescent below; margin membranous, translucent, white tinged, non-ciliate; tip long caudate, twisted; base cuneate; midrib densely pubescent below. *Inflorescence* 11.5–14.6 cm long, elliptic, dense, erect, compact with imbricate bracts. *Bracts* 5.5–5.7 x 2.9–3.4 cm, widely ovate, green, glabrous, pubescent towards tip margins, coriaceous, closely imbricate; margin non-ciliate, translucent, membranous, white, tip obtuse, cincinnus 3–4 -flowered. *Bracteoles* 3.7–3.9 x 3–3.3 cm outer one tubular, translucent, slightly 2 lobed at tip, pale green, white towards base, glabrous, pubescent towards tip, outer, leathery. *Flower* 15.3–15.7 cm long, white, 5–7 flowers open at a time, ascending, slightly fragrant. *Calyx* 4.4–4.5 cm long, *c.* 6 mm wide at mouth, pale green, pubescent, glabrous towards base, membranous, translucent, upper 2/3rd portion inflated, lower part closely appressed to corolla tube, unilaterally split upto 1.9–2 cm, 3-toothed at tip. *Corolla tube* 10–10.3 cm long, *c.* 5 mm wide at mouth, pale pink, sparsely hairy along dorsal side externally, hairy internally, bend to one side at centre. *Corolla lobes* oblong, white, pale greenish tinged towards tip, membranous, early decaying at base, drooping from flower, glabrous; dorsal lobe 5.7–5.9 x *c.* 1.1 cm, *c.* 9 mm long beaked at tip; lateral lobes 4.8–5 x *c.* 1 cm, *c.* 1 mm long beaked at tip. *Lateral staminodes* 5.7–6 x 3.2–3.4 cm, widely spatulate, clawed towards base, white, pink at base, spreading on flower, reflexed back, margin undulate, slightly notched at tip. *Labellum* 6.5–6.7 x 5.9–6.2 cm, very widely ovate, white, creamy yellow at centre and towards base,

spreading on flower, reflexed back on upper half, base cordate, abruptly clawed at base; claw 1–1.2 mm wide; sinus 1.4–1.8 cm deep; margin undulate, lobes rounded at tip. *Stamen* 5.8–6 cm long, slightly arching, pink with creamy yellow anther openings. *Filament* 4.6–4.8 cm long, *c.* 3 mm wide at base, pink, slightly arching. *Anther* 1.8–1.9 x *c.* 0.3 cm, oblong, sickle shaped in lateral view, split opens from top to bottom, attached with the filament at 5–6 mm above from base, thecae at an angle of 65°–70° with the filament axis; anther suture reddish-orange; connective pink, glabrous, non-crested, tip slightly notched. *Ovary* 5–6 x 4–4.5 mm, oblong, pale green, densely pubescent externally, angular. *Style* filiform, white, glabrous, pubescent towards tip, broadens and green tinged towards stigma. *Stigma c.* 2 mm wide, green, cup-shaped, slanting with a depression at center, pubescent, hairs hook-like, bulbous based, *c.* 1.5 mm exserted the anther. *Epigynous glands* two, 4.5–5 mm long, oblong, yellow, irregularly lobed at tip.

Notes: H. maximum is closely allied to *H. coronarium*, but can be distinguished from it mainly by its broader lamina, longer and broader lateral staminodes and labellum with pink tinges at the base and pink coloured filament. It also differs in the pubescent nature of calyx and ovary which is glabrous in *H. coronarium.* It differs from *H. coronarium* var. No. 1 in having white flowers and pink stamen, which is longer than labellum.

It was described by William Roscoe in his *Monandrian Plants* (1824) based on a plant sent by Loddiges in 1822 to Botanic Garden, Liverpool. While describing the species he compared it with *H. coronarium* and specifically differentiated from the latter. Later it was described by Ker Gawler in *Botanical Register* (1826), based on a plant introduced from India to British Gardens. While describing the species, he provided a generalized description of the species and an illustration prepared on the basis of a cultivated plant in Mr. Colvill's Nursery.

Later, Baker (1892) reduced it as a variety of *H. coronarium* and mentioned that leafy stem is taller than the type and flowers are pure white. Turrill (1914)

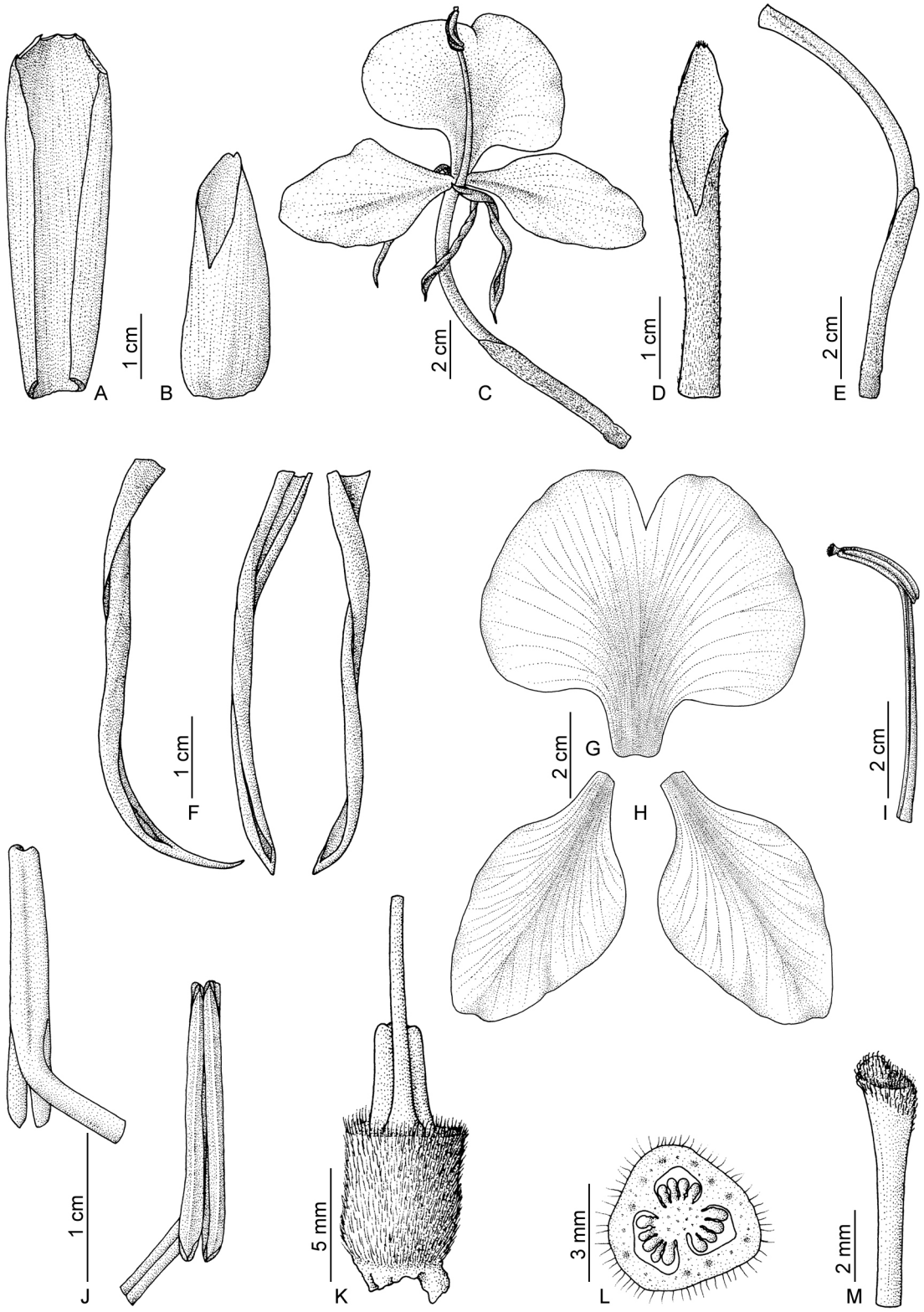

Figure 38. ***H. maximum***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, back view (above) and front view (below); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

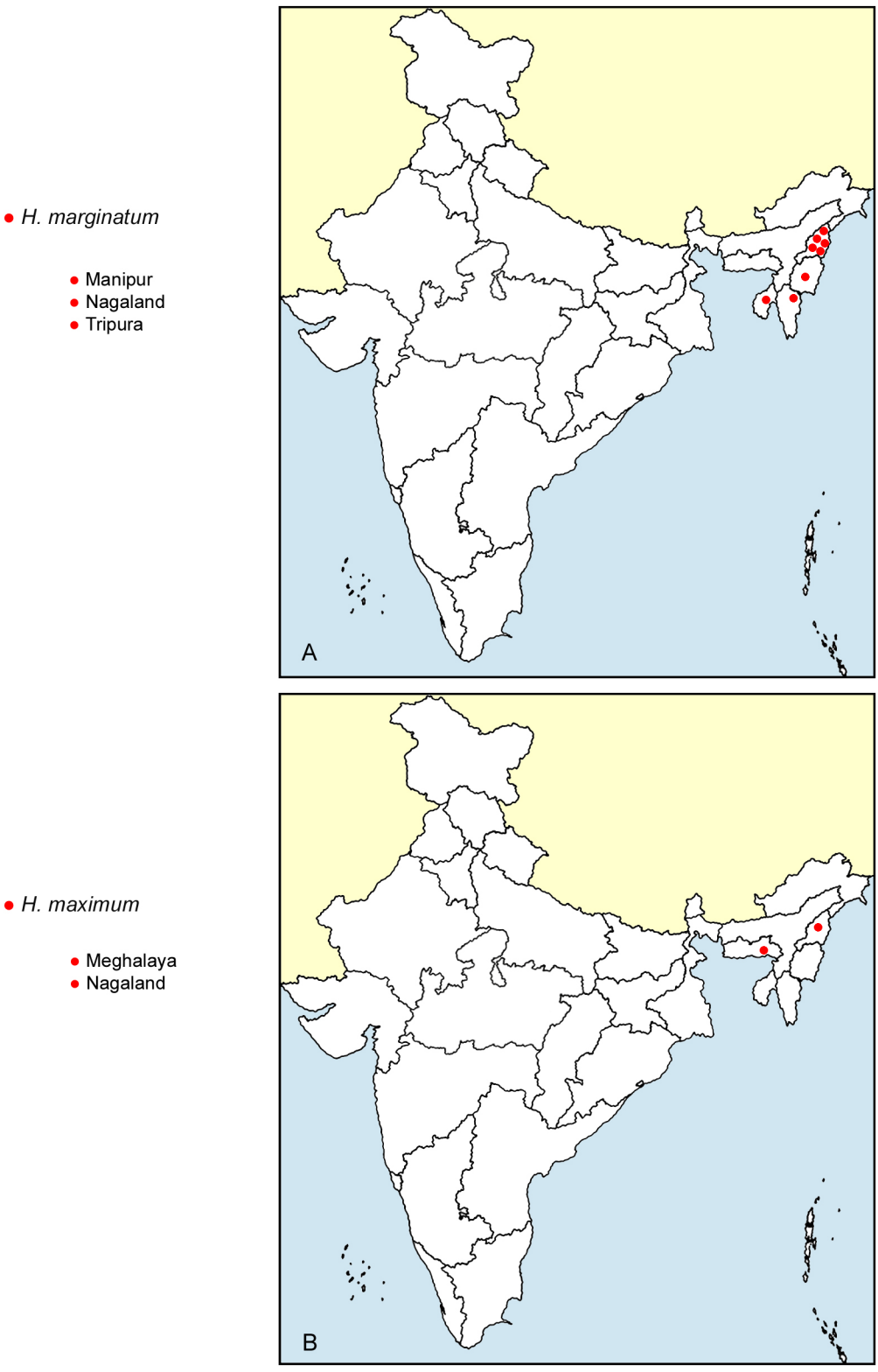

Figure 39. Distribution maps of
H. marginatum, and ***H. maximum***.

mentioned it as a probable variety of *H. coronarium* but treated at specific level. But based on our observations on live plants, we kept it as a distinct species.

Flowering: July–September.

Distribution: Endemic to Meghalaya and Nagaland. Collected from East Khasi Hills District of Meghalaya and Mokokchung District of Nagaland. The present collection form the rediscovery of the species after 60 years. (*Figure 39. B*)

IUCN Red list Category: There are only two collections of the species from Meghalaya, India. Because of the highly restricted distribution of the species, and smaller area of occupancy it is assessed against the Critically Endangered (CR B1b(i,ii,iv)+ 2b(i,ii,iv); E) category as per IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA**. **MEGHALAYA**. EAST KHASI HILLS Dt.: Shillong, 35 miles, G.S. Road, 6 Sep 1948, *G.K. Deka 22629* (CAL). **NAGALAND**. MOKOKCHUNG Dt.: Mokokchung, 26 Aug 2006, *E. Sanoj & V.P. Thomas 105514* (CALI).

21 Hedychium robustum

H. robustum A.S. Rao & P.K. Hajra, Bull. Bot. Surv. India 16: 166. 1974; S.C. Srivast. in S.K. Jain & R.R. Rao, Threat. Pl. India 236. 1983; S.K. Jain & V. Prakash., Rheedea 5(2): 161. 1995.

Type: INDIA. Arunachal Pradesh. Kameng Dt., Jamiri, near a stream to the right of the Rest House, 27 Aug 1974, *A.S. Rao 56654* (holo & iso ASSAM!).

(*Figure 40; Plate 20. F–H*)

Perennial rhizomatous herbs. *Rhizome* 4–5.5 cm wide, light yellowish internally, pale brownish externally, slightly aromatic, covered by brown scales. *Leafy shoot* 100–143 cm high, slanting with erect inflorescence, robust. *Leaves* 13–

15 in number, sessile; sheath 2–2.6 cm wide, margins green, membranous, translucent, pubescent; ligule 4.7–5.8 x *c.* 2.3 cm, ovate, single-lobed, tip unequal, obtuse, brownish or greenish-red, densely pubescent externally, membranous, translucent, closely appressed to the stem; lamina 56–68 x 9–10.4 cm, lanceolate, dark green and glabrous above, pale green and puberulent below; margin undulate, membranous, translucent, white tinged, non-ciliate; tip long caudate, twisted; base cuneate; midrib densely pubescent below. *Inflorescence* 38–40 cm long, cylindrical, lax, erect. *Bracts* 4.6–5.5 x 3.5–3.7 cm, elliptic, green with brown blotches, puberulent, pubescent towards tip, coriaceous, convolute; margin non-ciliate, translucent, membranous, white, tip obtuse-rounded, cincinnus 8–10 - flowered. *Bracteoles* 4.5–5.1 x 3.7–3.8 cm, non-tubular, coriaceous, slightly 2-lobed at tip, green with brown blotches, pubescent, puberulent towards base, outer one completely encircles the cincinnus. *Flower* 10–10.5 cm long, white, 8–11 flowers open at a time, ascending, slightly fragrant. *Calyx* 4.6–4.8 cm long, *c.* 4 mm wide at mouth, pale red, white towards base, pubescent, membranous, translucent, inflated, unilaterally split upto 2.2–2.4 cm, minutely 3-toothed at tip. *Corolla tube* 5.3–5.8 cm long, *c.* 4 mm wide at mouth, white, hairy internally, slightly bend to one side at centre. *Corolla lobes* elliptic, white, membranous, drooping from flower, glabrous; dorsal lobe 6–6.2 x 0.7–0.8 cm, 1.5–1.8 mm long beaked at tip; lateral lobes 4.8–5 cm x 6–6.5 cm, 2–2.5 mm long beaked at tip. *Lateral staminodes* 4.3–4.6 x 0.9–1 cm, oblanceolate, gradually clawed towards base, white, spreading on flower, reflexed back, margin undulate, tip rounded. *Labellum* 4.5–4.7 x 2.8–3 cm, elliptic, white, very faintly creamy yellow at centre, spreading on flower, reflexed back on upper half, gradually clawed at base; claw 4.5–5 mm wide; tip non-emarginate, obtuse or rounded; margin undulate. *Stamen* 3–3.2 cm long, shorter than Labellum, slightly arching, white. *Filament* 1.7–1.8 cm long, *c.* 1.5 mm wide at base, white, slightly arching. *Anther* 1.3–1.4 cm x *c.* 2.5 mm, elliptic, creamy white at openings, ciliate in thecae margins, split opens from top to bottom, attached with the filament at *c.* 2 mm above from base, thecae axis parallel with the filament; connective white, glabrous, non-crested, tip slightly

notched or truncate. *Ovary* 6–7 x 3.5–4 mm, barrel-shaped, puberulent-pubescent, angular. *Style* filiform, white, glabrous, pubescent towards tip, green tinged towards stigma. *Stigma c.* 1.5 mm wide, green, cup-shaped, slanting with a depression at center, pubescent, hairs hook-like, 1.5–2 mm exserted above the anther. *Epigynous glands* two, 3–3.5 mm long, oblong, yellow.

Notes: While describing the species, Rao and Hajra (1974) distinguished it from *H. dekianum* in having robust habit, large and lax spike with entire labellum. We could locate a good population of this species with the same character, even after the lapse of about 30 years from Arunachal Pradesh. Another collection, *Noltie et al., 198* (E!), from Deothang (Samdrup Jongkhar District) of Bhutan shows the extended distribution of the species in Bhutan also.

While searching for the type materials of this species we could locate both the types, holotype and isotype, from the ASSAM itself and the holotype has not been transferred to CAL as per the protologue.

Flowering: August–November.

Distribution: Distributed in Samdrup Jongkhar District of Eastern Bhutan and West Kameng District of Western Arunachal Pradesh of India. (*Figure 43. A*)

IUCN Red list Category: Due to the very restricted extent of occurrence and area occupancy with fewer numbers of mature individuals this species is categorized against the Critically Endangered (CR B1ab(i,ii,iv)+ 2ab(i,ii,iv); C1) as per IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA**. **ARUNACHAL PRADESH**. WEST KAMENG Dt.: 5 km from Seppa towards Bomdila, 11 Aug 2003*, M. Sabu & A. K. Pradeep 92544* (CALI).

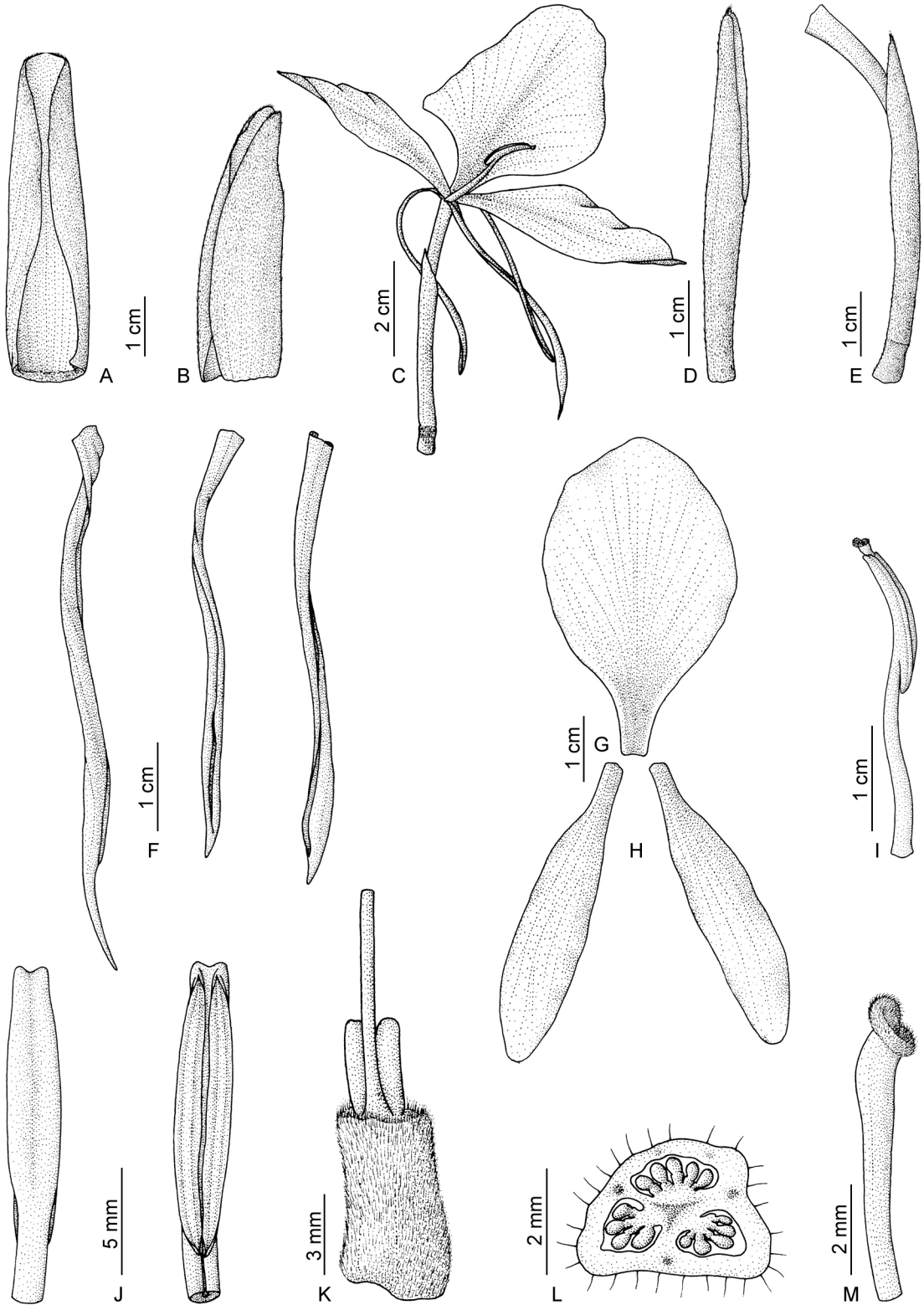

Figure 40. ***H. robustum***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, back view (left) and front view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

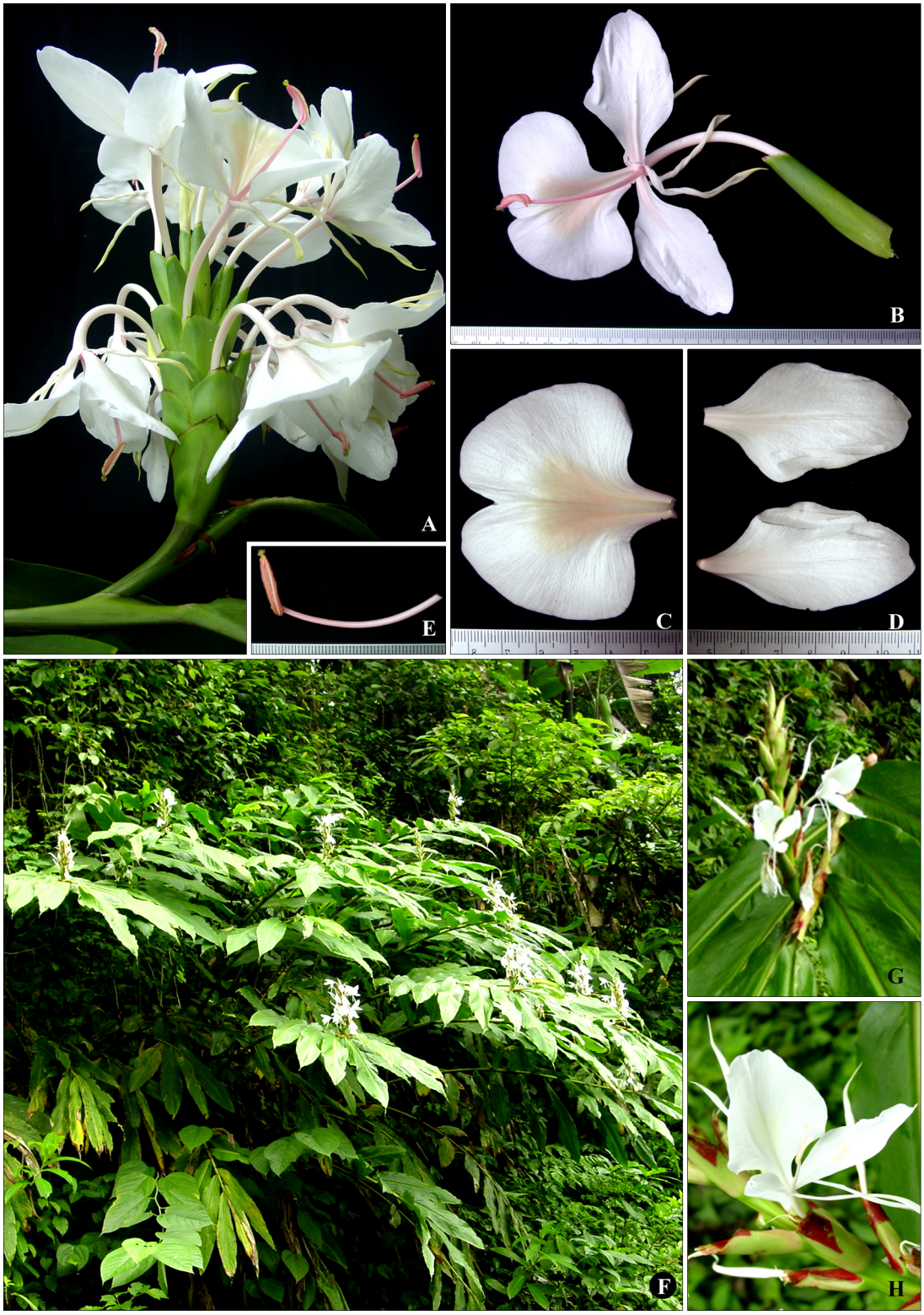

Plate 20. **A-E.** ***H. maximum*****: A.** inflorescence; **B.** single flower with bract; **C.** labellum,; **D.** lateral staminodes; **E.** stamen. **F-H.** ***H. robustum*****: F.** population; **G.** inflorescence; **H.** single flower close-up.

H. speciosum Wall. in W. Roxburgh, Fl. Ind. 1: 13. 1820; Spreng., Syst. Veg. 1: 9. 1825; A. Dietr., Sp. Pl. 1: 35. 1831; Wall., Pl. Asiat. Rar. 3: 51. t. 285. 1832; Paxton, Paxton's Mag. Bot. 4: 204. 1838; D. Dietr., Syn. Pl. 1: 10. 1839; Voigt, Hort. Suburb. Calcutt. 569. 1845; Baker in J.D. Hooker, Fl. Brit. India 6: 231. 1892; K. Schum. in A. Engler, Pflanzenr. IV. 46(heft 20): 54. 1904; Weathers, Bulb Book 269. 1911; J.N. Mitra, Monocot. E. India 1: 243. 1958; S.C. Srivast. in S.K. Jain & R.R. Rao, Threat. Pl. India 235. 1983; Karthik. et al., Fl. Ind. Enum. Monocot. 296. 1989; S.K. Jain & V. Prakash., Rheedea 5(2): 161. 1995.

Lectotype: NE BANGLADESH. Silhet, *G. Gomez & De Silva, Wallich 6550* (holo K, Microfische!).

H. gardnerianum var. β Horan., Prodr. Monogr. Scitam. 25. 1862.

Gamochilus speciosus (Wall.) T. Lestib., Ann. Sci. Nat., Bot. 2(15): 341. 1841.

(*Figure 41; Plate 21. A–C*)

Perennial rhizomatous herbs. *Rhizome* 2.6–3 cm wide, creamy white internally, slightly aromatic, covered by brown scales. *Leafy shoot* 60–65 cm high, erect. *Leaves* 5–6 in number, 4–5 cm apart, spreading, petiolate; petiole 1–1.5 cm long; sheath 1.8–2.2 cm wide, margins whitish-green, membranous, translucent, glaucous; ligule *c.* 1.5–2 cm, ovate, red tinged, single-lobed, truncate at tip, glabrous, glaucous externally, closely appressed to the stem; lamina 28–30 x 8–11 cm, elliptic, dark green and glabrous above, pale green, glabrous and glaucous below; margin undulate, membranous, translucent, white tinged, non-ciliate; tip long caudate, twisted; base cuneate. *Inflorescence* 24–25 cm long, cylindrical, lax, erect; rachis green, glabrous, glaucous. *Bracts* 3–3.3 x 1.2–1.5 cm, obovate, green, red tinged towards base, glabrous, glaucous externally, coriaceous, convolute;

margin non-ciliate, translucent, membranous, white, tip slightly notched, cincinnus 2-flowered. *Bracteoles* 1.8–2.3 x 0.45–0.5 cm (outer tubular), hyaline, slightly 2 lobed at tip, pale green, white towards base, glabrous, outer one completely encircles the cincinnus, leathery. *Flower* 11.7–12 cm long, lemon yellow with bright red stamens, many flowers open at a time, inclined on inflorescence, slightly fragrant. *Calyx* 2.4–2.8 cm long, *c.* 2 mm wide at mouth, creamy yellow, glabrous, hairy at the tip, membranous, translucent, closely appressed to corolla tube, unilaterally split upto 4–5 cm, 3-toothed at tip. *Corolla tube* 5.1–5.4 cm long, *c.* 2.5 mm wide at mouth, lemon yellow, glabrous externally, hairy internally, slightly bend to one side. *Corolla lobes* oblanceolate, lemon yellow, pale greenish tinged towards tip, membranous, drooping from flower, glabrous; dorsal lobe 4.2–4.5 x *c.* 0.35 cm, *c.* 2 mm long beaked at tip; lateral lobes 4.2–4.4 x *c.* 0.3 cm, non-beaked at tip. *Lateral staminodes* 3.6–3.8 x 0.4–0.5 cm, oblanceolate, lemon yellow, ascending on flower, reflexed back, margin undulate, tip acute. *Labellum* 3–3.1 x 1.2–1.3 cm, oblanceolate, lemon yellow, ascending on flower, gradually clawed at base; claw 1.2–1.5 mm wide; tip entire or emarginate upto 2–3 mm deep; margin undulate, lobes rounded at tip, irregularly lobbed. *Stamen* 6.6–6.7 cm long, slightly arching, bright red. *Filament* 5.8–6 cm long, *c.* 1.5 mm wide at base, bright red, slightly arching. *Anther* *c.* 8 x 1.5 mm, oblong, red, creamy white at openings, split opens from top to bottom, attached with the filament at *c.* 1.5 mm above from base, thecae axis parallel with the filament; connective red, glabrous, non-crested, tip truncate. *Ovary* 3–3.5 x *c.* 2 mm, oblong, pale green, glabrous. *Style* filiform, white, glabrous, broadens towards stigma. *Stigma c.* 2 mm wide, white with reddish spots, cup-shaped, slanting with a depression at center, bulbous projection at centre, pubescent, hairs hook-like, *c.* 1 mm exserted the anther. *Epigynous glands* two, *c.* 3 mm long, oblong, yellow.

Notes: The species *H. speciosum*, was described by Wallich in Roxburgh's *Flora Indica* (1: 13. 1820). It is a native of NE Bengal, and called as *'Kattia Lung Mutti'* in local Khasee language, was collected by G. Gomez and F. De Silva from

mountains of Sillet (Wallich 1832). Wallich noted that, it is one of the largest of the genus and the sessile undivided and acute lip distinguished it from the other species. It can be distinguished from other species in having long elongated spike, scattered fascicles with two-flowered cincinnus, pale yellow, fragrant flowers; lip entire, acute, ovate, tapering downwards; filament scarlet, somewhat longer than the tube. In *Plantae Asiaticae Rariores* (3: 51. t. 285. 1832) he also provided a colour drawing of the species. Roscoe (1828) noted that this is the only species that he had seen in the genus with entire lip (in the genus introduction), without providing a detailed description.

After the establishment of *H. gardnerianum* Ker Gawl. (Ker Gawler 1824b), Wallich (1853, 1855) concluded that "my *H. speciosum* and *H. gardnerianum* are identically one and the same species. I retain the latter name, being that of a very valued and honored friend ……." (*i.e.,* Edward Gardner), and reduced *H. speciosum* as the synonym of *H. gardnerianum*. But this retention cannot be accepted as per the priority deals of Nomenclature (ICBN Art. 11.3, McNeill *et. al.* 2006). Wallich himself stated that "I regret to say the figure in my *Plantae Asiaticae Rariores* does by no means justice to the plant, the original drawing having been taken from the first specimen sent down to me by post, from the Kasia range, by the late Mr. M. R. Smith, nearly forty years ago".

Hooker also described the species *H. gardnerianum* (Bot. Mag. 113: t. 6913. 1887), with *H. speciosum* and *H. aurantiacum* Roscoe as its synonyms. He also provided an excellent illustration of inflorescence and infructescence, based on a plant flowered in the Palm House of Royal Gardens, which was introduced by Wallich from Nepal.

Subsequently, Horaninow (1862) had observed the varietal difference between these two taxa and separated *H. speciosum* from synonymy and elevated as a variety, *H. gardnerianum* var. 'β'. Whereas the workers like Dietrich (1831),

Dietrich (1839), Voigt (1845), Baker (1892) and Schumann (1904) treated these taxa as distinct species.

Lestiboudois (1841) in *Annales des Sciences Naturelles; Botanique*, divided the genus *Hedychium* on the basis of labellum in to two. One is the nominal genus (labellum bifid) and another is *Gamochilus* T. Lestib., to include the species of *Hedychium* with entire labellum, with a single species *H. speciosum* Wall.

During this work we could collect both the taxa in live and their detailed morphological studies revealed that, they are closely related taxa but differs in a few characters which are sufficient to treat as a variety. As *H. speciosum* has priority over *H. gardnerianum,* the latter is reduced as new variety of the former.

Flowering: July–September.

Distribution: Restricted distribution in India, Bhutan and northern Bangladesh. In India distributed in Arunachal Pradesh, Meghalaya, Sikkim and West Bengal, at an altitude of 1,200-2,100 m. (*Figure 43. B*)

IUCN Red list Category: Due to the very restricted distribution of the species in Northeast India and Northern Bangladesh, and wider geographical distance between them, it is assessed here as Critically Endangered (CR B1b(i,ii,iv)+ 2ab(i,ii,iv); E) as per IUCN Guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA**. **ARUNACHAL PRADESH.** DIBANG VALLEY Dt.: Delei Valley, 28°20' N, 96°35' E, 4000 ft., *F.K. Ward 8501* (K). LOWER SUBANSIRI Dt.: 21st mile from Kimin, 26 Sep 1959, *G. Panigrahi 19597* (ASSAM); 2 km from Hapolin towards Itanagar, 8 Aug 2003, *M. Sabu & A.K. Pradeep 92541* (CALI). **MEGHALAYA**. Khasia, 4-6000 ft., *J.D. Hooker & J. Thomson s.n.* (E). EAST KHASI HILLS Dt.: Shillong, 6200 ft., 6 Sep 1886, *C.B. Clarke 44651* (CAL); Introduced in Woodlands, 26 Aug 1972, *U. Shukla 34697* (ASSAM). **SIKKIM**. *s.loc., G. King s.n.* (K), 6-7000 ft., *J.D. Hooker s.n.* (CAL). **WEST BENGAL**. DARJEELING Dt.: Darjeeling, Soone, 6000 ft., Sep 1874, *J.S. Gamble 8131* (MH).

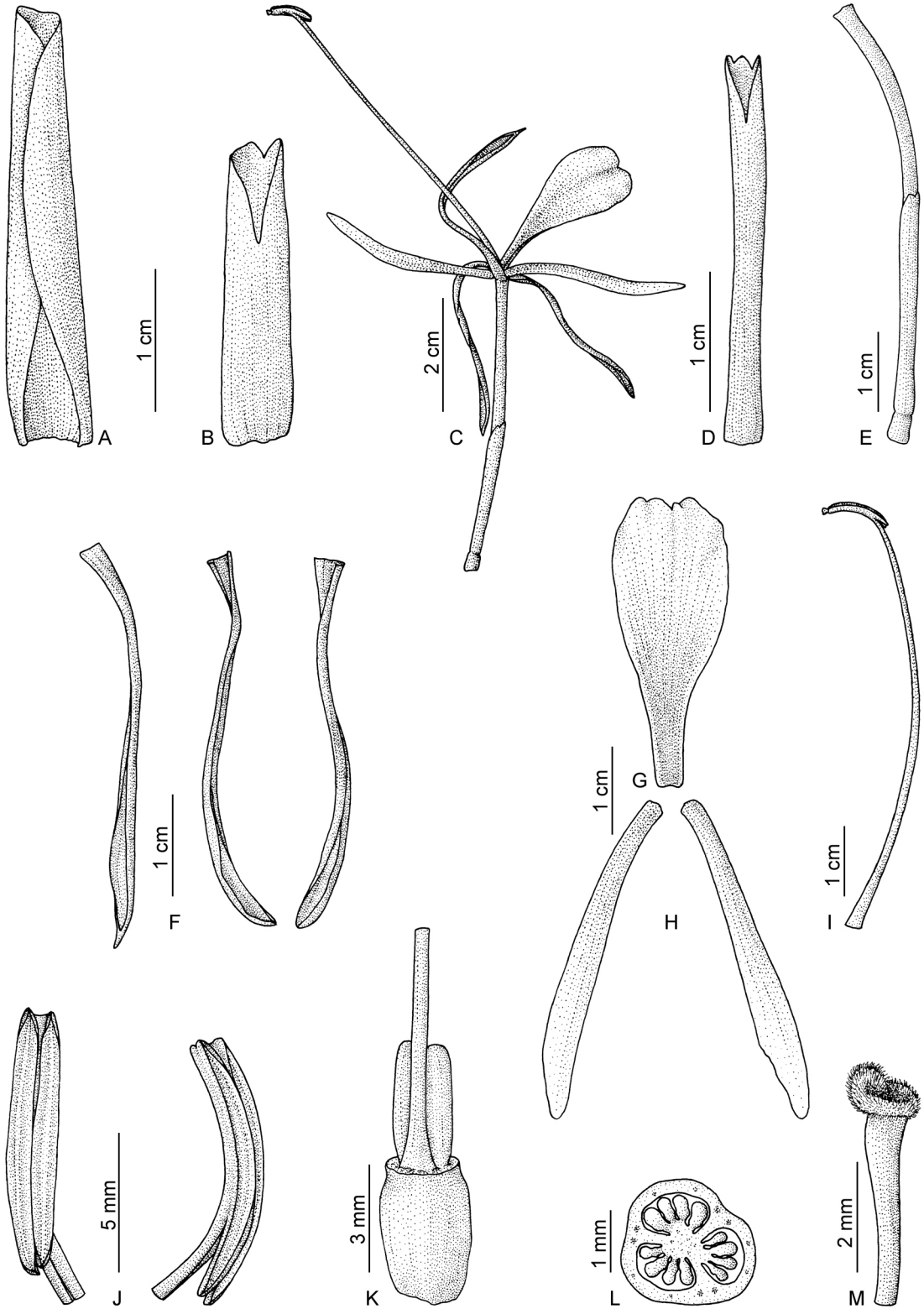

Figure 41. ***H. speciosum***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, front view (left) and lateral view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

Key to the varieties of *H. speciosum*

1a. Labellum oblanceolate, 1.2–1.3 cm wide; lateral staminodes 4–5 mm wide..... var. ***speciosum***

1b. Labellum obovate, 1.9–2 cm wide; lateral staminodes 7.5–9 mm wide..... var. ***gardnerianum***

22a **Hedychium speciosum** var. **gardnerianum**

H. speciosum var. ***gardnerianum*** (Ker Gawl.) Sanoj & M. Sabu, *stat. nov.*

H. gardnerianum Ker Gawl., Bot. Reg. 9. t. 774. 1824; Roscoe, Monandr. Pl. Scitam. 1/2: t. 62. 1824; A. Dietr., Sp. Pl. 1: 35. 1831; Paxton, Paxton's Mag. Bot. 4: 203. 1838; D. Dietr., Syn. Pl. 1: 9. 1839; Wall., Kew J. Bot. 369. 1853, J. Hort. Soc. London 9: 20. 1855 (excl. syn.); C. Muell., Ann. Bot. Syst. 6: 25. 1861 (excl. syn.); Horan., Prodr. Monogr. Scitam. 265. 1862 (excl. syn.); Voigt, Hort. Suburb. Calcutt. 570. 1845; Sci. committee Roy. Hort. Soc., Gard. Chron. 461. fig. 92, 93. 1875; Hook. f., Bot. Mag. 113: t. 6913. 1887 (excl. syn.); Baker in J.D. Hooker, Fl. Brit. India 6: 230. 1892**;** K. Schum. in A. Engler, Pflanzenr. IV. 46(heft 20): 56. 1904; Weathers, Bulb Book 269. 1911; J.N. Mitra, Monocot. E. India 1: 243. 1958; Naik & Panigrahi, Bull. Bot. Surv. India 3(1): 71. 1961; A.S. Rao & D.M. Verma, Bull. Bot. Surv. India 14: 133. 1972; N.P. Balakr., Fl. Jowai 2: 530. 1983; Karthik. et al., Fl. Ind. Enum. Monocot. 295. 1989; R.M. Sm. in A.J.C. Grierson & D.G. Long, Fl. Bhutan 2: 203. 1991; S.K. Jain & V. Prakash., Rheedea 5(2): 160. 1995; Press et al., Annot. Checkl. Fl. Pl. Nepal 330. 2000; S. Kumar, Zingber. Sikkim 52. 2001; M. Sabu & Pradeep, Folia Malaysiana 6(1&2): 13. 2005; Chaturv. & Moaakum, Folia Malaysiana 9(2): 133. 2008.

Type: Ker Gawler, Bot. Reg. 9: t. 774. 1824.

H. pallidum Regel, Index Sem. Hort. Petrop. 23. 1856, *syn. nov.,* Gartenflora 257. 1859,

Type: Unknown.

H. gardnerianum var. *pallidum* (Regel) Baker in J.D. Hooker, Fl. Brit. India 6: 230. 1892**;** Naik & Panigrahi, Bull. Bot. Surv. India 3(1): 72. 1961; Karthik. et al., Fl. Ind. Enum. Monocot. 295. 1989.

H. pynursulaeanum S.K. Jain & S.C. Srivast., J. Ind. Bot. Soc. 65(4): 535. 1986, *syn. nov.*; S.K. Jain & V. Prakash., Rheedea 5(2): 161. 1995.

Type: INDIA. Meghalaya, on way to Pynursula, 19 Jul 1981, *S.C. Srivastava 6174* (CAL). (*Figure 42; Plate 21. D–G*)

Common Name: Mr. Gardner's Garland Flower.

Terrestrial, perennial rhizomatous herbs. *Rhizome* 3–3.8 cm wide, creamy white internally, slightly aromatic, covered by brown scales. *Leafy shoot* 100–160 cm high, robust plants, slightly slanting with erect inflorescence. *Leaves* 12–16 in number, 5–9 cm apart, spreading, sessile; sheath 1.7–2.2 cm wide, margins white with green tinges, membranous, hyaline, non-ciliate, glaucous externally; ligule 1.7–2.3 x 1.7–2.2 cm long, oblong, single-lobed, rounded or truncate at tip, white with green tinges towards base, glabrous and glaucous externally, hyaline, closely appressed to the stem; lamina 29–49 x 7–12.3 cm, elliptic, glabrous, puberulent at tip, green above, pale green and glaucous below; margin undulate, membranous, translucent, white tinged, non-ciliate; tip long caudate, twisted; base obtuse. *Inflorescence* 22–30 cm long, cylindrical, lax, erect; rachis 6–8 mm thick, glabrous, glaucous. *Bracts* 3.5–3.6 x 1.4–1.5 cm, elliptic, pale green, red tinged towards base, glabrous, glaucous, coriaceous, convolute; margin non-ciliate, translucent, membranous, white, tip rounded, cincinnus 1–2 -flowered. *Bracteoles* 2.3–2.4 x

4.5–5 cm, tubular, translucent, pale red, glabrous, glaucous, completely encircles the cincinnus. *Flower* 12.5–12.8 cm long, lemon-yellow with red stamen, many flowers open at a time, inclined on inflorescence, slightly fragrant. *Calyx* 3.2–3.3 cm long, sub-equalising with the bract, *c.* 3 mm wide at mouth, pale green with red towards base, glabrous, membranous, translucent, upper 2/3 portion inflated, lower part closely appressed to corolla tube, unilaterally split upto 4–5 mm, 2-toothed at tip, teeth midrib hairy externally. *Corolla tube* 5.5–5.6 cm long, 2.5 cm longer than the bracts, *c.* 3 mm wide at mouth, yellowish green, white towards base, glabrous externally, hairy internally, erect. *Corolla lobes* narrowly oblanceolate, pale green, membranous, drooping from flower, glabrous; dorsal lobe 4.4–4.5 x *c.* 0.5 cm, *c.* 1.5 mm long beaked at tip; lateral lobes 4.2–4.3 x *c.* 0.45 cm, very minutely beaked at tip (*c.* 0.5 mm). *Lateral staminodes* 3.4–3.6 x 0.75–0.9 cm, spatulate, lemon-yellow, red-tinged towards the margins at base, ascending on flower, obtuse at tip. *Labellum* 2.9–3 x 1.9–2 cm, obovate, lemon-yellow, red-tinged towards the claw margins at base, ascending on flower, base cuneate, gradually clawed towards base; claw *c.* 4.5 mm wide; tip bilobed or acute. *Stamen* 6.9–7 cm long, red, slightly arching. *Filament* 6.4–6.6 cm long, *c.* 1.5 mm wide at base, red, slightly arching. *Anther* 8.5–9 x *c.* 2 mm, oblong, curved back, orange-red, hairy on the lateral sides of thecae, split opens from top to bottom, 2.5–3 mm long divided at base, thecae parallel with the filament; connective red, glabrous, non-crested, tip rounded. *Ovary* 3–3.5 x *c.* 2.5 mm, oblong, green, red towards base, glabrous externally. *Style* filiform, white, glabrous, green tinged towards stigma. *Stigma c.* 1 mm wide, green, cup-shaped, hairy on stigmatic head, hairs hook-like, *c.* 1 mm exserted the anther. *Epigynous glands c.* 2.5 x 2 mm, oblong, yellow, slightly lobed at tip. *Fruits* 1.5–1.7 x 1.2–1.4 cm, capsule, elliptic, three-angled, glabrous, trilocular, surface smooth; fruit wall green externally, orange-red internally, completely splitted and reflexed back on dehiscence. *Seeds c.* 3.5 x 4 mm, red, yellow at base, compactly arranged on central column. *Aril* red, covers the basal portion of seed, lacerate on upper half.

Notes: The species *H. gardnerianum*, was described by the Ker Gawler (1 Feb. 1824) based on a plant introduced to British Garden from Calcutta Garden; originally collected by Edward Gardner from Nepal. He also provided a drawing with much elongated spike with deep yellow flowers, bilobed and ovate lip. He also mentioned that the most striking feature of the species is the great breadth of the inflorescence.

Subsequently, *H. gardnerianum* was described by Roscoe (Feb.-Apr. 1/2: t. 62. 1824) on the basis of a dried specimen and live plants supplied by Dr. Wallich from Calcutta (under the name *H. excelsum*) to Botanic Garden, Liverpool. While describing the species he has also provided a colour drawing of the species with ovate and bilobed lip. Ker Gawler's (*l.c.*) publication is prior to Roscoe (1824) and he also cited this publication in his *Monanrdiran Plants of the Order Scitamineae*.

Wallich (1853, 1855) identified *H. speciosum* and *H. gardnerianum* are one and the same species. He reduced his species, *H. speciosum* as the synonym of *H. gardnerianum,* even though not the earlier published name, to honour his friend Edward Gardner. This was also followed by Hooker (1887). Later Horaninow (1862) treated *H. gardnerianum* as distinct species and *H. speciosum* as one of its varieties under the name 'β'. Whereas the workers like Dietrich (1831), Dietrich (1839), Voigt (1845), Baker (1892) and Schumann (1904) treated them as distinct species.

During this work we could make live collections of both taxa and detailed morphological studies revealed that, they are closely related taxa but differs in varietal level. As per priority concern the species *H. speciosum* reinstated and *H. gardnerianum* is reduced as its variety.

H. pallidum is a species described by Regel (1856) in *Hortus Botanicus Imperialis Petropolitanus* (St. Petersburg), and was again described by him in the *Gartenflora* (257. 1859). From the description and accompanying colour drawing it is evident that, *H. pallidum* is conspecific with *H. gardnerianum*.

H. pynursulaeanum is another species described by Jain and Srivastava (1986) on the basis a collection from Pynursula, Meghalaya. They differentiated it from *H. gardnerianum* in having 3–5 -flowered bracts, comparatively larger, ovate or orbicular lip, 0.5–10 mm deep sinus and stamen only 2 cm longer than lip. During this work we could observe a wide range of variation in size, shape and sinus of labellum and comparative length of stamen and labellum. In majority of morphological characters *H. pynursulaeanum* is inclusive to *H. gardnerianum*, and we considered the former as a larger flowered form of the latter.

Flowering & Fruiting: July–November.

Distribution: Widely distributed in India, Nepal, Myanmar, Bangladesh, Yunnan provinces of China and as wide invasive species in New Zealand, Hawaii and Micronesia. In India, it is distributed in Arunachal Pradesh, Meghalaya, Nagaland, Sikkim and West Bengal at an altitude of 900–1,600 m. (*Figure 43. B*)

IUCN Red list Category: It is one of the most cultivated species of *Hedychium* in the tropics. In India, due to the over exploitation for ornamental purpose, this species has become very rare in wild in India. However, it has become a dangerous invasive weed like *Eichhornia crassipes* (Mart.) Solms, *Ulex europaeus* L., *Lantana camara* L. *Chromolaena odorata* (L.) R.M. King & H. Rob. *etc.*, and included under the list of *100 of the World's Worst Invasive Alien Species* (Lowe et al. 2000). It is now distributed throughout the tropics invading natural forest ecosystems. The affected countries include Federated States of Micronesia, Fiji, New Caledonia, Cook Islands, Australia, French Polynesia, Hawaii, New Zealand, La Reunion Island (France), South Africa and Jamaica (Sankaran 2008).

The horticultural trade selected *H. gardnerianum,* under the name *'Kahili Ginger',* for its aesthetic qualities, without knowing what would be the impact outside of garden. It has been introduced around the world through the horticultural trade, and with few exceptions, is an aggressive invader of montane rain forests wherever it has been introduced. It is a large rhizomatous herb that can

invade the understory of undisturbed, intact montane rain forests, and is extremely difficult to remove once established (Anderson 2003). The 'ginger-strain' of the wilt causing bacterium *Ralstonia salonacearum* has been identified as potential biological control against Kahili Ginger. *R. solanacearum* is a Gram-negative, plant pathogenic, soil bacterium. It colonises the xylem and cause a bacterial wilt in a very wide range of host plants including gingers. *H. gardnerianum* reported to be spread by Bulbul birds (*Pycnonotus jocosus* L.) by eating the seeds (Smith 1987). Birds are attracted by the red fruits, distributing the seeds far from the mother plant. Because of the dangerous impact on overall biodiversity of invaded forest, *H. gardnerianum* in Hawaii, selected as the *Weed of the Week* on 13th Aug 2008.

As it is having a wide distribution it is assed here in the Least Concern (LC) category as per IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010). But in India, due to its overexploitation from the wild for ornamental purposes, it has become very rare in the wild.

Specimens examined: **INDIA**. **ARUNACHAL PRADESH**. LOWER SUBANSIRI Dt.: Begi to Ziro, 11 Jun 1961, *G.V.S. Rao 24999* (ASSAM); 30 Km point on road to Seppa from Zero point, 28 Nov 1970, *A.S. Rao 50713* (ASSAM). DIBANG VALLEY Dt.: Mayudya-Hunli, 1600-2000 m., 18 Aug 2000, *M. Bhaumik 2847* (CAL); Hunli, Dibang Valley, 1600 m., 21 Aug 2000, *M. Bhaumik 2994* (CAL); Anini, Dibang Valley, 1600 m., 19 Jul 2002, *M. Bhaumik 4274* (CAL). KAMENG Dt.: Sissini, 4050 ft., 26 Mar 1957, *G. Panigrahi 6075* (ASSAM); Sissini, 23rd mile, 6900 ft., 29 Mar 1957, *G. Panigrahi 6271* (ASSAM). TAWANG Dt.: Near Shakti, on the way to Lumla, 23 Aug 1976, *P.K. Hajra 68455* (ASSAM). WEST KAMENG Dt.: stream between Jalrang and Thegri, 1905 m., 5 May 1957, *G. Panigrahi 6455* (CAL). WEST SIANG Dt.: Minguing to Takepokong, 1160-1740 m., 18 Nov 1958, *R.S. Rao 17777* (ASSAM). **MEGHALAYA**. Khasia, 4-6000 ft., *J.D. Hooker & J. Thomson s.n.* (CAL); Khasia, 4-6000 ft., *J.D. Hooker s.n.* (MH). EAST KHASI HILLS Dt.: Towards Bishop falls, Shillong, 10 Dec 1962, *R.M. Dutta 25401* (ASSAM); Shillong, 5000 ft., 25 Feb 1885, *C.B. Clarke 37328* (CAL); Woodlands, 1470 m., 17 Aug 2004, *E. Sanoj 95636* (CALI). JAINTIA HILLS Dt.: Jarain – Jowai, 1450 m., 20 Aug 1968, *N.P. Balakrishnan 46884*

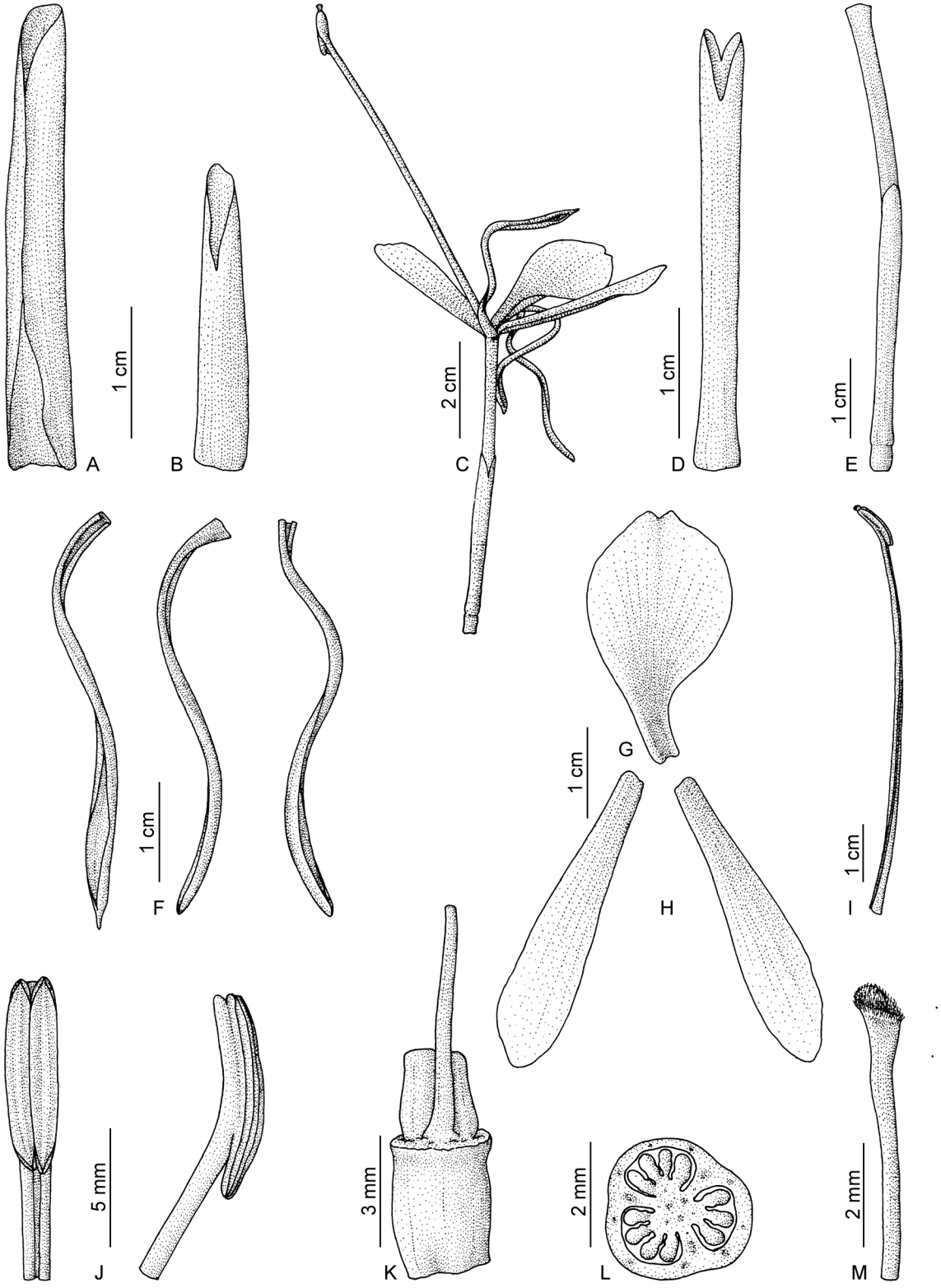

Figure 42. ***H. speciosum*** var. ***gardnerianum***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, front view (left) and lateral view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

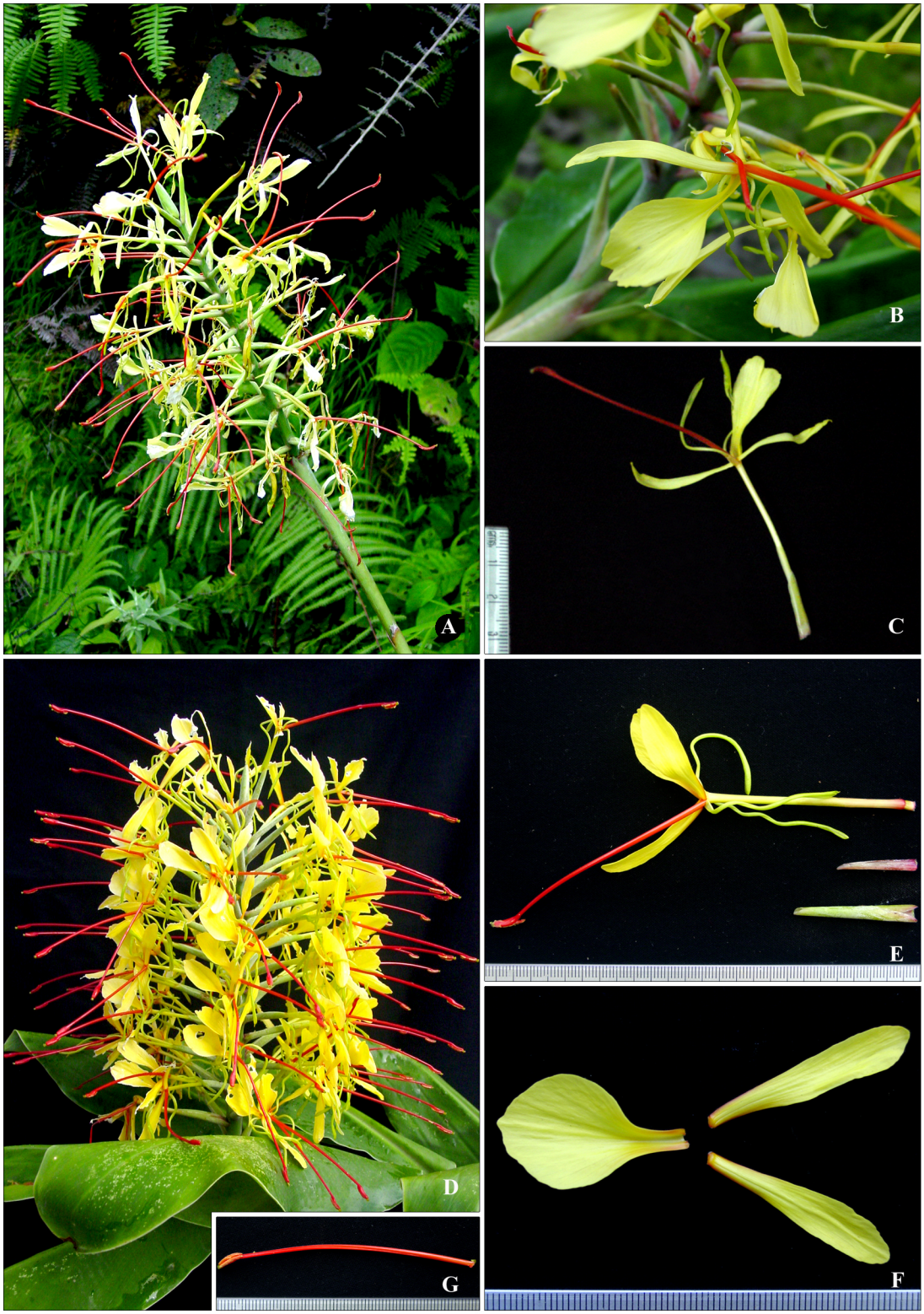

Plate 21. **A-C.** ***H. speciosum*****: A.** inflorescence; **B.** flower close-up; **C.** single flower with bract; **D-G.** ***H. speciosum*** var. ***gardnerianum*****: D.** inflorescence; **E.** single flower, bract and bracteole; **F.** labellum and lateral staminodes; **G.** stamen.

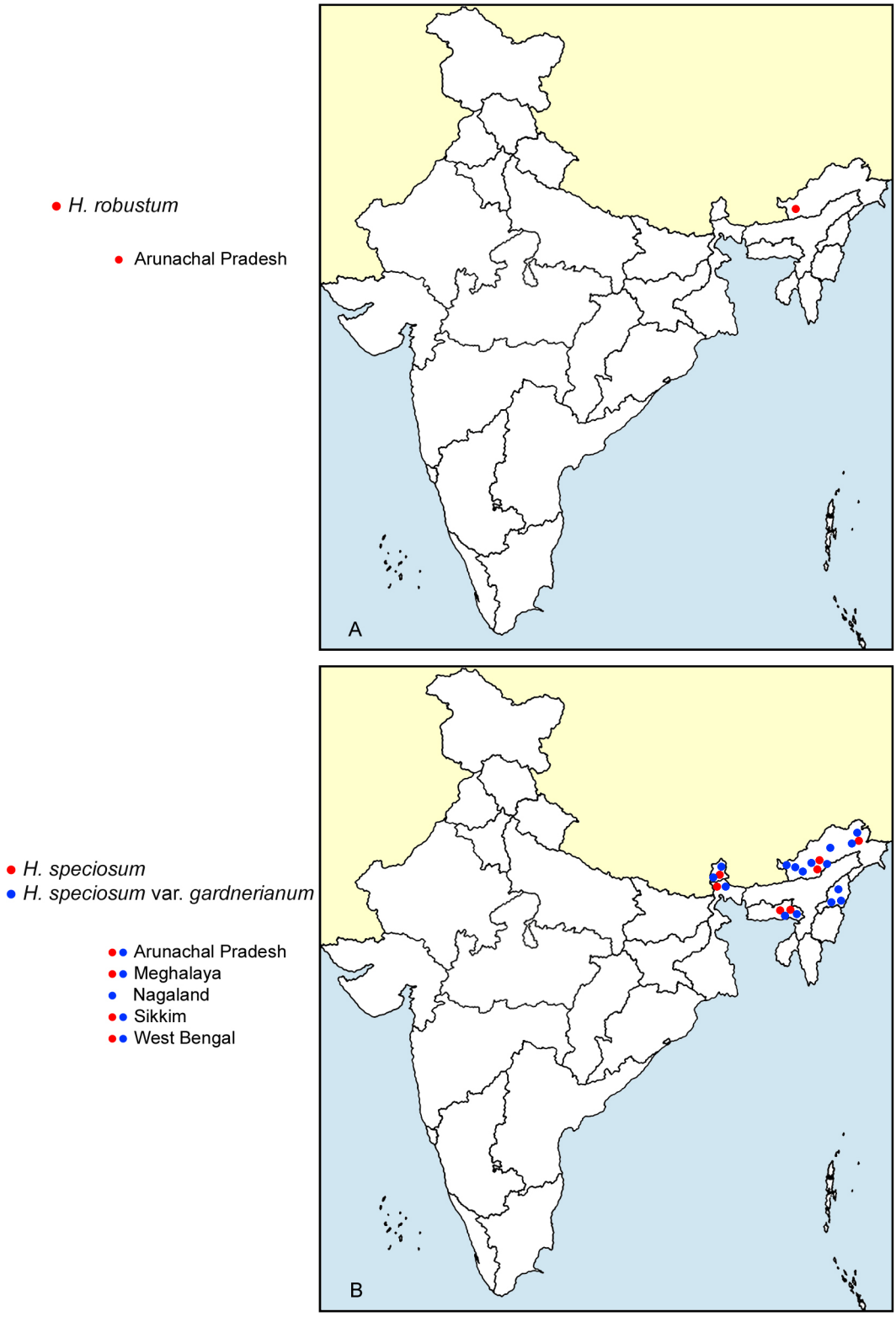

Figure 43. Distribution maps of ***H. robustum, H. speciosum*** and ***H. speciosum*** var. ***gardnerianum.***

(ASSAM). **NAGALAND**. MOKOKCHUNG Dt.: Mokokchung – Tuernang Road, Near Dikku, 19 May 2006. *M. Sabu & A.K. Pradeep 103612* (CALI). PHEK Dt.: Jotsoma, 1521 m., N 28°42'27.9", E 094°01'05", 31 Aug 2006, *E. Sanoj & V.P. Thomas 105577* (CALI); Sarhoba, 1746 m., N 25°42'27.9", E 094°26'2.3", 5 Sep 2006, *E. Sanoj & V.P. Thomas 105603* (CALI). **SIKKIM**. *s.loc., R.S. Rao 369* (CAL). *s.loc.,* 5000 ft., 27 Jul 1874, *G. King 1033* (CAL); *s.loc.,* 6-7000 ft., *J.D. Hooker s.n.* (K); Tashok, 3000 ft., 14 Oct 1908, *W.W. Smith 497* (CAL); Surcil, 5000 ft., 10 Feb 1910, *Ribu & Rhomoo 3507* (CAL), *C.C. Calder 979* (CAL). NORTH SIKKIM Dt.: 3 km. from Ravangala, 11 May 2007, *V.P. Thomas & Muhammed Nissar 95532* (CALI). WEST SIKKIM Dt.: Rathong, Chu Valley between Mintok khola and Paha Khola, 27°23' N, 88°13' E, 2100 m., 27 Jul 1992, *D.J. Long et al. 798* (E). **WEST BENGAL**. DARJILING Dt.: Darjiling, 6000 ft., 3 Sep 1877, *G. King 4061* (E, CAL). *Locality unknown:* E. Himalaya, *G. Griffith 5665* (CAL).

23 Hedychium spicatum

H. spicatum Buch.-Ham. ex Sm. in A. Rees, Cyclop. 17. n. 3. 1811; Spreng., Syst. Veg. 1: 9. 1825; A. Dietr., Sp. Pl. 1: 33. 1831; Paxton, Paxton's Mag. Bot. 4: 204. 1838; D. Dietr., Syn. Pl. 1: 9. 1839; Wall. in W.J. Hooker, Hooker's J. Bot. Kew Gard. Misc. 5: 328. 1853, J. Hort. Soc. London 9: 17. 1855; C. Muell., Ann. Bot. Syst. 6: 24. 1861; Horan., Prodr. Monogr. Scitam. 24. 1862; Baker in J.D. Hooker, Fl. Brit. India 6: 227. 1892; K. Schum. in A. Engler, Pflanzenr. IV. 46(heft 20): 50. 1904; Weathers, Bulb Book 269. 1911; J.N. Mitra, Monocot. E. India 1: 242. 1958; Naik & Panigrahi, Bull. Bot. Surv. India 3: 72. 1961; J. Joseph, Fl. Nongpoh 307. 1982; Karthik. et al., Fl. Ind. Enum. Monocot. 296. 1989; R.M. Sm. in A.J.C. Grierson & D.G. Long, Fl. Bhutan 2: 203. 1991; S.K. Jain & V. Prakash., Rheedea 5(2): 161. 1995; T.L. Wu & K. Larsen in Z. Wu & P.H. Raven, Fl. China 24: 373. 2000; Press et al., Annot. Checkl. Fl. Pl. Nepal 330. 2000; S. Kumar, Zingber. Sikkim 54. 2001; M. Sabu

& Pradeep, Folia Malaysiana 6(1&2): 13. 2005; M. Sabu, Zingiber. Costac. S. India 202. 2006.

Type: NEPAL. Narainhetty, borders of fields, *Buchanan-Hamilton s.n.* (holo Savage Cat. No. 8-27 LINN).

H. *acuminatum* Roscoe, Monandr. Pl. Scitam. 1/2: t. 47. 1824; Sims, Bot. Mag. 57: t. 2969. 1830; Lodd., Bot. Cab. 18(10): t. 1795. 1832; Paxton, Paxton's Mag. Bot. 4: 204. 1838; Weathers, Bulb Book 268. 1911; S.K. Jain & V. Prakash, Rheedea 5(2): 160. 1995; Chaturv. & Moaakum, Folia Malaysiana 9(2): 130. 2008.

Type: Roscoe, Monandr. Pl. Scitam. 1/2: t. 47. 1824.

H. spicatum var. *acuminatum* (Roscoe) Wall. in W.J. Hooker, Hooker's J. Bot. Kew Gard. Misc. 5: 328. 1853, J. Hort. Soc. London 9: 17. 1855; C. Muell., Ann. Bot. Syst. 6: 24. 1861; Horan., Prodr. Monogr. Scitam. 24. 1862; Baker in J.D. Hooker, Fl. Brit. India 6: 227. 1892; K. Schum. in A. Engler, Pflanzenr. IV. 46(heft 20): 50. 1904; J.N. Mitra, Monocot. E. India 1: 242. 1958; Naik & Panigrahi, Bull. Bot. Surv. India 3: 72. 1961; A.S. Rao & D.M. Verma, Bull. Bot. Surv. India 14: 130. 1972; Karthik. et al., Fl. Ind. Enum. Monocot. 296. 1989; T.L. Wu & K. Larsen in Z. Wu & P.H. Raven, Fl. China 24: 373. 2000; M. Sabu, Rheedea 10(1): 74. 2000; Press et al., Annot. Checkl. Fl. Pl. Nepal 330. 2000; S. Kumar, Zingber. Sikkim 56. 2001.

H. trilobum Wall. ex Roscoe, Monandr. Pl. Scitam. 15: 1828; A. Dietr., Sp. Pl. 1: 37. 1831; D. Dietr., Syn. Pl. 1: 10. 1839.

Lectotype (designated here): NEPAL. Aug 1821, *Wallich 6554 A* (K, BM!).

H. spicatum var. *trilobum* Wall. in W.J. Hooker, Hooker's J. Bot. Kew Gard. Misc. 5: 328. 1853, J. Hort. Soc. London 9: 17. 1855; C. Muell., Ann. Bot. Syst. 6: 24. 1861; Horan., Prodr. Monogr. Scitam. 25. 1862; Baker in J.D. Hooker, Fl. Brit.

India 6: 227. 1892; Karthik. et al., Fl. Ind. Enum. Monocot. 296. 1989; Press et al., Annot. Checkl. Fl. Pl. Nepal 330. 2000.

H. spicatum var. *khasianum* C.B. Clarke ex Baker in J.D. Hooker, Fl. Brit. India 6: 227. 1892; J.N. Mitra, Monocot. E. India 1: 242. 1958; Karthik. et al., Fl. Ind. Enum. Monocot. 296. 1989.

Lectotype (designated here): INDIA. Meghalaya, Shillong, 5800 m., 3 Aug 1885, *C.B. Clarke 38429* (K!).

H. raoii G.D. Pal & G.S. Giri, J. Bombay Nat. Hist. Soc. 95(1): 102. 1998, *syn. nov*.

Type: INDIA. Arunachal Pradesh. Lower Subansiri Dt., Yazali-Kimin road, 20 km from Yazali towards Kimin, 700 m., 20 Sep 1983, *G.D. Pal 1254* (holo CAL, iso CAL & ARUN). (*Figure 44; Plate 22*)

H. venustum auct. non Wight: M. Sabu, Zingiber. Costac. S. India 205. 2006.

Common Name: Spiked Garland Flower, Long spiked Garland-flower, Hedichium, Kapur Kachri (Sanskrit).

Terrestrial or epiphytic, perennial rhizomatous herbs. *Rhizome* fleshy, 2–2.8 cm thick, light yellow inside. *Leafy shoot* 93–100 cm high, slanting. *Leaves* 7–10 in number, 4.7–10.3 cm apart, sessile; sheath green, margins white, membranous, translucent, pubescent; ligule 1–1.3 x *c.* 1 cm long, ovate, single-lobed, rounded at tip, pale green, pubescent externally, membranous, translucent, closely appressed to the stem; lamina 23–42.5 x 6–12.2 cm, elliptic, dark green and glabrous above, pale green and pubescent below, densely pubescent towards midrib; margin undulate, membranous, translucent, white tinged, non-ciliate; tip long acuminate, twisted, bend down; base cuneate; midrib pale green. *Inflorescenc*e 10–38 cm long, erect or drooping, peduncle 4–8.5 mm wide, pubescent, green. *Bracts* 2.8–3.3 x 1.4–1.8 cm, oblong, green, glabrous, hairy only at the tip, moderately coriaceous, non-imbricate, convolute; margin non-ciliate, translucent, membranous, pale white

tinged; tip obtuse; cincinnus 1-flowered. *Bracteoles* 2–3.2 cm long, pale green, glabrous, hairy at tip only, tubular completely encircles the cincinnus, unilaterally split upto 7–9 mm long, membranous, translucent; margin non-ciliate. *Flower* 11–12 cm long, creamy white with red tinged at centre and red stamen, turn to yellow on second day, spreading, 2–4 flowers open at a time. *Calyx* 3.6–3.9 cm long, *c*. 3 mm wide at mouth, pale green, glabrous, membranous, translucent, upper half inflated, lower half closely appressed to corolla tube, persistent, unilaterally split upto 4–5 mm, obscurely 3-lobed at tip. *Corolla tube* 7.1–7.3 cm long, *c*. 3.5 mm wide at mouth, white at base, turn to red tinged towards tip, glabrous externally, hairy internally, erect, slightly bend to one side. *Corolla lobes* oblanceolate, creamy white with green towards tip, membranous, drooping from flower, glabrous; dorsal lobe 3.6–3.7 x *c.* 0.6 cm, *c.* 4 mm long beaked at tip, 5-nerved; lateral lobes 3–3.2 x *c.* 0.6 cm, non-beaked at tip, 5-nerved. *Lateral staminodes* 3.9–4.5 x 0.3–0.35 cm, oblong with a basal claw, creamy white with red tinged at base, spreading on flower, reflexed back, tip obtuse. *Labellum* 4.5–4.8 x 2–2.2 cm, oblanceolate, creamy white with red tinged at base, spreading on flower, reflexed back on upper half, gradually clawed at base; claw *c.* 3 mm wide, red; sinus 1.6–1.8 mm deep; lobes acuminate at tip. *Stamen* 3.1–3.3 cm long, L-shaped, red, arching over labellum. *Filament* 2–2.1 cm long, *c.* 1.5 mm wide at base, red, bend at centre (L-shaped), arching over labellum. *Anther* 1.3–1.4 x 0.25–0.3 cm, elliptic, reddish-yellow, split opens from top to bottom, attached with the filament at *c.* 32 mm above from base, thecae axis parallel with the filament; minutely spurred at base, connective red, glabrous, non-crested, divided upto 5–8 mm deep (rarely entire). *Ovary c.* 4.5 x 3.5 mm, barrel-shaped, pale green, glabrous. *Style* filiform, white, glabrous, orange-yellow tinged towards stigma. *Stigma* orange-yellow, flat in lateral view, cup-shaped, slightly slanting with a depression at center, densely pubescent, hairs long and normal, equalizing or slightly exserted the anther. *Epigynous glands* two lobed at tip, 2–2.5 mm long, oblong, finger-shaped, bright yellow. *Fruits* setting very rare, 1–1.5 cm in diameter, globose, greenish yellow

when mature, pubescent externally, hairs minute. *Seeds* many, *c.* 4 x 2 mm, black. *Aril* red, lacerate.

Notes: Described by Smith in Rees' *Cyclopedia* (17. n. 3. 1811) on the basis of a taxon gathered by Buchanan from Upper Nepal, where it was commonly called as '*Wohuttty Swa'* and admired for its beauty and fragrance. From the description provided by him it is evident that the species has 1-flowered cincinnus, convolute bracts, white flower, linear and widely spreading lateral staminodes, deeply divided or obcordate lip and shorter, inflexed filament and style.

Subsequently, *H. spicatum* was wrongly appeared in the *Botanical Magazine* (Sims 1822), *Botanical Cabinet* (Loddiges 1822b), *Exotic Flora* (Hooker 1823) and *Monandrian Plants* (Roscoe 1826). All of them were based on the plant collected by Wallich from Nepal. They described it as the species having imbricate bracts, much wider and white labellum with yellow and erect stamen. On detailed morphological studies it turned out as a new species and is described elsewhere.

Along with this species Roscoe (1824) also described another species from Nepal, *H. acuminatum*, which was also sent by Wallich, under the name *H. spicatum.* As *H. acuminatum* possesses the unique characters of the *H. spicatum* like deeply divided and shears-shaped labellum, curved stamen and considering wide range of variation, it is synonymized under the latter.

Following Roscoe (1824), Sims (1830) and Loddiges (1832) also described *H. acuminatum* with excellent colour drawings, which were also supplied by Wallich from Calcutta Garden.

Roscoe (1828) also erected another species, *H. trilobum* from Nepal (in the introductory part of the genus) on the basis of Wallich's description, he also mentioned that the copper-plate engraving of this species is already published under the name *H. spicatum,* which differs in having shorter filament and trilobate labellum.

Wallich (1853) described the species *H. spicatum*, and reduced *H. trilobum* as *H. spicatum* var. *trilobum* and described it as a taxon with bracts convolute and single-flowered, labellum with an additional short lobe at the sinus. He also reduced *H. acuminatum* as a variety.

While, Horaninow (1962) retained the *H. acuminatum* and *H. spicatum* in specific status and treated *H. trilobum* as the variety of the latter. Whereas Baker (1892) treated *H. trilobum* and *H. acuminatum* as the varieties of the *H. spicatum.* And he also described another new variety, *H. spicatum* var. *khasianum* C.B. Clarke ex Baker.

Baker (*l.c.*) treated *H. flavescens* and *H. bicornutum* Wall. (an abnormal species with two anthers and large spur at base, mentioned by Wallich in his MS) under *H. spicatum* var. *khasianum* as its synonyms. He mentioned that, var. *khasianum* differs from var. *acuminatum* only in pubescence on the lower surface of leaves.

Recently, Pal and Giri (1998) described another species, *H*. *raoii* G.D. Pal & G.S. Giri, from Arunachal Pradesh. They compared it with *H. robustum* and *H. dekianum* (= *H. forrestii*). Every effort to locate the types at CAL and ARUN was in vain. Based on the prtologue and illustration we recognized it only as a smaller form of *H. spicatum*, differs in having shorter corolla tube and stamen. These differences are not sufficient to warrant either a specific or varietal status and hence treated as conspecific.

The extensive studies on the live materials from all over India revealed that, there is a wide range of variation in size and shape of labellum which varies from narrowly oblanceolate to widely obovate. The lobbing of the labellum as an additional appendage at the center is an abnormal nature rarely observed in the genus, and cannot be considered as a constant character. Likewise the vestiture also varies considerably even within a species. Based on these observations we

recognized only one species, *H. spicatum*, and all other species and varieties discussed above are reduced to synonymies.

Typification: We could locate one collection of C.B. Clarke from Shillong (*C.B. Clarke 38429,* K!), which was designated as *H. khasianum* at Kew. On which Clarke noted that, it differs from the *H. gracile* in the leaves very hairy beneath. It is designated here as the lectotype of the name *H. spicatum* var. *khasianum*.

Flowering & Fruiting: June–October.

Distribution & Ecology: Distributed in Nepal, Bhutan, Myanmar, southwest China and northern Thailand. In India, it is widely distributed in Northeastern states and Western Ghats. Lexuriantly grows at soggy and shady locations from 700–3,000 m. altitudes. (*Figure 46. A*)

IUCN Red list Category: As a widespread species in Nepal, Bhutan, Myanmar, Southwest China, Northern Thailand and North-eastern India, *H. spicatum* can be regarded as of Least Concern (LC) according to the IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Uses: H. spicatum rhizomes are one of the ingredients of *Hinguvacādi Cūrna*, in the name of *Sati*. It is an Ayurvedic Herbomineral compound preparation usually prescribed for the treatment of cardiac failure, splenic disease, asthma, hiccup, cough, digestive impairment, constipation, anaemia and pain in urinary bladder, sacral region, anus and female genital tract (Saraswathy *et al.* 2009). Rhizome extracts and essential oil showed a broad spectrum of antibacterial and antifungal activity (Ray & Majumdar 1976, Bisht *et al.* 2006). The roots and leaves are used in several Ayurvedic preparations and has great potential for exports. The powder as well as decoction of root is carminative, digestive and emmenagogue. A small cup of root decoction twice in a day is expectorant, stimulant, stomachic, tonic and vasodilator. A one spoonful powder of root thrice in a day is useful in the treatment of liver complaints, and is also used in treating fevers, vomiting,

diarrhoea, inflammation, pains and snake bite. In Tibetan medicine the root powder is used as aphrodisiac. It is used in the treatment of indigestion and poor circulation due to thickening of the blood. The rootstock is acrid, bitter, pungent, heating, and astringent. The root powder 3-4 gm 2 times in a day is used in asthma, foul breath, bronchitis, hiccough, vomiting, *tridosha* and diseases of blood. Root powder is laxative to bowel and decoction is tonic to brain. Besides above medicinal properties the fruit is cooked and eaten in savoury dishes with lentils and also used for essential oil and incense. Both bruised and the dried root are very aromatic with a fragrant, somewhat pungent smell similar to orris root but more powerful. The rootstock yields 4% essential oil. This oil, which has a scent somewhat like hyacinths, is so powerful that a single drop will render clothes highly perfumed for a considerable period. The dried root is burnt as incense. The Fresh flowers are sweetly scented, the scent being most pronounced towards evening (Bhatt *et al.* 2009).

Phytochemistry: The dried rhizome of the plant contains essential oil, starch, resins, organic acids and glycosides. The essential oil has ethyl ester of p-methoxy cinnamic acid, d-sabirene cineole, sesquiterpenes and pentadecane methyl paracumarine acetate. It contain, β-sitosterol and its β-D-glycoside (http://www.indusextracts.com/hedychium-spicatum.htm).

Pharmacology: In preliminary pharmacological studies the drug is found to have a vasodilatory effect on coronary vessels, mild hy-potensive property and a non-specific antispasmodic effect on smooth muscles. Studies on the essential oil of the rhizomes of *H. spicatum* reveal that these oils possess a mild tranquilizing effect of short duration. They depressed the conditioned avoidance response, rotarod performance and potentiated pento-barbitone hypnosis and morphine analgesia in rats. The crude ethanolic extract of rhizomes possesses anti-inflammatory and analgesic activity. The anti-inflammatory activity was mainly localised in the hexane fraction from which 1% of pure active constituent was isolated. The analgesic activity was more prominent in the benzene fraction. Some

other minor active constituents were also present which may contribute to the total activity of rhizomes. The root stalk is useful in local inflammations, nausea, asthma, bronchitis, hiccups and in pain. The rhizome of the plant is said to be carminative, stimulant and a tonic. It has been described as useful, especially as an antiasthmatic agent. Clinical trials have been conducted in tropical eosinophilia, with promising results. It counteracts bad mouth taste and smell. In the doses commonly used, no adverse reactions have been reported (http://www.indusextracts.com/hedychium-spicatum.htm).

Specimens examined: **INDIA**. **ARUNACHAL PRADESH.** EAST KAMENG Dt.: Senge-Sappar road, 16 Km point, 7 Aug 1973, *P.K. Hajra 54004* (ASSAM). DIBANG VALLEY Dt.: Mayudia, 2200 m., 18 Aug 2000, *M. Bhaumik 2851* (CAL); way to Mayudia from Roing, 12 Aug 2009, N 28°13'10.7", E 095°47'57.9", *E. Sanoj & T. Rajesh Kumar 105657* (CALI); Near to Hunli, 13 Aug 2009, 2434 m., N 28°18'42.1", E 095°56'59.7", *E. Sanoj & T. Rajesh Kumar 105678* (CALI). TAWANG Dt.: Zimithang to Lumpu Village, 21 Aug 1976, *P.K. Hajra 68430* (ASSAM). WEST KAMENG Dt.: 5 Km. from Seppa towards Bomdila, 11 Aug 2003, *M. Sabu & A.K. Pradeep 92557* (CALI). **HIMACHAL PRADESH.** CHAMPA Dt.: Chamba, Kalatop Forest, 8000 ft., 30 Jul 1895, *J.H. Lace 771* (E, CAL); Dalhousie, *Clark 166* (CAL); Kati, 6500 ft., Aug 1878, *J.S. Gamble 6413* (CAL). KULLU Dt.: Kullu, 21 Aug 1864, *Brandis 3371* (CAL). SHIMLA Dt.: Shimla, 1831, *C.B. D. s.n.* (E), 7000 ft., Aug 1885, *H. Collet 634* (K), 6500 ft., Aug 1878, *J.S. Gamble 6413 A* (K); Jasri, Celensauelli, 6000 ft., 19 Aug 1877, *s.coll. 4861* (CAL). MANDI Dt.: Winvh Camp, Shanan, 799 m., 20 Aug 1977, *S.K. Murti & R. Prasad 61938* (BSD). SOLAN Dt.: Kasauli, 15 Nov 1959, *T.A. Rao 10918* (BSD). **JAMMU AND KASHMIR**. UDHAMPUR Dt.: 1.5 Km ahead of Bhairon Temple, 31 Aug 1989, *B.P. Uniyal 77469* (BSD). **KARNATAKA**. Concan, *J.D. Hooker & J. Thomson s.n.* (CAL). **KERALA**. IDUKKI Dt.: Idukki to Kattappana, 900 m., 27 Sep 1981, *C.N. Mohanan 72009* (CAL, MH); Kulamavu, 7 Jun 1984, *C.N. Mohanan 82001* (MH). PALGHAT Dt.: Below Ayyappan Kovil area, 850 m., 27 Oct 1976, *E. Vajravelu 48711* (CAL, MH). TRIVANDRUM Dt.: Ponmudi, 3000 ft., 26 Aug 1956, *A. Abraham 3121*

(K), 6 Jul 2002, *M.G. Prasanth Kumar 86371* (CALI); 9 Sep 2004, *E. Sanoj 95651* (CALI); Kurisumala, ± 1000 m., 30 Jul 1985, *Fr. Kadavil 1213* (CAL, MH); near lower sanatorium, *J.K. Mangaly 10291, 10293* (CALI); near upper sanatorium, *M. Sabu 37378* (CALI); Between Upper and Lower Sanatorium, *Ravi 2478* (CALI); ± 1100 m., 16 Aug 1980, *M. Mohanan 69230* (CAL, MH); 950 m., 31 Jul 1978, *M. Mohanan 56990* (MH). **MANIPUR**. SENAPATI Dt.: Kekrima, 6000-7000 ft., 23 Jul 1935, *N.L. Bor 6317* (K). **MEGHALAYA**. Khasia, 5-6000 ft., *J.D. Hooker & J. Thomson s.n.* (E, CAL, K, MH), 5-6000 ft., *J.D. Hooker & J. Thomson s.n.* (left side material only) (K), 1845 *Griffith s.n.* (K), Khasia Hills, Maoslangdep, 5000 ft., 8 Jun 1911, *I.H. Burkill & S.C. Banerji 35235* (CAL), Wah Mawlony, *U. Kanjilal 7402* (ASSAM), Dumpab, 28 Aug 1935, *G.K. Deka 13188* (ASSAM). EAST KHASI HILLS Dt.: Shillong, 3 Aug 1885, 5800 ft., *C.B. Clarke 38429* (CAL, K), 8 Aug 1885, 6000 ft., *C.B. Clarke 38594 A, E* (K), 5000 ft., Sep 1934, *W.J.H. Wenger s.n.* (K); Shillong Peak, 26 Oct 1960. *D.C.S. Raju 22006* (ASSAM), 1240 m., 18 Aug 2004, *E. Sanoj 95648* (CALI); Woodlands, 6 Jul 1972, *U. Shukla & M. Goon 34671* (ASSAM); Pynursla, 6 Sep 1941, *R.N. De & D.C. Forests 21092* (ASSAM); Mawphlang, 25 Jun 1949, *M.L. Saikei 22675* (ASSAM); On the way from Shillong to Jowai, 1500 m., 13 Aug 2004, *E. Sanoj 95609* (CALI); Seven Sister Falls, 20 Km. from Gangtok, *M. Sabu & A.K. Pradeep 92719* (CALI). JAINTIA HILLS Dt.: Jowai, Way to Ladrymbai, 1395 m., N 25°26.116", E 092°17.843", 16 Aug 2007, *E. Sanoj & T. Rajesh Kumar 95190* (CALI); Jowai-Jarain, 1350 m., 16 Aug 1968, *N.P. Balakrishnan 46122* (ASSAM); Nongkrem, 1380 m., 14 Aug 2004, *E. Sanoj 95634* (CALI). RI-BHOI Dt.: Nongpoh, 28 Jun 1949, *G.K. Deka 22926* (ASSAM). **MIZORAM**. LUNGLEI Dt.: Saireptlang, 1553 m., N 22°44.258", E 092°44.340", 7 Sep 2002, *M.G. Prasanth Kumar & Jana Skornickova 86220* (CALI). **NAGALAND**. Naga Hills, Lawlyngdong, 30 Jun 1936, *G.K. Deka 19651* (ASSAM). KOHIMA Dt.: Behind Secretariat, 1517 m., N 25°42'47.2", E 094°06'25.6", 2 Sep 2006, *E. Sanoj & V.P. Thomas 105589* (CALI); Jotsoma, 1578 m., N 25°40'03.2", E 094°03'48.2", 2 Sep 2006, *E. Sanoj & V.P. Thomas 105573* (CALI). PHEK Dt.: Jotsoma village, 2 km from Kohima city, 1400 m., *M. Sabu & A.K. Pradeep 103635* (CALI); Jotsoma, 1521 m., N 28°39'08.5", E 092°01'0.5", 31 Aug 2006, *E. Sanoj & V.P. Thomas 105574* (CALI).

PUNJAB. GURDASPUR Dt.: Pentapotamica, in Silvis umbosis ultra, 7000 ft., *J.R. Drummond 13782* (K, CAL). **SIKKIM**. *s.loc.,* 4-7000 ft., *J.D. Hooker s.n.* (E, MH, CAL); *s.loc.,* 6000 ft., *G. King 2236* (E); Phadonchen, 7000 ft., 20 Aug 1910, *W.W. Smith 4469* (CAL); Dobijhora, 6000 ft., Aug 1882, *J.S. Gamble 10543* (K); Laiha, 4 Aug 1869, 7000 ft., *J.D. Hooker s.n.* (K). EAST SIKKIM Dt.: Nongpu, 6th mile towards Darjeeling, 1659 m., N 27°01.332", E 88°18.641", 25 Aug 2004, *M. Sabu & A.K. Pradeep 92753* (CALI); 14th mile towards Darjeeling, 1712 m., N 27°03.650", E 88°21.744", 25 Aug 2004, *M. Sabu & A.K. Pradeep 92750* (CALI). WEST SIKKIM Dt.: Rathong Chhu Valley between Mintok Khola and Pha Khola, 27°23' N, 88°13' E, 2100 m., 27 Jul 1992, *D.J. Long et al. 787* (E). **TAMIL NADU.** DINDIGUL Dt.: Kodaikanal, Silvercascade, 14 Oct 1919, *K.C. Jacob 16112* (MH). MADURAI Dt.: Madurai, Highway nits, 4600 ft., 8 Sep 1925, *K.C. Jacob 77054* (K). NILGIRIS Dt.: Naduvattom, Aug 1878, *G. King s.n.* (K); Ootacunad, 1860, *H.J.B. Belghram s.n.* (E). **UTTAR PRADESH.** SAHARUNPUR Dt.: Saharunpur, Aug 1848*, Botanic Gardens, Cambridge s.n.,* (K). **UTTARAKHAND**. ALMORA Dt.: Binsar, in the forest below Forest Rest House, 2250 m., 20 Oct 1975, *J.N. Vohra 58102* (BSD). CHAMOLI Dt.: Manal, 29 Aug 1978, *G. Panigrahi & Wadhwa 65520* (BSD). DEHRADUN Dt.: Sahasradhara, 14 Sep 1962, *S.K. Malhotra 23786* (BSD), 5 Sep 1963, *S.K. Malhotra 29269* (BSD); 3 Lakshmi Road, 1 Sep 1976, *A.S. Rao 56939* (BSD), 27 Jul 1976, *A.S. Rao 57797* (BSD); Mussoorie, 15 Aug 1975, *A.S. Rao 50352* (BSD), *D. Bacon s.n.* (K), Camel back Road, 10 Aug 1978, *G. Panigrahi & B.M. Wadhwa 64846* (BSD), 15 Aug 1898, *P.W. Macking s.n.* (CAL), 1877, *s.coll. 807* (CAL), 23 Aug, *G. King 54* (CAL), Aug 1916, *A. Anderson s.n.* (E), 6500 ft., Oct 1915, *A. Anderson s.n.* (E), Nov 1958, *Y.K. Sania 7975* (BSD). NAINITAL Dt.: Nainital, 6500 ft., *R. Strachery & J.E. Winterbottom 2* (CAL), Jul 1874, *Wansai s.n.* (CAL), 5000 ft., Oct 1905, *A. Meebold 288* (CAL); Chun Peak, 2200-2900 m., 7 Oct 1957, *J. Ananda Rao 4841* (BSD). PITHORAGARH Dt.: Chilkila Dam Site, Dhauliganga Valley, 13 Sep 1985, *H.J. Choudhary & S. Singh 78174* (BSD); Thanidhar, 1800 m., 6 Oct 1975, *C.M. Aroar 56731* (BSD); Panchachuli, Near Bungling, 4 Aug 1998, *B.P. Uniyal & Bipin Balodi 93791* (BSD); Kumaon Shaudev, 31 Aug 1968, *C.M. Arora 38819* (BSD); Dafia Dhoora, 2 Sep 1973, *C.M. Arora 53239*

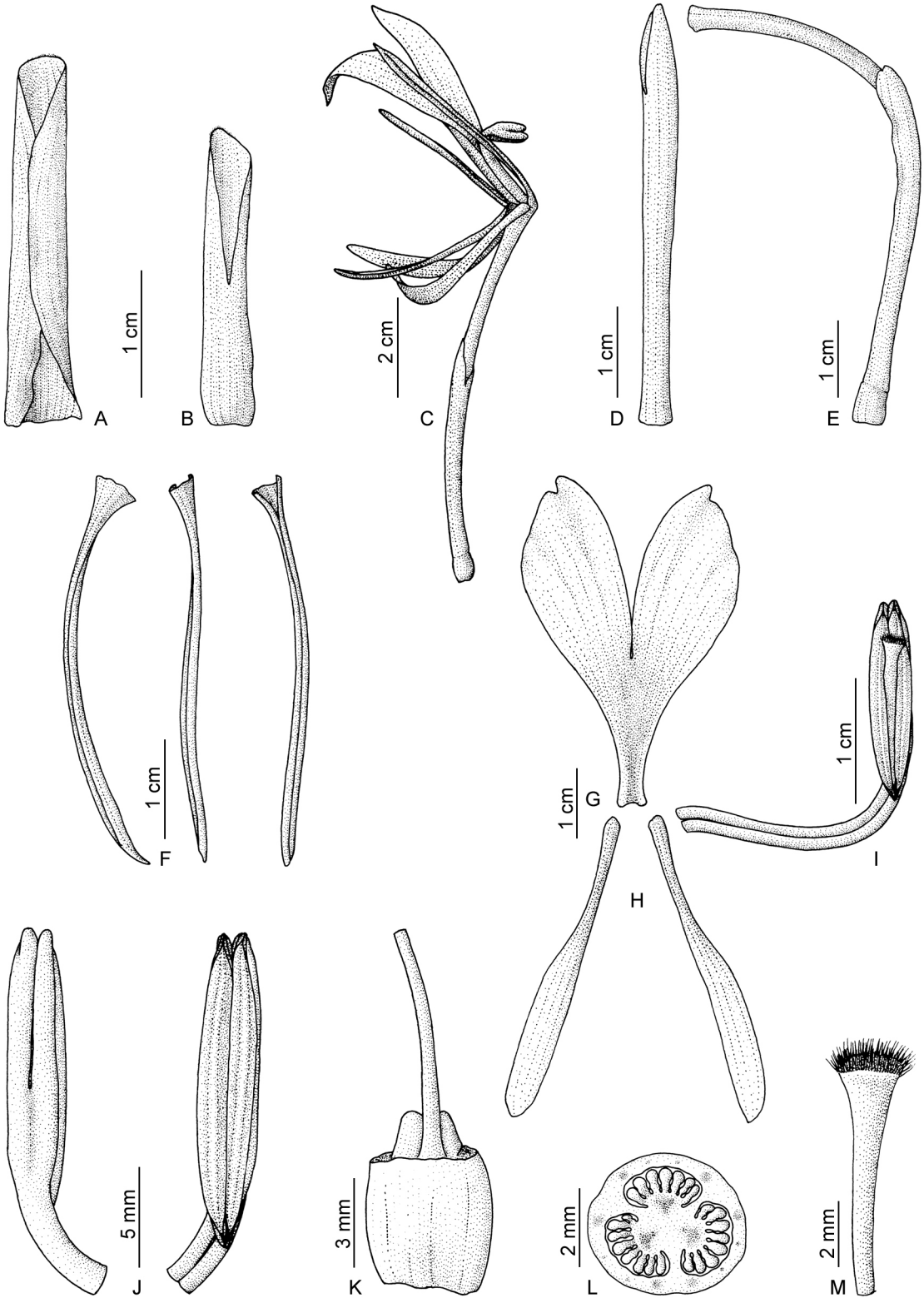

Figure 44. ***H. spicatum***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, back view (left) and front view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.



Plate 22. ***H. spicatum*: A & B.** inflorescence showing differences in morphology; **C.** single flower, bract and bracteole; **D.** labellum; **E.** lateral staminodes; **F.** stamen; **G.** dehisced fruits with seeds and aril.

(BSD); Bhaichan, 2500 m., 6 Jul 1972, *C.M. Arora 49626* (BSD). TEHRI GARHWAL Dt.: Garhwal, 6000 ft., Nov 1883, *Sehlieb s.n.* (CAL); Govindghat, 1800 m., 14 Aug 1963, *U.C. Bhattacharyya 29313* (BSD); Phala-Gauri Kund, 1800 m., 9 Aug 1968, *M.A. Rau 38618* (BSD); Deolang, 1800-2000 m., 17 Aug 1978, *A.K. Goel 64584* (BSD); Nag Tibba, 27 Jul 1964, *U.C. Bhattacharyya 33754* (BSD). UTTARKASHI Dt.: near Dhatmir, ± 2 km above Taluka bifurcation, 26 Aug 1987, *D.R. Agarwal 79804* (BSD). **WEST BENGAL**. E. Bengal. *Griffith 5687* (CAL). DARJEELING Dt.: Darjeeling, 7000 ft., 13 Aug 1875, *C.B. Ckarke 26987 A* (K), 5500 ft., 1 Sep 1877, *G. King 4057* (CAL); Rangbee, 13 Aug 1819, *C.B. Clarke 8568* (CAL), 5000 ft., 5 Jul 1887, *C.B. Clarke 12138* (K); Ruksra, 6 Aug 1893, *J.M. Cowan s.n.* (E); Bushaha, Dec 1913, *R.S. Hole 241* (CAL); Poshok, 1862, 4-5000 ft., *T. Anderson 1283* (CAL). *Locality unknown*. *s.loc.,* 1865, *Falconer 1237* (CAL); *s.loc.,* 28 Jul 1857, *Cole s.n.* (CAL).

24 Hedychium stenopetalum

H. stenopetalum Lodd., Bot. Cab. 20(1): t. 1902. 1833; Baker in J.D. Hooker, Fl. Brit. India 6: 231. 1890; K. Schum. in A. Engler, Pflanzenr. IV. 46(heft 20): 58. 1904; Haines, Bot. Bihar Orissa 5: 1139. 1924; J.N. Mitra, Monocot. E. India 1: 243. 1958; Naik & Panigrahi, Bull. Bot. Surv. India 3(1): 72. 1961; A.S. Rao & D.M. Verma, Bull. Bot. Surv. India 14: 133. 1972; J. Joseph, Fl. Nongpoh 307. 1982; N.P. Balakr., Fl. Jowai 2: 530. 1983; R.M. Sm. in A.J.C. Grierson & D.G. Long, Fl. Bhutan 2: 204. 1991; S.K. Jain & V. Prakash., Rheedea 5(2): 161. 1995; Chaturv. & Moaakum, Folia Malaysiana 9(2): 134. 2008.

Type: Loddiges, Bot. Cab. 20(1): t. 1902. 1833.

H. coccineum var. β *pro parte* (*H. stenopetalum & H. barbatum*) Wall. in W.J. Hooker, Hooker's J. Bot. Kew Gard. Misc. 5: 373. 1853.

H. barbatum Wall., Numer. List. 6544, *nom. nud.*

Type: *N. Wallich 6544* (Microfisch !).

H. elatum var. β Horan., Prodr. Monogr. Scitam. 26. 1862.

H. sirirugsae M. Dan & Sathish, Nordic J. Bot. 19(30): 335. 1999.

Type: KERALA. Thiruvananthapuram Dt., Tropical Botanical Garden, Palode, (introduced from Saikul, Manipur) *M. Dan TBGRI* (holo TBGT).

(*Figure 45; Plate 23. A–E*)

Terrestrial, perennial rhizomatous herbs. *Rhizome* 2.8–4 cm wide, creamy white internally, pale pink externally, slightly aromatic, covered by brown scales. *Leafy shoot* 137–300 cm high, robust. *Leaves* 9–12 in number, 5.7–13.2 cm apart, spreading, sessile; sheath 1.8–2.6 cm wide, margins green, membranous, translucent, pubescent; ligule 2–2.7 x 1.8–2.6 cm long, ovate, single-lobed, rounded-obtuse at tip, pale green, pubescent externally, membranous, translucent, papery, closely appressed to the stem; lamina 45–62 x 6.3–13 cm, elliptic, dark green and puberulent above, pale green and pubescent below; margin undulate, membranous, translucent, white tinged, non-ciliate; tip long caudate, twisted; base cuneate-rounded; midrib densely pubescent below. *Inflorescence* 28–52 cm long, cylindrical, lax, erect. *Bracts* 4.6–4.8 x 2.8–3.1 cm, elliptic, green, glabrous, pubescent towards tip, coriaceous, convolute; margin non-ciliate, translucent, membranous, white, tip acute, cincinnus 4–8 -flowered. *Bracteoles* 3.7–4 x 2.4–2.5 cm, non-tubular, ovate, 3-lobed at tip, pale green, pubescent, glabrous towards base, outer one completely encircles the cincinnus, leathery. *Flower* 12.6–12.8 cm long, white with faintly creamy yellow blotch at centre of labellum, many flowers open at a time, slightly fragrant. *Calyx* 4.4–4.6 cm long, *c.* 3 mm wide at mouth,

white, pale green towards tip, pubescent, puberulent towards base, membranous, translucent, closely appressed to corolla tube, unilaterally split upto 0.9–1.1 cm, 3-toothed at tip. *Corolla tube* 4.6–5 cm long, *c.* 2 mm wide at mouth, white, hairy internally, slightly arching. *Corolla lobes* narrowly oblanceolate, white, pale greenish tinged towards tip, membranous, early decaying at base, drooping from flower, glabrous; dorsal lobe 5–5.5 x *c.* 0.4 cm, *c.* 5 mm long beaked at tip; lateral lobes 4.6–4.7 x *c.* 0.35 cm, very minutely beaked at tip. *Lateral staminodes* 3.2–3.4 x *c.* 0.3 cm, linear, white, drooping on flower, coiled on opposite directions, margin undulate, tip acute. *Labellum* 3.1–3.3 x 1.8–1.9 cm, obovate, white, faintly creamy yellow at centre, spreading on flower, reflexed back on upper half, gradually clawed at base; claw 2.5–3 mm wide; sinus 0.9–1.1 cm deep; margin highly undulate; lobes obtuse at tip. *Stamen* 7.6–7.8 cm long, arching, white. *Filament* 6.6–6.8 cm long, *c.* 2 mm wide at base, white, arching. *Anther* 1–1.1 cm long, oblong, white, creamy white at openings, ciliate in thecae margins, split opens from top to bottom, attached with the filament at *c.* 2 mm above from base, thecae axis parallel with the filament; connective white, glabrous, non-crested, tip truncate or slightly notched. *Ovary* 4–5 x *c.* 3 mm, barrel-shaped, pale green, densely pubescent externally, angular. *Style* filiform, white, glabrous, pubescent towards tip, green tinged towards stigma. *Stigma c.* 2 mm wide, green, cup-shaped, slanting with a depression at center, pubescent, hairs hook-like, *c.* 2 mm exserted from the anther. *Epigynous glands* two, 5–6 mm long, linear, yellow.

Notes: The tallest species of the genus and produces largest inflorescence of about 2 feet, with white flowers in lax spike. During this revisionary work, we could collect many accessions from North-eastern states of India. The plant shows wide range of variation depending on the age of rhizome and habitat. The variation includes the size of the plant, inflorescence, number of flowers in a cincinnus *etc.*

The size of inflorescence ranges from 28 to 52 cm in favorable conditions and when rhizomes are much older, likewise the number of flowers in each cincinnus also varies from 4 to 12.

Loddiges (1833b), in the protologue, illustrated labellum of the species as acuminate at tip, which is followed by Schumann (1904) also. But we could observe the labellum as acute or obtuse at tip. This variation was also observed by Haines (1924) in his materials.

Recently, Dan *et al.,* (1999) erected one new species *H. sirirugsae* M. Dan & Sathish, on the basis of a cultivated material at Tropical Botanical Garden, Palode, Trivandrum (*M. Dan TBGRI 22667*, TBGT) collected from Saikul, Manipur. They distinguished it from the *H. stenopetalum* in having "glabrous lamina, shorter spikes, smaller bracts, longer corolla lobes and orbicular labellum". The live specimens of both species were studied and compared and found that they are one and the same. Hence *H. sirirugsae* is here synonymised with *H. stenopetalum*. The variations described with the *H. sirirugsae* are merely due to the climatic change and the younger age of rhizome (described from a cultivated material from TBGRI in 1997, just after one year after planting).

Flowering & Fruiting: August–November.

Distribution: Reported from India, Bangladesh, Myanmar, Yunnan and Guangxi provinces of China, northern Thailand, Vietnam and Laos. In India, it is distributed in Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram and Nagaland of NE India at an altitude of 250–1,600 m. (*Figure 46. B*)

IUCN Red list Category: *H. stenopetalum* has a wide distribution but is close to qualifying for or is likely to qualify for a threatened category in the near future,

hence it falls within the Near Threatened (NT) category as per IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA**. **ARUNACHAL PRADESH**. CHANGLANG Dt.: Jairampur and Surroundings, 11 Oct 1959, *R.S. Rao 19999* (ASSAM); Wakka to Nagminu, 5 Jul 1961. *D.B. Deb 26548* (ASSAM); Lailongsong, Chenglang, 510 m., 19 Jun 1961, *D.B. Deb 25832* (ASSAM, CAL). DIBANG VALLEY Dt.: Towrads Hunli from Roing, 2434 m., N 28°18'42.2", E 095°56'59.7", 13 Aug 2009, *E. Sanoj & T. Rajesh Kumar 105673* (CALI). EAST SIANG Dt.: Near BSI field station, Senkar view, 6 Aug 2003, *M. Sabu & A.K. Pradeep 92520* (CALI); Keyit, way to Along, 255 m., N 28°05'39.8", E 095°17'01.8", 30 Aug 2005, *E. Sanoj 92165* (CALI). LOHIT Dt.: Hexuliang to Nara, 508.3-550 m., 26 Nov 1957, *R.S. Rao 10841* (ASSAM); Forest around Chamba Village, 17 Dec 1969*, J. Joseph 48802* (ASSAM, CAL); Damwe, Tezu, 6 Aug 2009, *E. Sanoj & T. Rajesh Kumar 105628* (CALI). TIRAP Dt.: Laju Hill, 1600 m., 24 Aug 1958, *G. Panigrahi 14691* (ASSAM). WEST KAMENG. 4200 ft., 14 Jul 2002, *Bowes Lyon 15004* (E). **ASSAM**. CACHAR Dt.: Haflong, 2675 ft., 10 Aug 1908, *W.G. Craib 208* (CAL). DIBRUGARH Dt.: Nowjan, 14 Oct 1885, *C.B. Clarke 40798* (K). LAKHIMPUR Dt.: Jaypur (Nenchang Road) 25 Dec 1945, *G.K. Deka s.n.* (ASSAM). NORTH CACHAR HILLS Dt.: Haflong, 10 Aug 1908, *W.G. Craib 203, 208* (CAL). **MEGHALAYA**. JAINTIA HILLS Dt.: Raliang, East of Jowai, 24 Jan 1957, *G.K. Deka 5110* (ASSAM, CAL); Jowai, 19 Aug 1958, *G.K. Deka 17114* (ASSAM); Shangpung, Jowai, 1374 m., N 25°28'41.4", E 094°19'13.5", 12 Aug 2007, *E. Sanoj & T. Rajesh Kumar 95174* (CALI). EAST KHASI HILLS Dt.: Woodlands, 13 Sep 1968, *A.S. Rao 35698* (ASSAM), 13 Aug 1970, *D.M. Verma 38431* (ASSAM); Shillong to Jowai, 1500 m., 13 Aug 2004, *E. Sanoj 95609* (CALI). RI-BHOI Dt.: Umpih, 20 Sep1917, *U. Kanjilal 7245* (ASSAM); K & J Hills, Umsaw, Jan 1935, *C.S. Purkayastha 10958* (ASSAM); Umsaw Forest, Aug 1936, *S.R. Sharma 13559* (ASSAM); Nongpoh, 33 miles from Shillong, 19

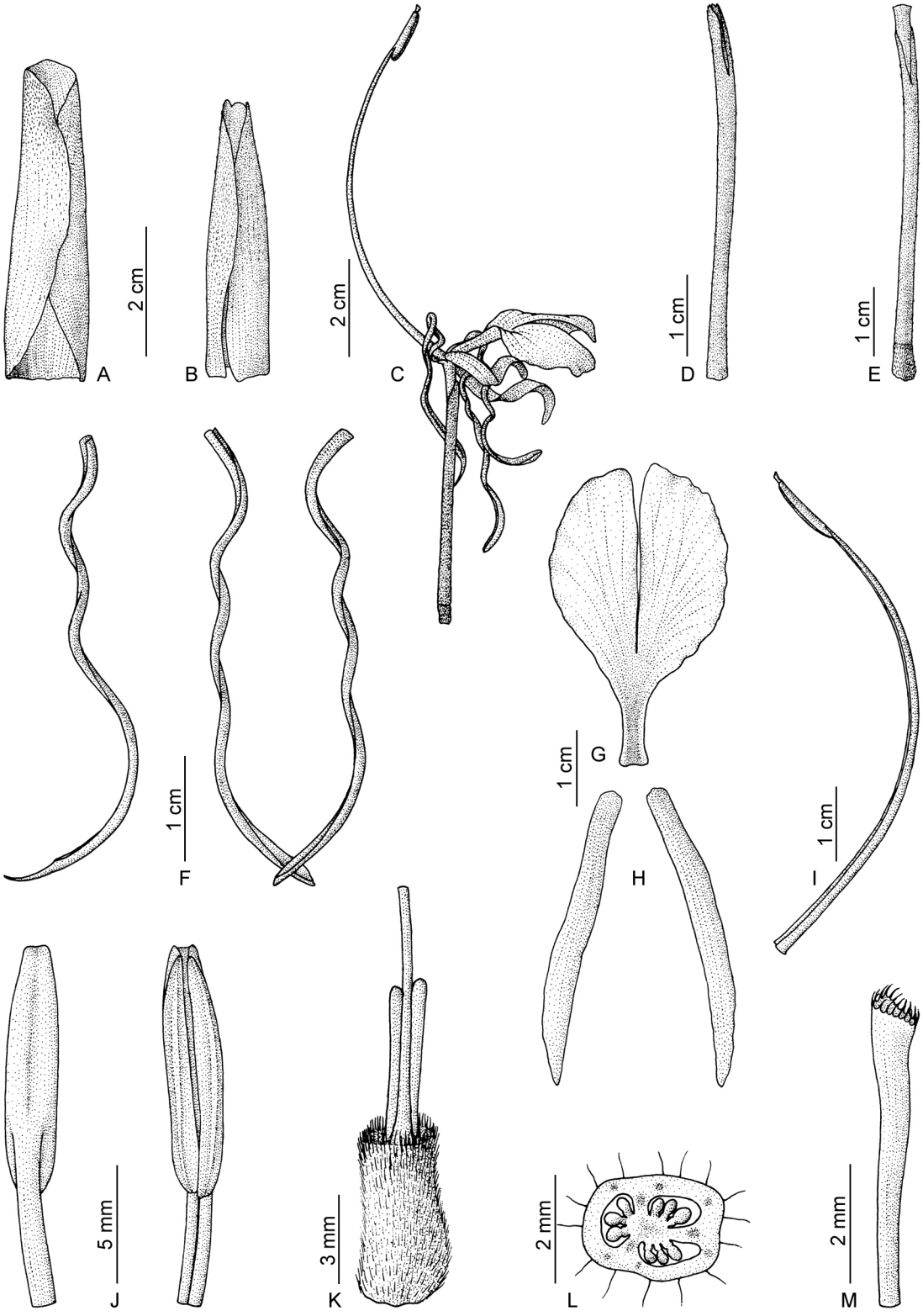

Figure 45. ***H. stenopetalum***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, back view (left) and front view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

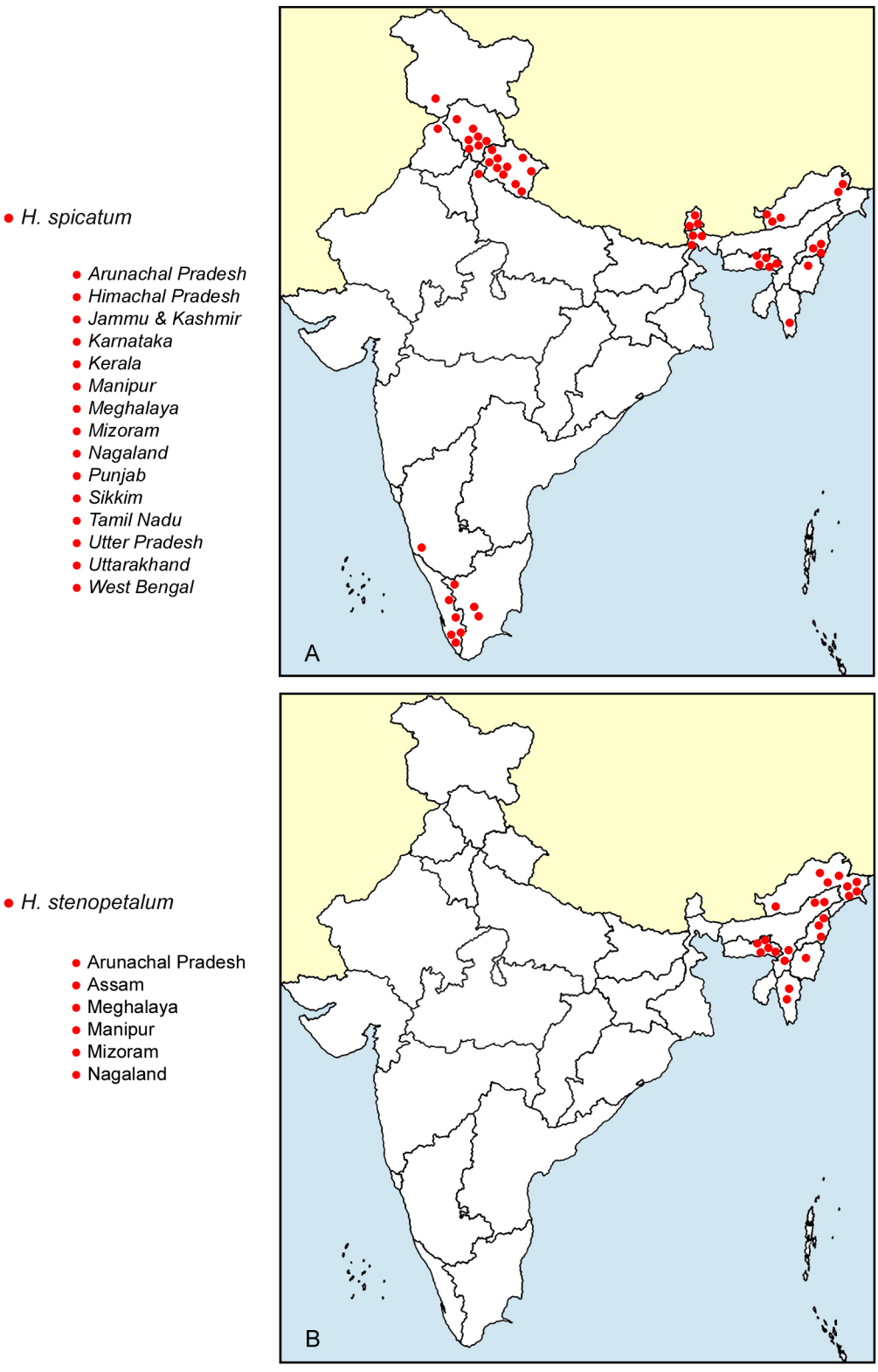

Figure 46. Distribution maps of
H. spicatum and ***H. stenopetalum***.

Aug 1949, *G.K. Deka s.n.* (ASSAM); Umsaw, K & J Hills, 17 Dec 1949, *M.L. Saika 22816* (ASSAM). **MANIPUR**. *s.loc.,* Feb 1906, *A. Meebold 5180* (CAL); *s.loc., D.B. Deb 1369* (CAL). **MIZORAM**. LUNGLEI Dt.: Khuaikham, Lunglei, 1300 m., N 22°50'81.8", E 90°48'80.5", 7 Sep 2002, *M.G. Prasanth Kumar & Jana Skornickova 86207* (CALI). AIZWAL Dt.: Zomabok, 9 km. South of Aizwal, Towards Lunglei, 1 Sep 2007, *M. Sabu & A.K. Pradeep 113402* (CALI). **NAGALAND**. MOKOKCHUNG Dt.: Lumami, Nagaland University Botanical Garden, 870 m., N 26°13'15.1", E 094°28'25.4", 23 Jun 2005, *E. Sanoj 92113 (*CALI). PHEK Dt.: 5 Km. from Phek to Kutsepo, 1746 m., N 25°42'06.2", E 094°27'17.9", 6 Sep 2006, *E. Sanoj & V.P. Thomas 105607* (CALI); ZUNHEBOTO Dt.: Baimho, 5000 ft., 2 Jul 1935, *N.L. Bor 5068* (K); Way to Dikku, 643 m., N 26°19'35.5", E 094°32'57.8", 28 Aug 2006, *E. Sanoj & V.P. Thomas 105541* (CALI).

25 Hedychium thyrsiforme

H. thyrsiforme Buch.-Ham. ex Sm. in A. Rees, Cyclop. 17. n. 4. 1811; Roscoe, Monandr. Pl. Scitam. 7/8: t. 56. 1826; Paxton, Paxton's Mag. Bot. 4: 204. 1838; Wall. in W.J. Hooker, Hooker's J. Bot. Kew Gard. Misc. 5: 373. 1853; Wall. J. Hort. Soc. London 9: 17. 1855; C. Muell., Ann. Bot. Syst. 6: 23. 1861; Baker in J.D. Hooker, Fl. Brit. India 6: 230. 1890; K. Schum. in A. Engler, Pflanzenr. IV. 46(heft 20): 57. 1904; Haines, Bot. Bihar Orissa 5: 1139. 1924; J.N. Mitra, Monocot. E. India 1: 243. 1958; Naik & Panigrahi, Bull. Bot. Surv. India 3(1): 72. 1961; A.S. Rao & D.M. Verma, Bull. Bot. Surv. India 14: 132. 1972; Deb, Fl. Tripura 2: 377. 1983; Karthik. et al., Fl. Ind. Enum. Monocot. 296. 1989; R.M. Sm. in A.J.C. Grierson & D.G. Long, Fl. Bhutan 2: 201. 1991; S.K. Jain & V. Prakash., Rheedea 5(2): 161. 1995; Press et al., Annot. Checkl. Fl. Pl. Nepal 330. 2000; S. Kumar, Zingber. Sikkim 56. 2001; M. Sabu & Pradeep Folia Malaysiana 6(1&2): 14. 2005.

Type: NEPAL. Narainhetty, *Buch.-Ham. s.n.* (not located).

H. heteromallum Ker Gawl., Bot. Reg. 9: t. 767. 1824.

Type: Ker Gawler, Bot. Reg. 9: t. 767. 1824. (*Figure 47; Plate 23. F –J*)

Common Name: Dense spiked Garland flower.

Terrestrial, perennial rhizomatous herbs. *Rhizome* 2.8–3.2 cm wide, white internally, hyaline at margins, slightly aromatic, covered by brown scales. *Leafy shoot* 58–88 cm high, slanting with erect inflorescence. *Leaves* 8–10 in number, 6–9 cm apart, sessile; sheath 3.5–3.8 cm wide, green, margins white, membranous, translucent, densely pubescent; ligule 3.5–4.7 cm long, ovate, single-lobed, slightly notched at tip, pale green, densely sericeous externally, membranous, translucent, closely appressed to the stem; lamina 29–41 x 8–11.1 cm, elliptic, dark green and glabrous above, pale green and densely sericeous below, veins raised after regular intervals; margin highly undulate, membranous, translucent, white tinged, non-ciliate; tip long caudate, twisted, bend down; base cuneate. *Inflorescence* 8.5–12 cm long, conical-cylindrical, erect; peduncle 5–6 cm wide, pubescent, green. *Bracts* 2.8–3 x 1.1–1.5 cm, elliptic, green, glabrous, hairy only at the tip, moderately coriaceous, non-imbricate, convolute, reflexed back, basal 2 empty, navicular; margin non-ciliate, translucent, membranous, pale white tinged; tip obtuse; cincinnus 2 or 3-flowered. *Bracteoles* 2–2.8 cm long, pale green, puberulent, pubescent at tip only, non-tubular (outer one tubular at base, completely encircles the cincinnus), membranous, translucent; margin non-ciliate. *Flower* 10–10.2 (8.2–8.5) cm long, white with spreading stamen, spreading, many flowers opene at a time. *Calyx* 2.6–2.8 cm long, *c*. 2.5 mm wide at mouth, pale green, sparsely pubescent externally, membranous, translucent, closely appressed to corolla tube, exceeding the tube bracts by 3–4 mm, unilaterally split upto 8–10 mm deep, 3-toothed at tip, lobes equal. *Corolla tube* 3.6–4.1 cm long, 2–2.5 mm wide at mouth, white, glabrous externally, hairy internally, straight. *Corolla lobes* white, green

tinged towards tip, membranous, drooping from flower, glabrous; dorsal lobe 5.3–5.7 x 0.35–0.45 cm, oblanceolate, *c.* 1.5 mm long beaked at tip, 5 or 6-nerved; lateral lobes 4.7–5.1 x 0.25–0.35 cm, oblanceolate, non-beaked at tip, 3 or 4 nerved. *Lateral staminodes* 3.1–3.3 x 0.35–0.4 (1.7–2 x 0.2) cm, oblanceolate, white, spreading on flower, reflexed back, margin undulate, not entire, tip obtuse. *Labellum* 2.3–2.9 x 1.1–1.3 (1.8–2 x 0.8) cm, obovate-spatulate, white, pale yellow blotch at centre, spreading on flower, reflexed back on upper half and margins, gradually clawed at base; claw 3–4 mm wide; sinus 0.9–1.2 mm deep; margin undulate, not entire. *Stamen* 6.9–7.3 (4.2–4.5) cm long, white, slightly arching, spreading on flower. *Filament* 5.8–6.4 (3.6–4) cm long, *c.* 2 mm wide at base, white, slightly arching. *Anther* 9–10 x 2.5–3 mm, elliptic, white, split opens from top to bottom, attachment at 1.5–2 mm above from base, thecae right angle with the filament; connective white, glabrous, prolonged in to a crest of *c.* 0.5 mm long, truncate at tip. *Ovary* 3–3.5 x 2–2.5 mm, ovate, yellowish green, pubescent externally. *Style* filiform, white, glabrous, green tinged towards stigma. *Stigma* green, stigmatic head flat, slanting with a depression at centre, sparsely hairy, hairs hook-like, *c*. 0.5 mm exserted the anther. *Epigynous glands* two, unequal, 3.5–4.5 mm long, oblong, finger-shaped, pale yellow. *Fruits* 3.5–4 x *c.* 3 cm, loculicidal capsule, ovate, three-angled, glabrous, trilocular, surface smooth; fruit wall yellow externally (when mature), orange internally, completely splitted and refexed back on dehiscence. *Seeds* 4–5 x 3 mm, elliptic, red, yellow at base, compactly arranged on column. *Aril* red, lacerate, fleshy, basal.

Notes: Described by Smith in Rees' *Cyclopedia* (Smith 1811) on the basis of a specimen gathered by Buchanan in August 1802 from Narainhetty, Upper Nepal. A distinct species which has white flowers on an ovate dense spike with gently recurved and convolute bracts. The flowers are arranged as a pincushion-like with projected stamens and upturned anthers. A full ring of, about 10 or more flowers open at a time.

Ker Gawler (1824a) described another species, *H. heteromallum*, based on a plant brought from Calcutta Garden and a drawing was also made. A generalized description provided by the author is not sufficient to assign to any species of the genus. The excellent colour drawing associated with this is much similar to the species *H. thyrsiforme* except in the length of inflorescence and anther colour. Earlier workers like Roscoe (1826), Wallich (1853), Voigt (1845), Schumann (1904) *etc.* were also treated it as a synonym of *H. thyrsiforme.* Naik and Panigrahi (1961) noted the facultative epiphytic nature of *H. thyrsiforme*, but we never observed this species in epiphytic condition.

Some collections of the species from North-east India differs in having rather cylindrical inflorescence, smaller flowers with shorter and narrow labellum and lateral staminodes and shorter filament. But it is not sufficient to consider them even as a variety and considered only as a smaller form of the species.

Flowering & Fruiting: June–September.

Distribution: Occurs in Bangladesh, Bhutan, Nepal and India. In India, *H. thyrsiforme* is infrequently distributed in states like Arunachal Pradesh, Meghalaya, Mizoram, Sikkim, Tripura, Uttarakhand, Utter Pradesh and West Bengal at an altitude of 600–1,800 m. (*Figure 50. A*)

IUCN Red list Category: Due to the infrequent distribution and wide geographical range of occurrence in the wild, *H. thyrsiforme* is assessed here as Near Threatened (NT) according to the IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA**. **ARUNACHAL PRADESH**. LOWER SUBANSIRI Dt.: (NEFA), 8th mile on Kimin – Ziro Road, 24 Sep 1959, *G. Panigrahi 19348* (ASSAM). **MEGHALAYA**: *s.loc.,* 28 Sep 1915, *U. Kanjilal 5939* (CAL). RI-BHOI Dt.: Nongpoh, 14 Aug 1952, *G.K. Deka s.n.* (ASSAM). WEST GARO HILLS Dt.: Tura

Mountain, 4500 ft., 1879, *N.E. Parry 806* (K), 12 Dec 1960, *G. Panigrahi 22428* (ASSAM), 3850 ft., 29 Aug 1962, *D.B. Deb 28938* (ASSAM). **MIZORAM**. Khuaikham area, 1300 m., N 22°50'81.8", E 092°48'80.5", 7 Sep 2002, *M.G. Prasanth Kumar & Jana Skornickova 86210* (CALI). AIZWAL Dt.: Sairang, 2220 ft., 12 Jan 1963, *D.B. Deb 30606* (ASSAM). LUNGLEI Dt.: Hauruang, 4 mile from Tunghli, 27 Jan 1963, *D.B. Deb 31378* (ASSAM). MAMIT Dt.: Mamit, PWD IB, 19 Sep 2002, *M.G. Prasanth Kumar & Jana Skornickova* 86277 (CALI). **SIKKIM**. *s.loc., J.D. Hooker & J. Thomson s.n.* (CAL), 2000 ft., 4 Sep 1874, *G. King s.n.* (CAL), 1875-6, *G. King s.n.* (CAL). EAST SIKKIM Dt.: 3 Km from Ranipool towards Siliguri, 25 Aug 2004, *M. Sabu & A.K. Pradeep 92740* (CALI). NORTH SIKKIM Dt.: Kabi SRT, 1612 m., N 27°24'34.8", E 088°37'15.7", 23 Aug 2004, *M. Sabu & A.K. Pradeep 92723* (CALI); Kabi, 11 April 2005, *E. Sanoj 92760* (CALI). **TRIPURA**. NORTH TRIPURA Dt.: Vanghmuri, 2250 ft., 23 Jan 1962, *D.B. Deb 27084* (ASSAM, CAL). WEST TRIPURA Dt.: Ghorakappa, MBB College, Agartala, 25 Nov 1959, *D.B. Deb 1979* (CAL). **UTTARAKHAND**. NAINITAL Dt.: Kathgodam, Oct 1905, *A. Meebold 281* (CAL); Ghilmodya Sot Suttan, Corbet National Park, 12 Nov 1970, *P.C. Pant 43186* (BSD); Corbet National Park, 15 Nov 1972, *K.P. Janardhanan 50139* (BSD). **UTTER PRADESH.** AMBEDKAR NAGAR Dt.: Gharwal Bhabar 1869/70, *G. King s.n.* (CAL); RAEBARELI Dt.: Thakur, Aug 1881, *J.S. Gamble 9709* (CAL)**. WEST BENGAL**. DARJEELING Dt.: Darjlling, 5000 ft., 19 Sep 1839, *C.B. Clarke 9318* (K); Tista, 11 Jul 1867, *T. Anderson s.n.* (E); Badamtam, 1500 ft., Nov 1879, *J.S. Gamble 7342* (K); Tahoar, 5000 ft., Aug 1881, *J.S. Gamble 9769* (CAL); Mungpo, 3500 ft., *W.W. Smith 99* (CAL). JALPAIGURI Dt.: Bengal Terai, Raimatong, 26 Mar 1945, *S.K. Mukherjee 1392* (CAL); Sinchu, 6000 ft., 17 May 1979, *J.K. Sikdar 6912* (CAL); Kodalbusti, 6 Dec 1995, *S. Chanda & S.K. Mandal 1062* (CAL); Chapramani W.L.S., *J. Bhattacharya & Party 32346* (CAL).

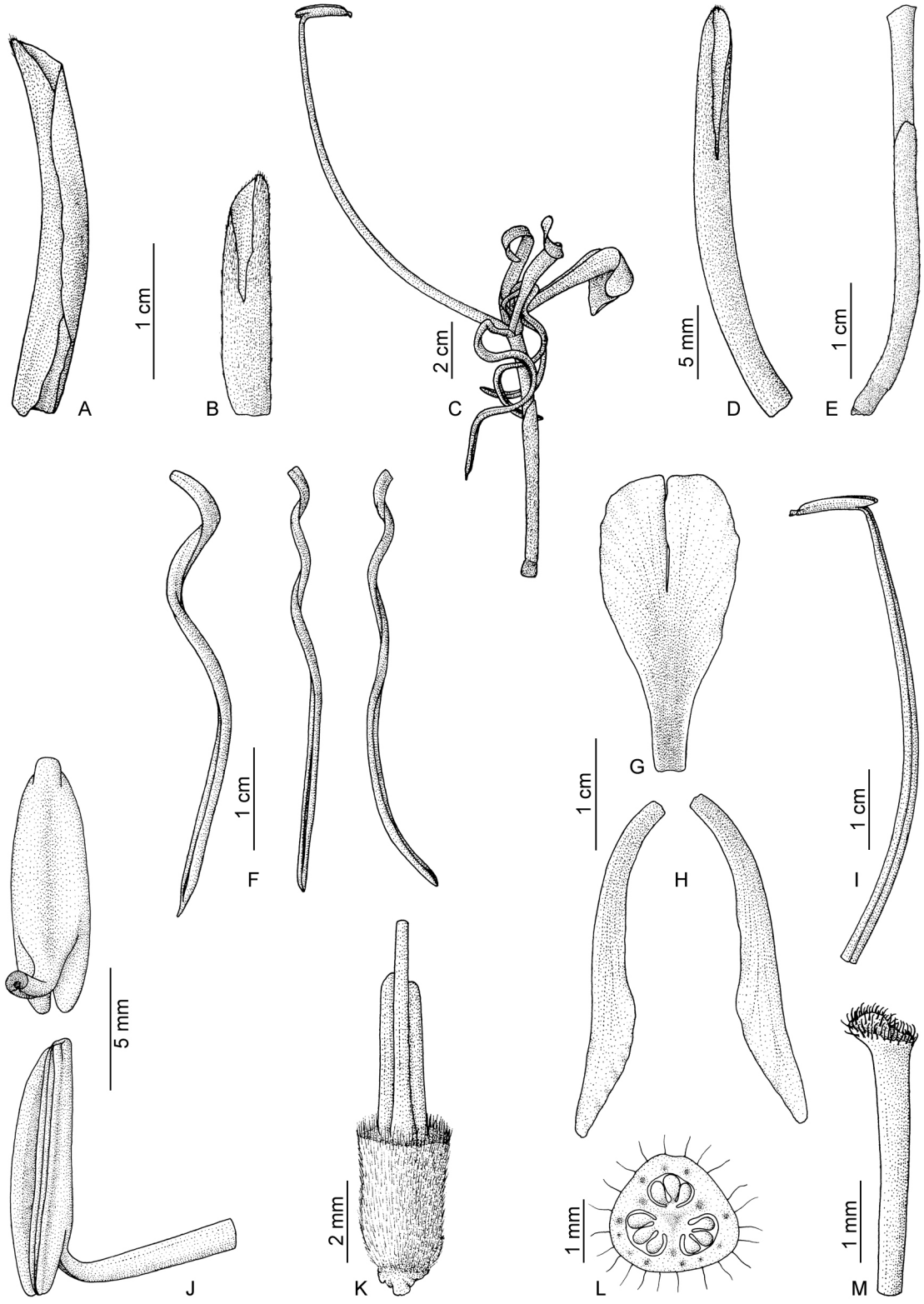

Figure 47. ***H. thyrsiforme***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, back view (left) and lateral view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.



Plate 23. **A-E.** ***H. stenopetalum*****: A.** inflorescence; **B.** entire cincinnus; **C.** labellum; **D.** lateral staminodes; **E.** stamen. **F-J.** ***H. thyrsiforme*****: F.** inflorescence; **G.** single flower, bract and bracteole; **H.** labellum; **I.** lateral staminodes; **J.** stamen.

H. urophyllum Lodd., Bot. Cab. 18(9): t. 1785. 1832; Turrill, Bull. Misc. Inform. Kew 1914(10): 369. 1914; Horan., Prodr. Monogr. Scitam. 24. 1862; S.K. Jain & V. Prakash., Rheedea 5(2): 161. 1995.

Type: Loddiges, Bot. Cab. 18(9): t. 1785. 1832.

H. coronarium var. *urophyllum* (Lodd.) Baker in J.D. Hooker, Fl. Brit. India 6: 226. 1892; Naik & Panigrahi, Bull. Bot. Surv. India 3(1): 71. 1961; A.S. Rao & D.M. Verma, Bull. Bot. Surv. India 11(1&2): 122. 1969, 14(1-4): 128. 1972; N.P. Balakr., Fl. Jowai 2: 528. 1983; S.C. Srivast. in S.K. Jain & R.R. Rao, Threat. Pl. India 235. 1983.

H. coronarium var. γ Wall. in W.J. Hooker, Hooker's J. Bot. Kew Gard. Misc. 5: 325. 1853, J. Hort. Soc. London 9: 15. 1855; C. Muell., Ann. Bot. Syst. 6: 23. 1861.

H. flavum auct. non Roxb.: Hook., Bot. Mag. 58: t. 3039. 1831.

(*Figure 48; Plate 24. A–D*)

Perennial rhizomatous herbs. *Rhizome* 2.2–2.7 cm wide, creamy white internally, slightly aromatic. *Leafy shoot* 54–167 cm high, slightly slanting. *Leaves* 10–14 in number, 3.8–7 cm apart, sessile; ligule 1.9–2.3 cm long, single-lobed, tip obtuse, ovate, pale green, pubescent externally, membranous, closely embracing with the stem; lamina 38–44.5 x 7–9.5 cm, elliptic, dark green above, pale green below, glabrous; margin non-ciliate; tip long acuminate; base long obtuse; midrib pubescent below. *Inflorescence* 10–16 cm long, lanceolate-elliptic, erect, compact with imbricate bracts. *Bracts* 6.7–7 x 2.8–3.6 cm, ovate, green, glabrous on both sides, coriaceous, closely imbricate; margin hyaline, non-ciliate; tip obtuse; cincinnus 3-flowered. *Bracteoles* 2.4–3.2 x 2.2–2.5 cm, ovate, pale green, glabrous on both sides, hairy externally at tip, translucent, outer one non-tubular, inner

ones tubular, moderately coriaceous; margin non-ciliate; tip obscurely 2 or 3-lobed, outer bracteoles completely encircles the cincinnus. *Flower* 11.8–12.1 cm long, deep yellow, drooping, 4–6 opens at a time. *Calyx* 2.7–3 cm long, *c.* 7 mm wide at mouth, yellow, glabrous, pubescent externally at tip, tubular, upper 2/3rd portion inflated, lower portion closely appressed to tube, distinctly 3-toothed at tip, unilaterally split upto 1.5–1.6 cm. *Corolla tube* 7.8–8 cm long, deep yellow with orange tinged towards tip, pale yellow towards base, glabrous externally, hairy internally, tube curved towards tip. *Corolla lobes* elliptic, deep yellow with orange tinge towards base, glabrous, early decaying at base; dorsal lobe 3.8–4 x 0.9–1 cm, 5–7 mm long beaked at tip, 7 or 8-nerved; lateral lobes 3.2–3.5 x 0.9–1 cm, *c.* 1 mm long pouched at tip, 4 or 5-nerved. *Lateral staminodes* 3.3–4.1 x 0.8–1.2 cm, obovate, dark yellow, orange tinged towards base, straight, ascending on flower, margin crumpled and undulate, tip obtuse. *Labellum* 3.5–3.6 x 4.4–4.6 cm, widely depressed ovate, deep yellow, orange tinged towards base, spreading on flower, margins reflexed back, base abruptly clawed; claw 0.9–1 cm wide, yellow-orange; sinus 3–6 mm deep; margin undulate. *Stamen* 3.3–3.6 cm long. *Filament* 2.5–3 cm long, deep yellow, orange tinged towards base. *Anther* 14–16.5 x *c.* 0.35 cm, oblong, yellow, thecae parallel, split opens from top to bottom, attached with the filament at *c.* 5.5 mm above from base, thecae at an angle of *c.* 70° with the filament axis; anther suture yellow; connective yellow, minutely crested at tip; crest *c.* 1 mm, tip truncate. *Ovary* 4–6 x 3.5–4 mm, barrel-shaped, pale green, puberulent externally. *Style* long, filiform, white, glabrous, green tinged towards stigma. *Stigma c.* 2 mm wide at mouth, green, stigmatic head flat, slanting with a depression at center, hairy, hairs hook-like. *Epigynous glands* two, *c.* 2 mm long, finger-shaped, yellow.

Notes: It is a distinct species, but frequently been reduced as a variety of *H. coronarium* J. Koenig. It can be easily distinguished by their smaller and deep yellow flower with smaller labellum, shorter and narrower lateral staminodes.

H. urophyllum was described by Loddiges (1832) based on a material sent by Wallich to the Horticultural Society, London. Meanwhile, Hooker in *Curtis's Botanical Magazine* (58: 3039. 1831) misidentified this taxon and described, along with an illustration, under the title *H. flavum* Roxb. Which was based on a material brought by Wallich from India in August 1828.

Wallich (1853, 1855) reduced *H. urophyllum* under the var. 'γ'of the species *H. coronarium*. Again Baker (1892) reduced it as the variety of *H. coronarium* and mentioned "structure of the type, flowers bright yellow". Whereas Schumann (1904) reduced it as the synonym of *H. flavum*. But based on the studies of live materials from Meghalaya we identified it as a distinct species from *H. coronarium* and hence kept separately, which has also been followed by Horaninow (1862).

Turrill (1914) stated that labellum of this species as entire or slightly bilobed or undulating, but based on live material study we identified it is having a distinctly bilobed labellum.

Flowering: June–September.

Distribution: Endemic to Meghalaya at an altitude of 1,000–1,600 m.

(*Figure 50. B*)

IUCN Red list Category: As it is having very limited extent of occurrence and area of occupancy with distant subpopulations, it is assessed against Endangered (EN B1b(i,ii,iv)+2b(i,ii,iv); C1) category as per IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA**. **MEGHALAYA**. Khasia, 3-4000 ft., *J.D. Hooker & J. Thomson s.n.* (E, K). EAST KHASI HILLS Dt.: Bishop Falls, Shillong, 4050 ft., *C.B. Clarke 44675* (K); Lawkyntang, 21 Aug 1937, *N.L. Bor 15625* (ASSAM); Barapani forest, 21 Jul 1944, *G.K. Deka 21727* (CAL); Woodlands, 13 Aug 1965, *D.M. Verma 37054* (ASSAM); 9 Aug 1967, *G.K. Deka 37332* (ASSAM); Shillong to Jowai, 1500 m.,

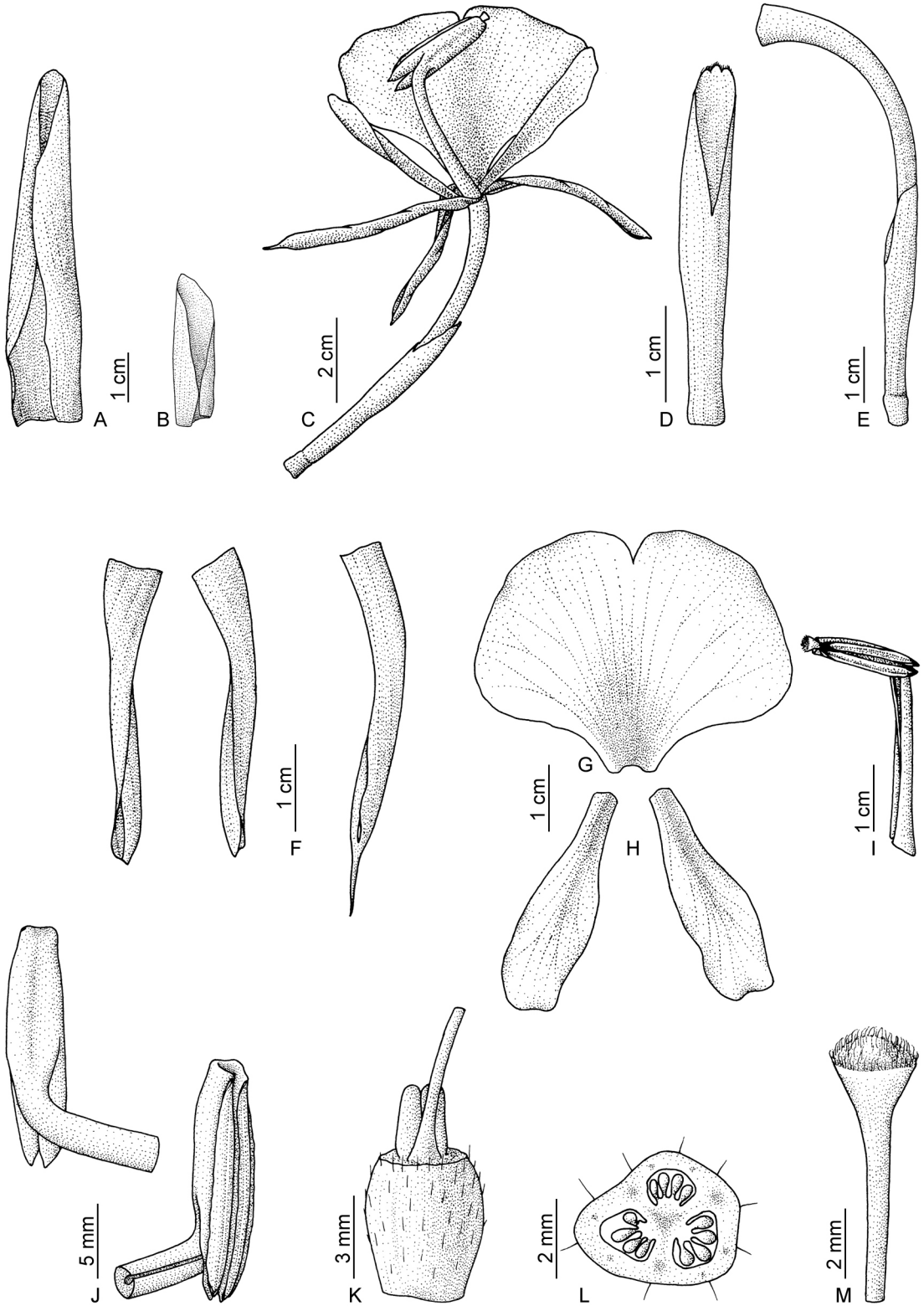

Figure 48. ***H. urophyllum***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, back view (left) and lateral view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

13 Aug 2004, *E. Sanoj 95610* (CALI), 1520 m., 13 Aug 2004, *E. Sanoj 95611* (CALI). JAINTIA HILLS Dt.: Jowai, 17 Jul 1968, *A.S. Rao 35692* (ASSAM); Near Jowai, on road to Jorain, 1450 m., *N.P. Balakrishnan 42857* (ASSAM); way to Ladrimbai, 1395 m., N 25°26.116', E 092°17.843', 16 Aug 2007, *E. Sanoj & T. Rajesh Kumar 95187* (CALI), *E. Sanoj & T. Rajesh Kumar 95189* (CALI).

Key to the varieties of *H. urophyllum*

1a. Filament deep yellow; lateral staminodes obovate; labellum widely depressed ovate; sinus 0.3–0.6 cm deep……. var. ***urophyllum***

1b. Filament deep red; lateral staminodes oblanceolate; labellum very widely ovate; sinus 1.7–1.8 cm deep…… var. ***elwesii***

26a **Hedychium urophyllum** var. **elwesii**

H. urophyllum var. ***elwesii*** (Baker) Sanoj & M. Sabu, *stat. nov.*

H. elwesii Baker in J.D. Hooker, Fl. Brit. India 6: 226. 1892; K. Schum. in A. Engler, Pflanzenr. IV. 46(heft 20): 46. 1904; Weathers, Bulb Book 269. 1911; Turrill, Bull. Misc. Inform. Kew 1914(10): 369. 1914; J.N. Mitra, Monocot. E. India 1: 242. 1958; A.S. Rao & D.M. Verma, Bull. Bot. Surv. India 11: 123. 1969, 14: 129. 1972; S.C. Srivast. in S.K. Jain & R.R. Rao, Threat. Pl. India 235. 1983; Karthik. et al., Fl. Ind. Enum. Monocot. 295. 1989; S.K. Jain & V. Prakash., Rheedea 5(2): 160. 1995; M. Sabu & Pradeep, Folia Malaysiana 6(1&2): 8. 2005.

H. coronarium var. *elwesii* (Baker) Naik in Naik & Panigrahi, Bull. Bot. Surv. India 3(1): 71. 1961.

Type: INDIA. Meghalaya, East Khasi Hills Dt., Bishop Falls near Shillong, 4000 ft., 8 Sep 1886, *H.J. Elwes 44675* (holo K!). (*Figure 49; Plate 24. E–H*)

Terrestrial, perennial rhizomatous herbs. *Rhizome* 2.3–2.9 cm wide, creamy white internally, slightly aromatic. *Leafy shoot* 50–160 cm high, slightly slanting. *Leaves* 10–14 in number, 7.5–10 cm apart, spreading on plant, sessile; ligule 2–2.5 cm long, ovate, pale green, pubescent externally, single-lobed, membranous, closely embracing with the stem; lamina 32–37 x 6.7–9.2 cm, elliptic, dark green and glabrous above, pale green and puberulent below; margin non-ciliate, hyaline, pubescent below; tip long acute, base obtuse; midrib pubescent below. *Inflorescence* 12–13 cm long, lanceolate-elliptic, erect, dense with imbricate bracts. *Bracts* 5.6–6.5 x 2.8–3.4 cm, elliptic-ovate, green, glabrous, puberulent at margins towards tip, coriaceous, closely imbricate; margin hyaline, membranous, non-ciliate; tip acute; cincinnus 3-flowered. *Bracteoles* 2–2.6 x 1.3–1.8 cm, ovate, pale green, glabrous on both sides, pubescent externally at tip, non-tubular, sub-coriaceous; margin membranous, non-ciliate; tip acute. *Flower* 10–10.4 cm long, deep yellow, drooping, 4–6 opens at a time. *Calyx* 2–2.5 cm long, *c.* 4 mm wide at mouth, yellow, puberulent, tubular, membranous, translucent, upper 2/3rd portion inflated, lower portion closely appressed to the tube; tip obscurely 2 or 3-toothed, unilaterally split upto 6–7 cm. *Corolla tube* 6.2–6.3 cm long, *c.* 5 mm wide at mouth, deep yellow with red tinged towards tip, pale yellow towards base, glabrous externally, tube curved towards tip. *Corolla lobes* oblong, yellow, red tinged towards base, glabrous, early decaying at base; dorsal lobe 3.3–3.5 x *c.* 0.7 cm, *c.* 4 mm long beaked at tip, 5 or 6-nerved; lateral lobes 3.2–3.4 x *c.* 0.7 mm, non-pouched at tip, 4 or 5-nerved. *Lateral staminodes* 3.5–4 x 0.6–0.7 cm, oblanceolate, deep yellow, deep red patch towards base, ascending on flower; tip truncate, slightly notched a centre. *Labellum* 3.8–4 x 3.8–4 cm, very widely ovate, deep yellow, deep red patch towards base, spreading on flower, margins refluxed back, gradually clawed; claw 6.5 mm wide, deep red; sinus 1.7–1.8 cm deep; margin undulate. *Stamen* 3.4–3.6 cm long, red. *Filament* 2.4–2.5 cm x 2 mm, deep red. *Anther* 14–15 x *c.* 3 mm, oblong, yellow, lobes parallel, split opens from top to bottom, attached with the filament at *c.* 4 mm above from base, thecae at an angle of *c.* 65° with the filament axis; anther suture yellow; connective yellow with red

tinge, minutely crested at tip; crest *c.* 1 mm, tip truncate, slightly notched. *Ovary* 5–6 x *c.* 3 mm, barrel-shaped, pale green, densely pubescent externally. *Style* long, filiform, white, green tinged towards stigma. *Stigma c.* 2 mm wide at mouth, stigmatic head flat, slanting with a depression at center, green, hairy, hairs hook-like. *Epigynous glands* two, 2.5–3 mm long, finger-shaped, yellow.

Notes: Baker (1892) established *H. elwesii*, based on a solitary collection of Elwes from Bishop's Falls, near Shillong. Turrill (1914) considered *H. elwesii* as a separate species and mentioned that, *H. elwesii* and *H. urophyllum* are closely related to *H. coronarium* in having stamen shorter than labellum and both have deep yellow flowers which is smaller than those of *H. coronarium*. He also provided an illustration of the flower prepared on the basis of a collection at Kew. Later, Naik and Panigrahi (1961) reduced *H. elwesii* as a variety of *H. coronarium* by considering wide range of morphological intergrades between *H. coronarium* complex and its somatic counts. They have done this reduction only on the basis of dried specimens from ASSAM (BSI, Shillong) without any additional live collections or without access to any authentic collections.

Rao and Verma (1969a) reinstated it as the species and concluded that any definitive decision and the identity of *H. elwesii* need comprehensive collections (preferably from type locality) and critical study. During our field explorations, we could collect this taxon from Mawlai, near Shillong, very near to the type locality of *H. elwesii*. On critical studies it is revealed that it shows much affinity with *H. urophyllum* than any other species and it differs in lateral staminodes and labellum shape, and in having labellum with a deep red patch towards the base and stamen deep red. Hence the status of *H. elwesii* is reduced as a variety of *H. urophyllum*.

Flowering: August–September.

Distribution: Endemic to Meghalaya and Mizoram, India at an altitude of 1,000–1,300 m. (*Figure 50. B*)

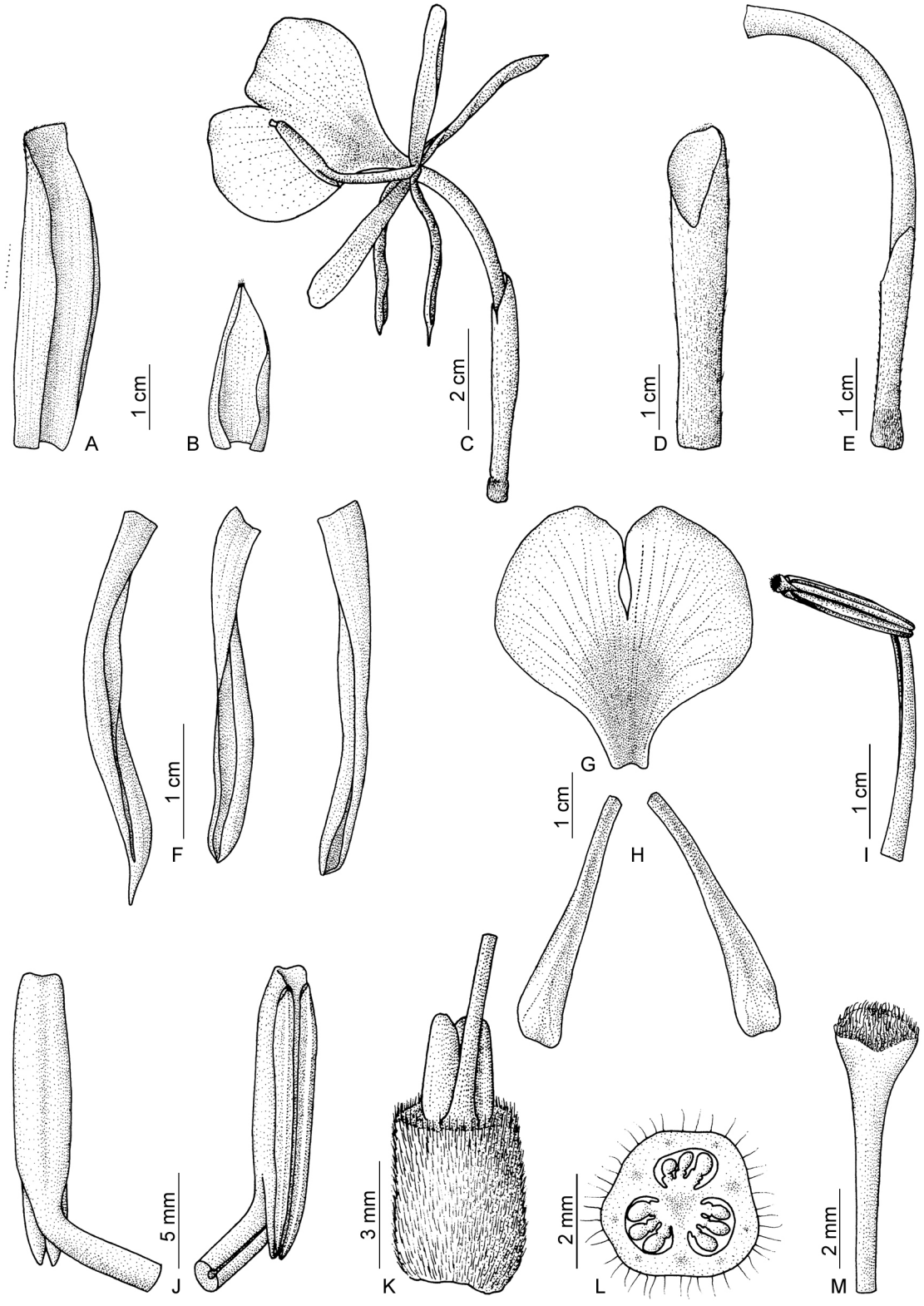

Figure 49. ***H. urophyllum*** var. ***elwesii***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, back view (left) and lateral view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.



Plate 24. **A-D.** ***H. urophyllum*: A.** inflorescence; **B.** labellum; **C.** lateral staminodes; **D.** stamen; **E-H.** ***H. urophyllum*** var. ***elwesii*: E.** inflorescence; **F.** labellum; **G.** lateral staminodes; **H.** stamen. (**B-D & F-H** -from pickled specimens)

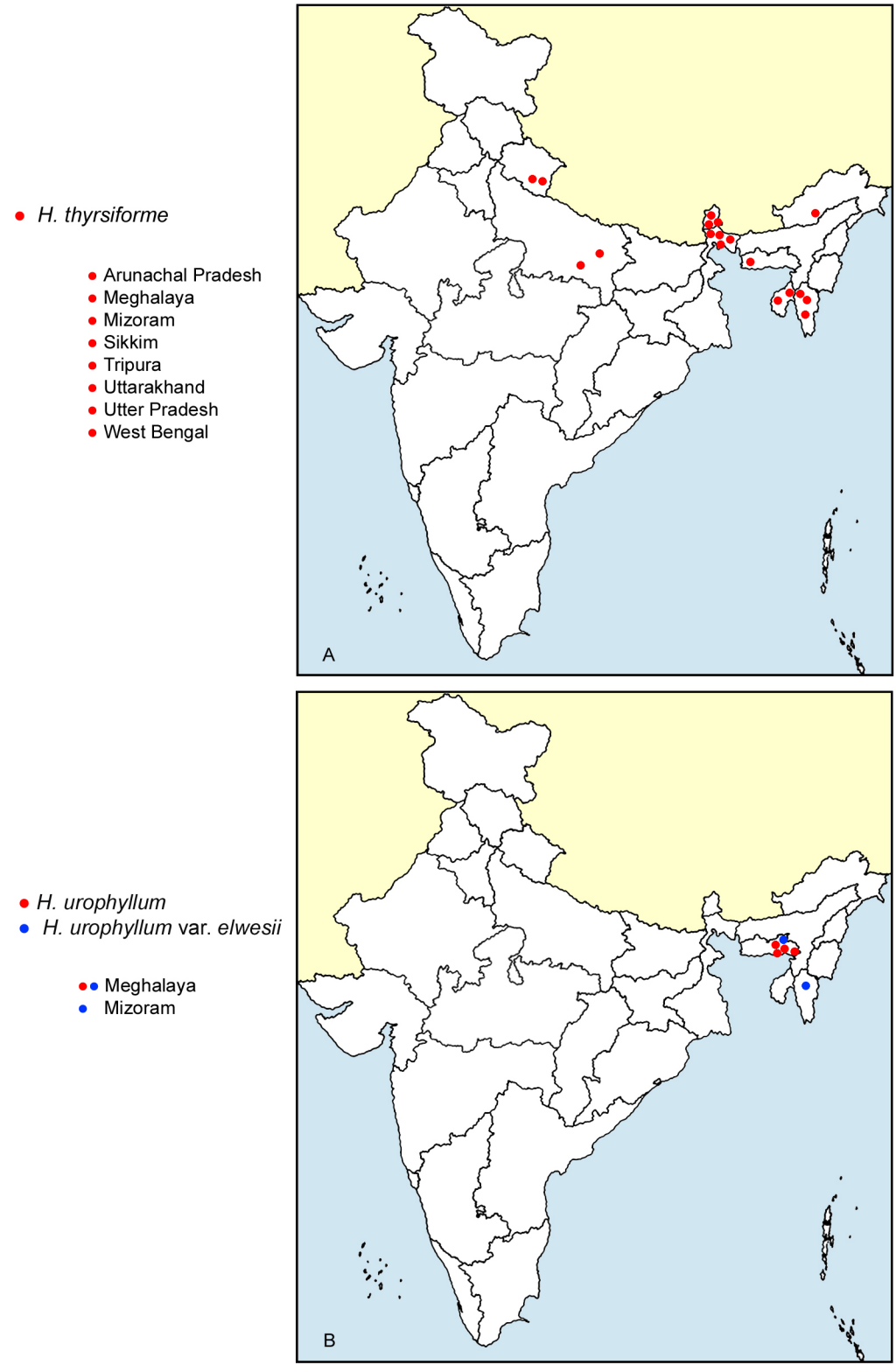

Figure 50. Distribution maps of ***H. thyrsiforme, H. urophyllum*** and ***H. urophyllum*** var. ***elwesii.***

IUCN Red list Category: As this species having a very limited extent of occurrence and area of occupancy in Meghalaya and Mizoram with wider geographical subpopulations, it is assessed against the Critically Endangered (CR B1ab(i,ii,iv)+ 2ab(i,ii,iv); D; E) category as per IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA**. **MEGHALAYA**. RI-BHOI Dt.: Mawlai, 5 km towards Guwahati, 2 Aug 2003, 1380 m*., M. Sabu & A. K. Pradeep 92501* (CALI). **MIZORAM**. AIZWAL Dt.: Lushai, 4-5000 ft., Aug 1930, *W.J.H. Wenger 310* (K).

27 Hedychium villosum

H. villosum Wall. in W. Roxburgh, Fl. Ind. ed. Carey 1: 12. 1820; Voigt, Hort. Suburb. Calcutt. 569. 1845.

Lectotype (designated here): E. Sylhet, 1815, *M.R. Smith s.n. pro parte* (middle specimen; BM!). (*Figure 51; Plate 25. A–D*)

Epiphytic perennial herbs. *Leafy shoots* 60–90 cm high, erect, slender. *Leaves* 8–12 in number, spreading, at a distance of 3.4–7.5 cm, sessile; sheath 1.9–2 cm wide, puberulent at margins; ligule 1.8–2.1 x 0.7–0.8 cm, single-lobed, oblong, membranous, puberulent externally, tip acute; lamina 14–20 x 3.7–4.5 cm, elliptic-lanceolate, dark green and glabrous above, pale green and puberulent below; midrib pubescent below; tip long acuminate; base obtuse; margin non-ciliate, translucent, white tinged. *Inflorescence* 16.5–33 cm long, erect or drooping, lax, cylindrical. *Bract* 1.2–1.4 x 0.4–0.5 cm, one on each flower, convolute, elliptic, boat-shaped, brown, non-tubular, more or less leathery, densely hairy externally, hairs brown; margin non-ciliate; cincinnus 2–3 -flowered. *Bracteoles* 1–1.3 x *c.* 0.25 cm, brown, tubular, unilaterally split upto 5–8 mm, densely hairy externally, hairs

brown; margin non-ciliate. *Flower* 4.7–5.2 cm long, pale yellow, highly fragrant, many open at a time. *Calyx* 1.6–1.8 x *c.* 0.15 cm, tubular, unilaterally split up to 5–6 mm, gradually convolute towards the tip, membranous, translucent, densely pubescent externally; hairs brown; obscurely 3 –lobed at tip. *Corolla tube* 1.9–2.1 cm long, *c.* 1.5 mm wide at mouth, straight, exceeding the calyx and bract, pale yellow, densely pubescent externally, hairs brown, hairy internally. *Corolla lobes* oblong, pale yellow, lower half pubescent externally, glabrous on upper half, margins non-ciliate, non-beaked at tip, lobes 3-nerved; dorsal lobe 1.6–1.7 x *c.* 0.15–0.2 cm long; lateral lobes 1.5–1.6 x c. 0.15 cm long. *Lateral staminodes* 1.3–1.5 x *c.* 0.15 cm, linear, straight, pale yellow, tip acute. *Labellum* 1.3–1.4 x *c.* 0.5 cm, elliptic, narrow towards base, pale yellow, sinus 0.8–0.9 cm deep, lobes tip acute; claw *c.* 1 mm wide at base. *Stamen* 2.6–2.8 cm long. *Filament* 2.4–2.6 cm long, scarlet, straight, c. 0.5 mm wide at base. *Anther c.* 1.5 x 1.5 mm, sagittate, brown, glabrous, non-crested, pink, truncate at tip, glabrous. *Ovary c.* 3 x 2 mm, oblong, pale green, densely pubescent externally. *Style* filiform, white, glabrous. *Stigma* cup-shaped, margin ciliate, *c.* 0.5 mm exserted from anther. *Epigynous glands* two, 2.5–3 mm long, oblong. *Fruits* unknown.

Notes: It is a much confused species with its succeeding variety due to sagitate anther. But based on the extensive literature and herbarium studies we could delimit these two taxa at varietal status. As we could not collect the live plants, the description provided here is based on the earlier publications and herbarium studies. Detailed discussion about the nomenclature and typification of both the taxa are provided under the succeeding variety.

Flowering: December–April, One of the species which flowers in winter season, other than monsoon.

Distribution: Distributed in India, Myanmar and Bangladesh. In India, it is distributed in Arunachal Pradesh, Meghalaya and Mizoram at an altitude of 660–1,400 m. (*Figure 54. A*)

IUCN Red list Category: Due to its very restricted distribution and lesser area of occupancy in the wild it is categorized against Critically Endangered (CR B1ab(i,ii,iv)+ 2ab(i,ii,iv); D; E) as per IUCN Guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA. ARUNACHAL PRADESH**. CHANGLANG Dt.: Chenglang to Khela, 666.6 m., 12 Mar 1958, *G.K. Murthy 12939* (ASSAM). DIBANG VALLEY Dt.: Thewarygaon, 1200 m., 20 May 1998, *M. Bhaumik 1922* (CAL); Anini, 1640 m., *M. Bhaumik s.n.* (CAL); Mehao Lake, 1300 m., 1 Dec 1996, *M. Bhaumik & M.K. Pathak 1153* (CAL); 1200 m., 20 May 1998, *M. Bhaumik & M.K. Pathak 1902* (CAL). WEST SIANG Dt.: Nokka to Nagminu, 5 Jul 1961, *D.B. Deb 26547* (ASSAM). **MEGHALAYA**. Khasia, 4000 ft., *J.D. Hooker & J. Thomson s.n.* (K), Khasia *No. 6* (CAL), *s.loc., s.coll. K.6* (CAL), K. Hills, Lower Saiges, Feb 1837, *s.coll. s.n.* (CAL), *s.loc.,* Feb 1851, *s.coll. s.n.* (CAL). **MIZORAM**. AIZWAL Dt.: Sialsuk, Lushai Hills, 4700 ft., 15 Jan 1963, *D.B. Deb 30713* (ASSAM). LUNGLEI Dt.: Theiriat, Lushai Hills, 25 Jan 1963, *D.B. Deb 31265* (ASSAM). SERCHIP Dt.: Kheitum, Lushai Hills, 23 Jan 1963, *D.B. Deb 31185* (ASSAM). *Locality unknown*. *s.loc., Mack s.n.* (K), s.*loc., Griffith s.n.* (BM), *s.loc., Wallich 6545 A* (BM).

Key to the varieties of *H. villosum*

1a. Inflorescence 16.5–33 cm long; flowers pale yellow; corolla tube 1.9–2.1 cm long, densely pubescent externally; filament 2.4–2.6 cm long; anther c. 1.5 mm diameter. …….. var. ***villosum***

1b. Inflorescence 8.4–12.3 cm long; flowers white; corolla tube 5–5.2 cm long, glabrous externally; filament 5.3–6.3 cm; anther *c.* 3.5 x 2.5–3 mm. …….. var. ***tenuiflorum***

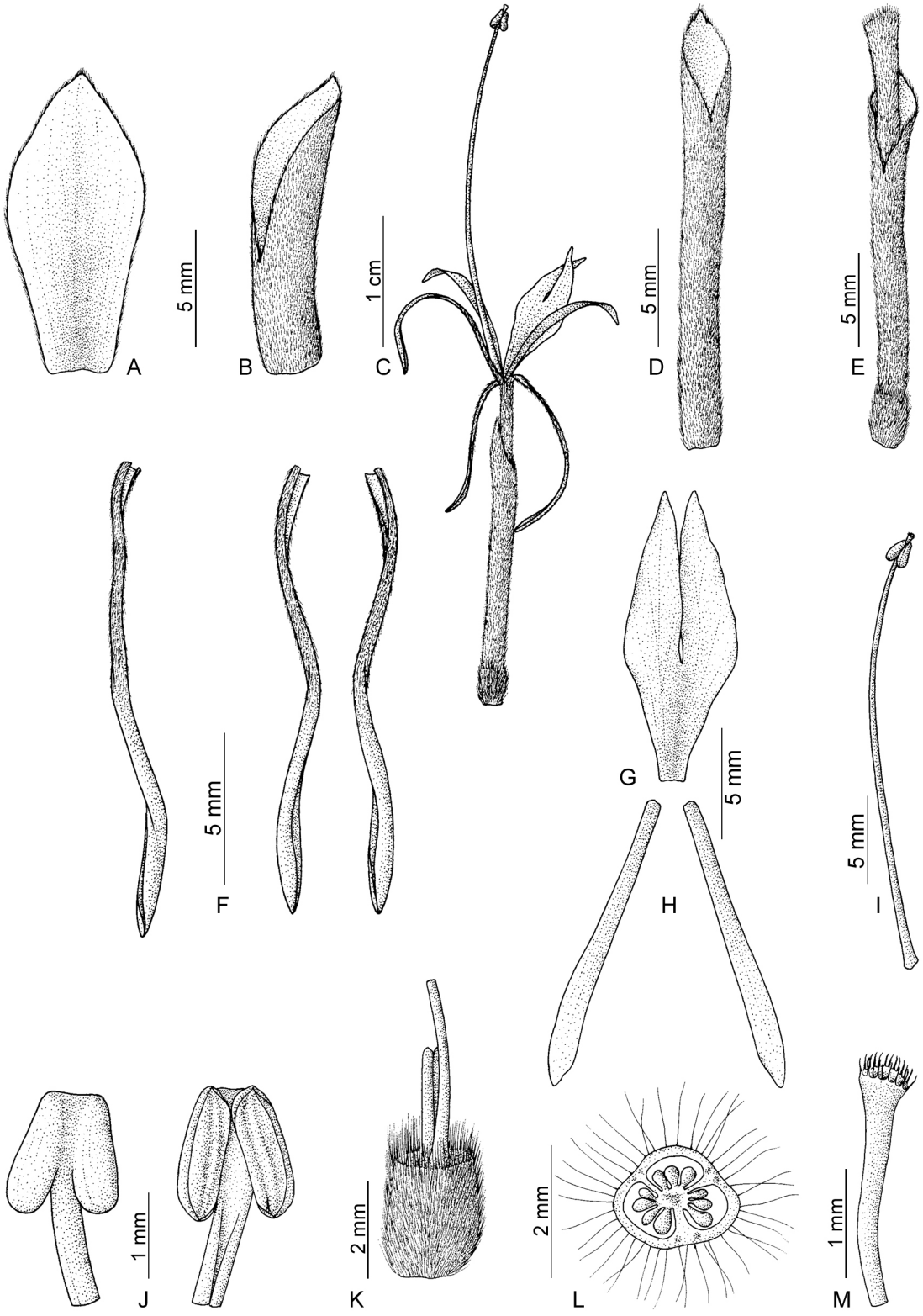

Figure 51. ***H. villosum***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, back view (left) and front view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

H. villosum var. ***tenuiflorum*** (Wall. ex Voigt) Wall. ex Baker in J.D. Hooker, Fl. Brit. India 6: 229. 1892 (excl. des.); J.N. Mitra, Monocot. E. India 1: 243. 1958.

H. tenuiflorum Wall. [in Roscoe, Monandr. Pl. Scitam. 11/12: sub t. 54. 1827, *nom. invalid*.] ex Voigt, Hort. Suburb. Calcutt. 570. 1845; K. Schum. in A. Engler, Pflanzenr. IV. 46(heft 20): 51. 1904 (excl. des.); A.S. Rao & D.M. Verma, Bull. Bot. Surv. India 14(1-4): 131. 1972.

Lectotype (designated here): Botanic Garden Calcutta, originally from Sylhet, *N. Wallich 6545 C* (lecto BM!; Microfische!)

H. villosum var. *tenuiflorum* Wall., Numer. List 6545 C. 1832, *nom. nud*.

(*Figure 52; Plate 25. E–H*)

Epiphytic perennial herbs. *Leafy shoots* 66–70 cm high, slanting or erect. *Rhizomes* 1.7–3 cm wide, pale green internally, slightly aromatic. *Roots* 0.6–12 mm wide, velamen type. *Leaves* 5–10 in number, at a distance of 4–8.5 cm, sessile; sheath 1.9–2 cm wide, green, margins pink, pubescent externally; ligule 2.9–3.4 x 1.3–1.6 cm, single-lobed, oblong, pale pink, densely pubescent externally, tip acute, margins and tip brown, early dried off; lamina 34–40 x 8–9 cm, elliptic-lanceolate, dark green above, pale green below, glabrous; midrib pubescent below, becomes glabrous towards tip; tip long acuminate; base obtuse; margin non-ciliate, translucent, pale pink tinged. *Inflorescence* 8.4–12.3 cm long, erect, lax, cylindrical. *Bract* 2.7–2.9 x 1.1–1.2 cm, one on each flower, convolute, lanceolate, boat-shaped, brown, non-tubular, leathery, easily dried before flowering, densely hairy externally, hairs brown; margin ciliate towards tip; cincinnus 3–4 -flowered.

Bracteoles 2.1–2.2 x 0.7–0.75 cm, lanceolate, brown, tubular, unilaterally split upto 9–10 mm, somewhat leathery, densely hairy externally, hairs brown; margin ciliate towards time. *Flower* 11.8–12.2 cm long, white with red stamen, mildly fragrant, three-many opens at a time. *Calyx* 3.3–3.7 x 0.2–0.3 cm, pale green, pink tinged towards tip, tubular, unilaterally split up to 5–9 mm, lower 2/3 portion closely appressed to corolla tube, membranous, translucent, densely pubescent externally; tip easily dried while flowering, obscurely 2 or 3 -lobed. *Corolla tube* 5–5.2 cm long, 2–2.5 mm wide at mouth, straight, exceeding the calyx and bract, creamy white, translucent towards base, glabrous externally, hairy internally. *Corolla lobes* oblong, greenish white, glabrous, drooping from flower; tip non-pouched, margins non-ciliate, lobes 3-nerved; dorsal lobe 4.3–4.4 cm long; lateral lobes 4–4.1 cm long. *Lateral staminodes* 3.3–3.5 x 0.1–0.15 cm, linear, straight, linear, white with a slight yellow tinge at base; tip acute, rarely forked. *Labellum* 3.1–3.5 x 1.2–1.5 cm, oblanceolate, boat-shaped, white with a yellow tinge at base, sinus 1.9–2.2 cm deep, lobes ensiform, unequal; claw 4–4.5 mm wide at base. *Stamen* 5.8–6.5 cm long. *Filament* 5.3–6.3 cm long, straight, *c.* 1.5 mm wide at base, red, light red towards tip. *Anther c.* 3.5 x 2.5–3 mm, sagittate, brown, glandular hairy; connective red, glabrous, row of hairy at margin, tip prolonged in to a crest; crest *c.* 1 mm long, red, truncate or slightly notched at center, glabrous. *Ovary* 2.5–3 x 2–2.5 mm, barrel-shaped, pale green, densely pubescent externally. *Style* filiform, white, glabrous, pale pink spotted towards stigma. *Stigma* cup-shaped, margin ciliate, 2–5 mm exserted from anther. *Epigynous glands* two, 3.5–5.5 mm long, oblong-lanceolate, yellow, free at base, fused towards tip. *Fruits* 1–1.1 x 1–1.1 cm, globular, sericeous, slightly angular.

Notes: *H. villosum* was originally described by Wallich (1820) based on a specimen sent to him by Mathew Robert Smith from the mountains of northeast of Bengal. From the descriptions provided by him it is evident that it is a species having cylindrical inflorescence of 25–30.5 cm long, with flowers small sized and yellow coloured (Corolla tube *c.* 3.8 cm long, bracts much shorter than tube, calyx

somewhat shorter than tube, filament as long as tube and scarlet colour). We could locate a colour plate drawn by Wallich at Kew, which closely resembles the description of *H. villosum* Wall. Incidentally Wallich also mentioned a variety, var. *tenuiflorum* under this taxon in his catalogue (*Numer. List.* 1832) for *Wallich 6545 C*, but not formally published or included later under *H. villosum* in his latter publications (Wallich 1853, 1855). But it was evident from Walllich's own statement ("they differ not even as varieties I belive"), that he had not preferred to keep his var. *tenuiflorum* as distinct. Wallich (1832) cited it as "*6545-C: Hedychium villosum* Wall. ? var. *tenuiflorum* Wall. HBC" (Hortus Botanicus Calcutta) "*e Sillet"* (from Sylhet, Bangladesh).

In the mean time, Roscoe (1827) while treating *Monandrian Plants of the order Scitamineae,* accepted Wallich's broader view, but refrain from recognizing any infrageneric taxa under *H. villosum*. It was evident from his observation - ("the chief diversity we have observed between our plant and that described in the *Flora Indica*, is in the downy margin and mid-rib of the leaves, and in the colour of the flowers, which in the *Flora Indica* are described as of a pale yellow colour, whilst in ours they are a pure white"), that he had not attempted for recognizing any rank at intraspecific level probably for the reason that the sagittate anther peculiar to *H. villosum* is also present in the other element. He also quoted "Dr. Wallich has also communicated another species under the name *Hedychium tenuiflorum*, which resembles the present, as well in the deep-lobed, undulated lip, as in the small *sagittate* anther.....". Interestingly, the description and figure (t. 54) provided by Roscoe (*l.c.*) under the name *H. villosum* is an excellent match for var. *tenuiflorum* (*sensu Wallich 6545 C*), and not pertaining to *H. villosum* (*sensu* Wallich 1820). In 1890, C.B. Clarke probably following Roscoe (*l.c.*) annotated two herbarium materials at Kew with two specimens mounted on single sheets. He determined the left hand side specimens (K000640488, K000640489) which bearing long cylindrical inflorescence and rather small flowers and anthers as var. *tenuiflorum* Wall., and the right hand side specimens (K000640486, K000640487) which bearing rather

large flowers and anthers as *H. villosum*. It appears that many of the subsequent authors (Baker 1892, Schumann 1904) treated *H. villosum* Wall. not as understood by Wallich (1820) but in the sense of Roscoe (1827) and Clarke's annotation in 1890. Baker (1892) attempted to provide a short description for Wallich's variety, var. *tenuiflorum,* for the first time and cited the original material of Wallich, *i.e., Wallich 6545 C ("6546 C")*. Unfortunately his description ("flowers much smaller than the type, corolla-segments staminodes and lip ½ in.") is not applicable to var. *tenuiflorum* (*sensu Wallich 6545 C*), but to the typical variety. Baker cited Roscoe's plate (Monandr. Pl. Scitam. t. 54) and considered the white and large flowered one as the typical *H. villosum* Wall., and not the pale yellow and small flowered one as Wallich (1820) described. This error was generated by C.B. Clark, who followed Roscoe (*l.c.*), while determining collections at Kew.

Schumann (1904) recognized var. *tenuiflorum* as a distinct species. He differentiated his 'new species' by the nature of inflorescence, less than 1 mm long anthers, narrower leaves and smaller flowers. As with Baker (*l.c.*), Schuman's description of *H. tenuiflorum* (Baker) K. Schum. (except *"corolla prob. albae"*) - *"Folia omnia summa ipsa sessilia stricte lanceolata longissime attenuato-acuminata et rostrata acutissima basi angustata utrinque glabra ....., Spica 25-30 cm longa anguste cylindrica....., anther vix 1 mm longa"* perfectly agrees with what is currently understood as *H. villosum* Wall. Inspection of cited specimens like *Hooker f. & Thomson s.n.* (K!), *Griffith 5661* (K!) and *Prain 43* (CAL!) is also agreeing with this judgement. Schumann (*l.c.*) also cited a specimen from Silhet, *Wallich 6545 A* both for his *H. tenuiflorum* and *H. villosum*. Although he mentioned Robert Smith's introduced material in 1815 under *H. villosum*, his description was not perfectly agreeing with the Wallich's protologue. There are two sheets Wallich's Microfisch bearing catalogue number, *6545 A*, both are collected from 'Chirrapunjee' and not from 'Silhet' as was indicated by Schumann. However, a Silhet specimen (*Wallich 6545 B*) collected in 1820 is available with Wallich's *H. villosum* (*non. sensu* Schumann). Among the two sheets, *Wall. Cat. n. 6545 A*, the second one is

mounted with two taxa, top left hand side material correspond to *H. villosum* and other two specimens matches with what is currently understood as *H. villosum* var. *tenuiflorum*. Judging from the description and materials cited Schumann (*l.c.*), it appears that he has treated *H. villosum* in the sense of Roscoe (*l.c.*) which had treated not in the strict sense of Wallich.

The present study on the genus by consulting a large number of specimens both live and herbarium, also in consultation with types, protologue and other relevant literature corroborate the view expressed by late J.O. Voigt (1865) in his *Hortus Suburbanus Calcuttensis* in which he rightly listed *H. villosum* in the strict sense of Wallich (1820) by citing not of Roscoe ("*H. villosum* Wall. not Roscoe"), and included *H. tenuiflorum* Wall. as *H. villosum* of Roscoe and not of Wallich ("*H. tenuiflorum* Wall. –*H. villosum* Roscoe, not Wall.").

On examination of live specimens, herbarium specimens and colour plates of both taxa and relevant literature, we feel that, these two taxa are distinct and have only varietal difference. Hence, *H. villosum* is treated as the nominal variety and latter as its variety, *H. villosum* var*. tenuiflorum.*

Typification: During the herbarium studies at BM we could locate one specimen, which was collected from E. Sylhet on 1815. Although the specimen lack's the collector name, it is inferred from the protologue that it was collected by M. R. Smith. It is also mounted with two taxa, right hand side material correspond to *H. villosum* var. *tenuiflorum* and other two specimens matches with what is currently understood as *H. villosum.* Hence, among this collection middle material is selected and designated here as the lectotype of *H. villosum*. As Voigt (1845) referred Wallich in Roscoe, while describing the species *H. tenuiflorum*, he implicitly included *N. Wallich 6545 C*. We could also locate *Wallich 6545 C* (BM!) collected from Botanic Garden Calcutta, originally from Sylhet, is designated here as the lectotype of the *H. villosum* var*. tenuiflorum*.

Flowering & Fruiting: January–April. This is one of the *Hedychium*, which flowers in winter, other than during rain (Rarely flowers up to–October).

Distribution: Widely distributed in Northeastern India (Meghalaya, Mizoram, Manipur, Nagaland, Arunachal Pradesh *etc.*), Bangladesh, northern Myanmar, southern Yunnan and Guangxi provices of China, Thailand, Laos, Vietnam, and Malaysia at an altitude of 600–1,800 m. (*Figure 54. A*)

IUCN Red list Category: Due to the fair extend of occurrence and area of occupancy with distant subpopulations, it is assessed against the Vulnerable (VU A2a; B1b(i,ii)+2b(I,ii); D2) category as per IUCN Guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA**. **ARUNACHAL PRADESH**. CHANGLANG Dt.: Wakka to Nagminu, 5 Jul 1961, *D.B. Deb 26547* (ASSAM, CAL); Chenglang to Khela, 666.6 m., 12 Mar 1958, *G.K. Murthy 12939* (ASSAM, CAL). DIBANG VALLEY Dt.: Delei Valley, 28°21' N, 96°37' E, 14 Jul 1928, *F.K. Ward 8448* (K). EAST SIANG Dt.: Rengging, Flora of Abor expedition, 24 Feb 1912, *J.H. Burkill 36708* (CAL). LOHIT Dt.: Dreyi above Denning, 28°10' N, 96°15' E, 2000-4000 ft., 5 Mar 1928, *F.K. Ward 7916* (K); Forest around Hayuliang along Dalai River, 13 Jan 1970, *J. Joseph 48932* (ASSAM). **ASSAM**. *s.loc., Dr. King's Collector s.n.* (CAL). KAMRUP Dt.: Guwahaty, May 1837, *s.coll. s.n.* (CAL). GOLAGHAT Dt.: Jabocka, Naga Hills, 6000 ft., Mar 1899, *Prain's Collector 99* (CAL). LAKHIMPUR Dt.: Kakopathar, 23 Feb 1947, *M.M. Srinivasan 21955* (ASSAM). **MANIPUR**. *s.loc.,* 22 Jan 1953, *D. Deb 682* (CAL); Koupia N.W. range, 4-6000 ft., 10 Feb 1882, *G. Watt 5844* (CAL, E, K). IMPHAL Dt.: Kauglatonghi, *s.coll. 10815* (K), 3000 ft., Feb 1906, *A. Meebold 10815* (CAL), 3500 ft., 5 Mar 1946, *J. Hake 980* (K). **MEGHALAYA**.

Khasia, 4000 ft., *J.D. Hooker & J. Thomson s.n.* (K), 1845, *Griffith 45* (K), Nunklion, Feb 1850, *s.coll. s.n.* (K), 5000 ft., 1878, *Geo. Gallatly 108* (CAL), *Native collectors of Bot. Garden Calcutta s.n.* (E), 5-6000 ft., Feb 1906, *A. Meebold 5179* (CAL), 8 Mar 1921, *U. Kanjilal 7660* (ASSAM). EAST KHASI HILLS Dt.: Baedon Falls, Shillong, 22 Mar 1892, *D. Prain 43* (CAL); Pynursla forest, 18 Oct 1938, *R.N. De & D.C. Forests 19615* (ASSAM); Mawrynklang, near Wattle Plantation, 27 Jan 1957, *G.K. Deka 5232* (ASSAM, CAL); Mawswai, K&J Hills, 1200 m., 26 Mar 1960, *G. Panigrahi 21338* (ASSAM); Woodlands, 11 Mar 1966, *D.M. Verma 36862* (ASSAM); Barapani, 5000 ft., *Geo Gallatly 108* (K); Jorain, 1580 m., 13 Aug 2004, *E. Sanoj 95619* (CALI). JAINTIA HILLS Dt.: Lumsnong, 4 Jan 1958, *A. Sanyal 9* (CAL). WEST KHASI HILLS Dt.: Nongstoin village, 9 Mar 1972, *P.C. Pant 51483* (ASSAM). **MIZORAM**. Zopui-Tlang, 1332 m., N 22°50'83.2", E 092°48'80.5", 07 Sep 2002, *M.G. Prasanth Kumar & Jana Skornickova 86213* (CALI). LUNGLEI Dt.: Near Fort Lungleh, 3-4000 ft., Apr 1899, *A.T. Gage 120* (CAL); Lushai Hills, Darzo, 5000 ft., Jan 1928, *N.E. Parry 581* (K). **NAGALAND**. Naga hills, Naga Hills, Pipluma, 1 Mar 1882, *s.coll. 158* (CAL), Jun 1935, *N.L. Bor 21217* (ASSAM), Jisi, 5000 ft., 6 Mar 1955, *N.L. Bor 2871* (K). KOHIMA Dt.: Tseminyu forest-Wokha Road, 12 Apr 1975, *Chandra Bahadur 61794* (ASSAM). TUENSANG Dt.: 5 Km from Noklak, 20 May 2007*, V.P. Thomas & V.A. Muhammed Nissar 103700* (CALI). **WEST BENGAL.** HOWRAH Dt.: Botanic Garden Calcutta, originally from Sylhet, *Walllich 6545 C* (BM). *Locality unknown. Mack s.n.* (K); *C.B. Clarke s.n.* (K); E.I.C, *s.coll. s.n.* (K); *Hooker & Thomson 6545* (K); *N.E. Parry s.n.* (CAL); *s.coll., 1650* (CAL); *Griffith s.n.* (CAL). Nanigcheicha, 1080 ft., Feb 1986, *King's Collector 19* (CAL); Cheira Coal Hill, 24 Jan 1886, *C.B. Clarke 42798* (CAL); Manikwu, 5000 ft., Jan 1890, *H. Collett s.n.* (CAL); Mikukhety, Feb , *s.coll. s.n.* (CAL).

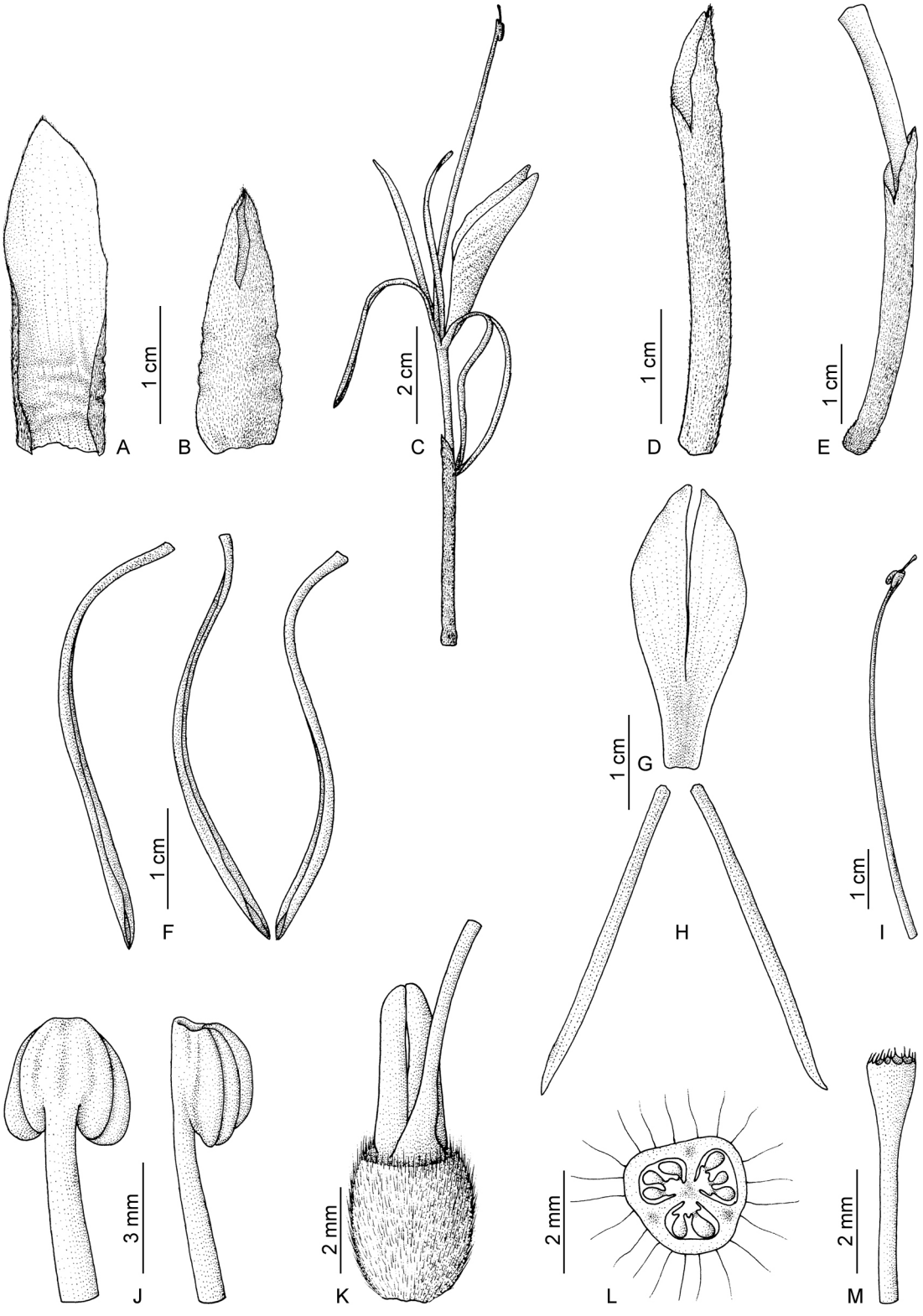

Figure 52. ***H. villosum*** var. ***tenuiflorum***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, back view (left) and lateral view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

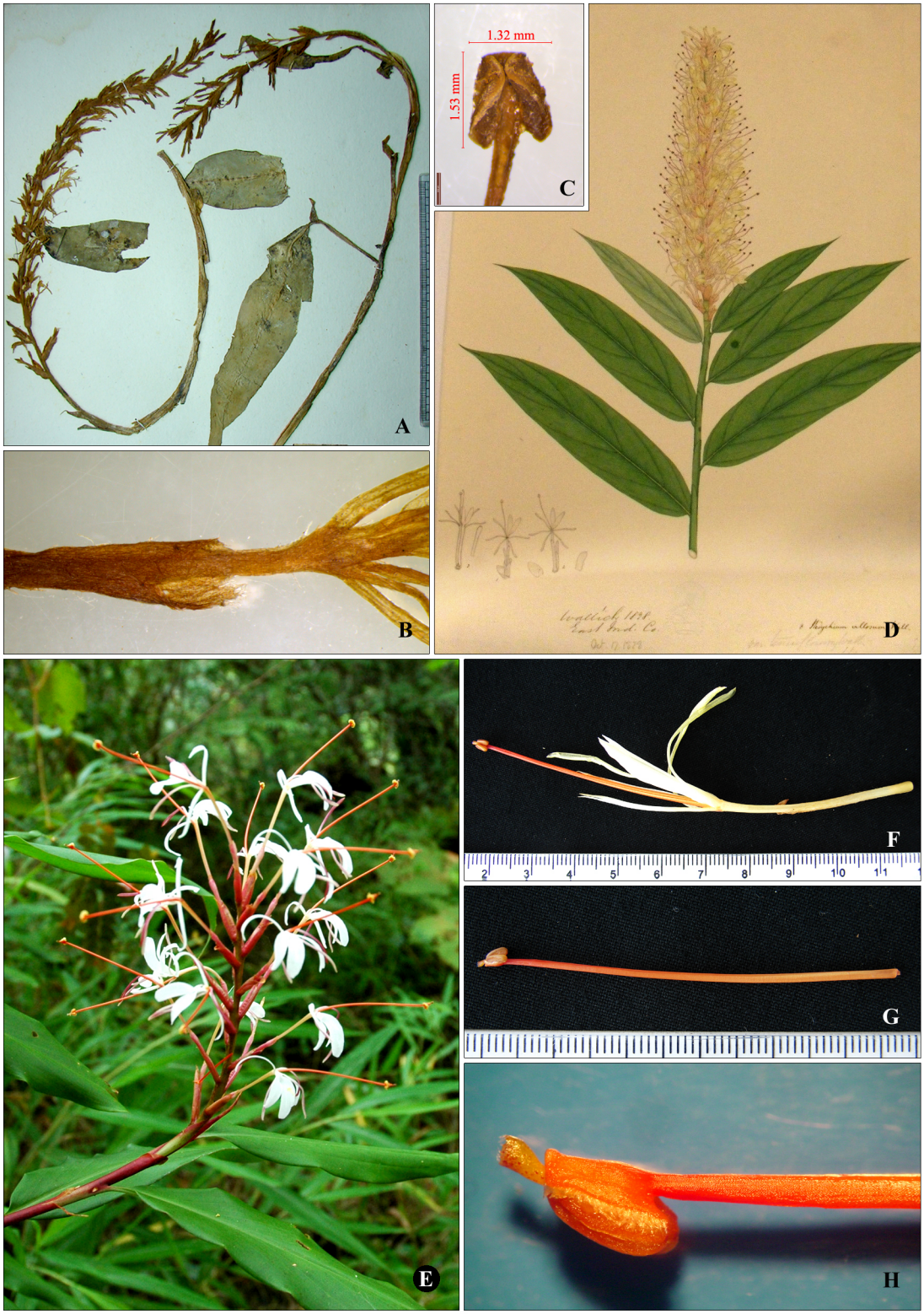

Plate 25. **A-D. *H. villosum*: A.** inflorescence (*M. Bhaumik & M.K. Pathak 1153,* CAL!); **B.** flower portion close-up showing pubescent nature of calyx and corolla tube; **C.** anther close-up; **D.** illustration by Wallich (K!). **E-H. *H. villosum*** var. ***tenuiflorum*: E.** inflorescence; **F.** single flower; **G.** stamen; **H.** anther close-up.

H. wardii C.E.C. Fisch., Bull. Misc. Inform. Kew 1936(4): 283. 1936; A.S. Rao & D.M. Verma, Bull. Bot. Surv. India 11(1&2): 128. 1969, 14(1-4): 130. 1972; N.P. Balakr., Fl. Jowai 2: 526. 1983; A. Mehrotra & S.C. Srivast., J. Econ. Tax. Bot. 7(3): 612. 1985; S.C. Srivast. in S.K. Jain & R.R. Rao, Threat. Pl. India 235. 1983; Karthik. et al., Fl. Ind. Enum. Monocot. 296. 1989; S.K. Jain & V. Prakash., Rheedea 5(2): 161. 1995; M. Sabu & Pradeep, Folia Malaysiana 6(1&2): 14. 2005.

Type: INDIA. Arunachal Pradesh. Delei Valley, 28°21' N, 96°37' E, in clumps in open rocky places amongst small trees and shrubs at the bottom of the valley, 5000 ft., 18 Jul 1928, *F. K. Ward 8463* (holo K!).

H. satyanarayanum S.C. Srivast., Ind. J. Forest. 22(1): 85. 1999, *syn. nov.*

Type: INDIA. Meghalaya, Shillong, Old Barapani Road, 11 Sep 1970, *A.S. Rao 38640* (holo ASSAM). (*Figure 53; Plate 26. A–E*)

Terrestrial, perennial rhizomatous herbs. *Rhizome* 2.6–3.7 cm wide, creamy white internally, pale pink externally, slightly aromatic, covered by brown scales. *Leafy shoot* 80–150 cm high, slanting with erect inflorescence, robust. *Leaves* 12–16 in number, 6.5–9.5 cm apart, spreading, sessile; sheath 4.5–5 cm wide, pink at leaf base, margins pink, membranous, translucent, pubescent; ligule 1.8–2 x 4.5–4.8 cm, oblong, single-lobed, truncate at tip, pale pink, pubescent externally, membranous, translucent, papery, closely appressed to stem; lamina 39–50 x 7–18 cm, elliptic, glossy dark green and glabrous above, pale green and very sparsely pubescent below; margin undulate, membranous, translucent, white tinged, non-ciliate; tip long caudate, slightly twisted; base obtuse; midrib pubescent below. *Inflorescence* 14–23.2 cm long, elliptic, compact, erect. *Bracts* 4.8–5.8 x 3.9–4.3 cm, obovate, green, glabrous, pubescent towards tip margins and base, coriaceous,

closely imbricate; margin non-ciliate, translucent, membranous, white, tip truncate, cincinnus 3–4 -flowered. *Bracteoles* 2.2–2.6 x 2–2.5 cm, ovate, non-tubular, translucent, slightly 3-lobed at tip, pale green, white towards base, glabrous, pubescent towards tip and base, outer one completely encircles the cincinnus, leathery. *Flower* 10.3–10.6 cm long, lemon yellow, 5–14 flowers open at a time, inclined, slightly fragrant. *Calyx* 3.1–3.5 cm long, *c.* 5 mm wide at mouth, pale yellow, pubescent externally, membranous, translucent, upper half inflated, lower half closely appressed to corolla tube, unilaterally split upto 0.9–1.1 cm, 3-toothed at tip. *Corolla tube* 6.8–7.2 cm long, *c.* 4 mm wide at mouth, lemon yellow, pale yellow towards base, hairy internally, bend upto 90° to one side at centre. *Corolla lobes* elliptic, lemon yellow, membranous, early decaying at base, drooping from flower, glabrous; dorsal lobe 2.5–2.6 x *c.* 0.8 cm, 1.5–2 mm long beaked at tip; lateral lobes 2.3–2.4 x *c.* 0.8 cm, very minutely beaked at tip. *Lateral staminodes* 3–3.1 x 0.9–1.1 cm, oblancelote, clawed towards base, white, lemon yellow, spreading on flower, reflexed back, margin undulate, truncate at tip. *Labellum* 2.8–3 x 4–4.2 cm, widely depressed ovate, lemon yellow, spreading on flower, reflexed back on upper half, base truncate; claw more or less absent; sinus 1.2–1.4 cm deep; margin undulate, lobes rounded at tip. *Stamen* 0.9–1 cm long, erect, deep yellow. *Filament* 1–1.5 x 1.5–2 mm, deep yellow, slightly bend to one side. *Anther c.* 8 x 4 mm, oblong, deep yellow, yellow at openings, hairy in the margins of mouth openings, split opens from top to bottom, attached with the filament at *c*. 1.5 mm above from base; thecae axis at an angle of *c.* 30° with the filament; connective yellow, glabrous, non-crested, tip slightly notched. *Ovary* 4–5 x 3–4 mm, oblong, pale pink, tomentose externally. *Style* filiform, white, glabrous, yellow tinged towards stigma. *Stigma c.* 2 mm wide, deep yellow, cup-shaped, hairy on stigmatic head, *c.* 1.5 mm exserted the anther. *Epigynous glands* two, 1.5–2 mm long, oblong, yellow, unequal.

Notes: The plants can be easily distinguished by their lemon yellow coloured large flowers with sub-sessile anthers. The loosely imbricating bracts are filled with water.

It was described by Fischer (1936) on the basis of a collection of Capt. F. Kingdom Ward from Delei Valley (*F. K. Ward 8463,* K!). While describing the species he compared it with the *H. urophyllum* Lodd. and distinguished from it mainly in sessile anthers. But our studies on the herbarium materials and live materials from Arunachal Pradesh revealed that the anthers are sub-sessile with 1-1.5 mm long filament.

H. satyanarayanum was described by Srivastava (1999) based on some earlier collections of Rao (holo *A.S. Rao 38640,* ASSAM), Balakrishnan (para *N.P. Balakrishnan 47145*, ASSAM!) and Clarke (para *C.B. Clarke 44683*, CAL), in and around Shillong, Meghalaya. Inspite of our intense search at CAL and ASSAM we could not locate the holotype. Howerver we are successful in locating one of the paratypes (*Balakrishnan 47145*) and some other collections which has been determined as *H. satyanarayanum* by the original author. Balakrishnan (1983) stated that, one of his collections identified as *H. wardii* (*Balakrishnan 47143*, ASSAM) may be a hybrid between *H. wardii* and *H. coronarium*, having a white flower. A critical study of these materials, illustration, and description has revealed that *H. satyanarayanum* and *H. wardii* are conspecific and treated as a new synonym. They differ only in the colour of the flower, *i.e.,* white in the former and yellow in the latter.

Flowering: July–September.

Distribution: Rare but located from Arunachal Pradesh and Meghalaya, and distributed at extreme SE Tibet, Yunnan Provinces of China and Northern Myanmar. Usually grows at an altitude of 800–2,500 m., as clumps of 5–10 plants in water dripping rocky places. (*Figure 54. B*)

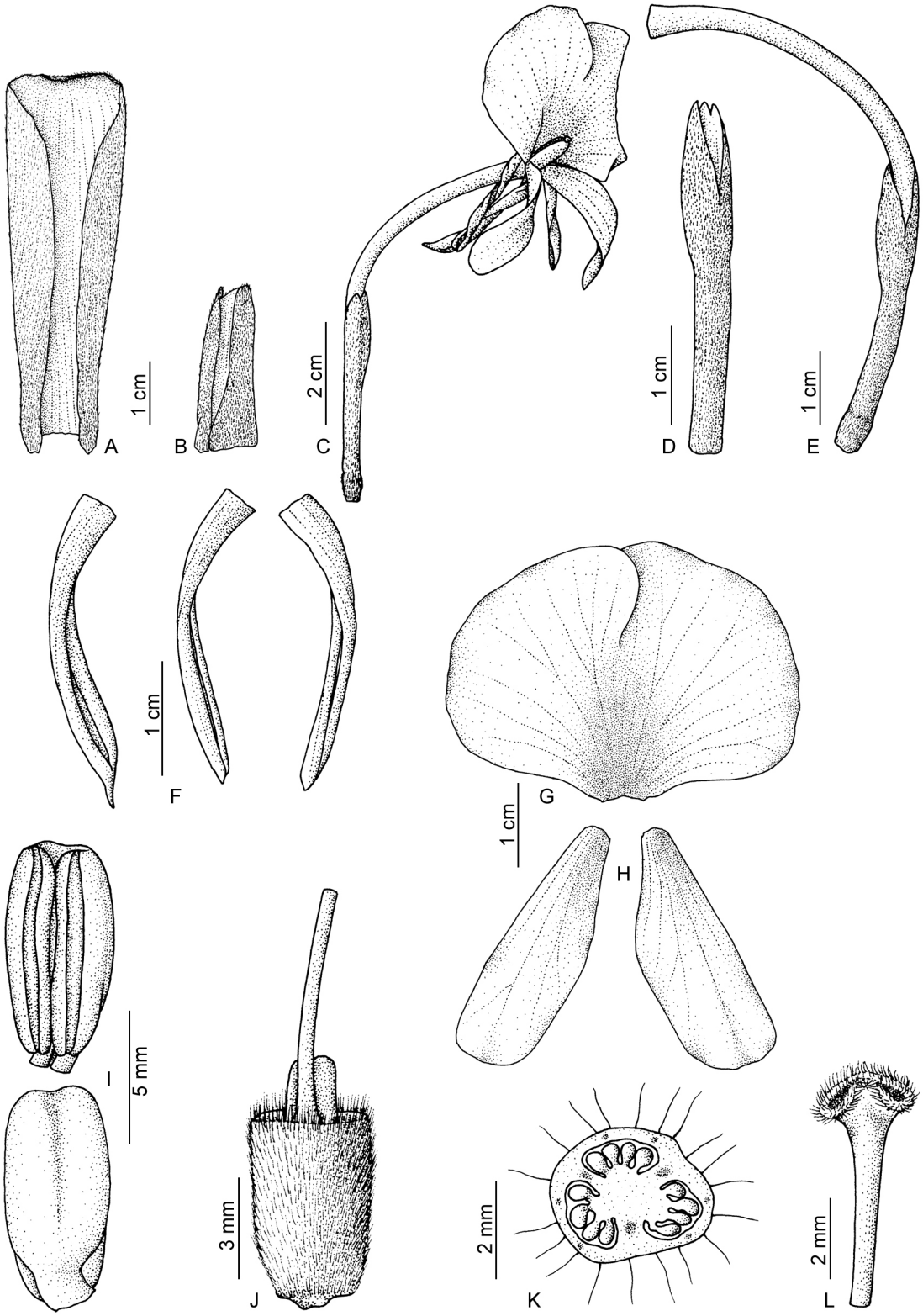

Figure 53. ***H. wardii***: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen, front view (left) and back view (right); **J.** ovary with epigynous glands and base of style; **K.** cross section of ovary. **L.** stigma with a part of style.

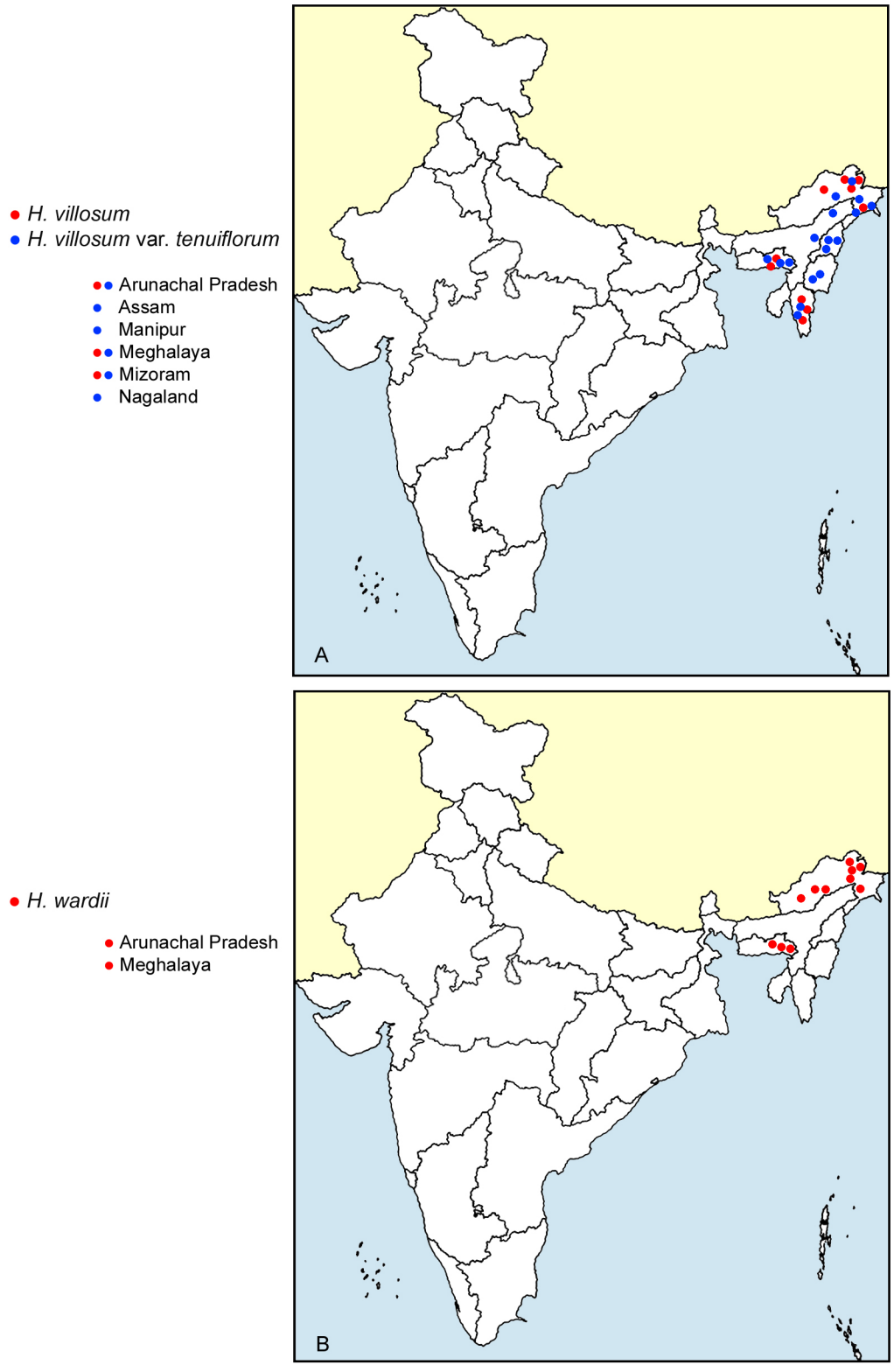

Figure 54. Distribution maps of
H. villosum, H. villosum var. ***tenuiflorum*** and ***H. wardii***.

IUCN Red list Category: Based on the best available evidence and as it is facing high risk of extinction in the wild *H. wardii* is assessed as Endangered (EN A2; B1b(i,ii)+2b(i,ii) category as per IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA**. **ARUNACHAL PRADESH**. DIBANG VALLEY Dt.: Way to Mayudia from Roing, 1675 m., N 28°13'31.3", E 095°51'55.5", 12 Aug 2009, *E. Sanoj & T. Rajesh Kumar 105665* (CALI), 2508 m., N 28°14'07.3", E 095°55'12.9", 12 Aug 2009, *E. Sanoj & T. Rajesh Kumar 105670* (CALI); Towards Hunli from Mayudya, 2434 m., N 28°18'42.1", E 095°56'59.7", 13 Aug 2009, *E. Sanoj & T. Rajesh Kumar 105675* (CALI). EAST KAMENG Dt.: 5 km from Seppa towards Bomdila, 11 Aug 2003, *M. Sabu & A.K. Pradeep 92549* (CALI). LOWER SUBANSIRI Dt.: 5 km from Hapolin towards Itanagar, 1600 m., N 27°32.643', E 093°47.705', 8 Aug 20003, *M. Sabu & A.K. Pradeep 92540* (CALI). LOHIT Dt.: Udayak Pass, way to Hayuliang from Tezu, 1647 m., N 27°56'28.6", E 096°22'26.6", 6 Aug 2009, *E. Sanoj & T. Rajesh Kumar 105637* (CALI). **MEGHALAYA**. EAST KHASIA Hills Dt.: Umjaisaw to Mynsynghat, 800 m., K. & J. Hills, 26 Aug 1968, *N.P. Balakrishnan 47143, 47145* (ASSAM). JAINTIA HILLS Dt.: Garampani-Raliang Road, ± 1000 m., *N.P. Balakrishanan 46985* (ASSAM).

29 **Hedychium** sp. No. 1

Hedychium sp. No. 1

Type: INDIA. Nagaland, Mokokchung Dt., Way to Alichen, 28 Aug 2006, *E. Sanoj & V.P. Thomas 105552* (holo CALI; iso CAL, MH).

H. luteum auct. non Baker: A.S. Rao & D.M. Verma, Bull. Bot. Surv. India 14(1-4): 134. 1972; Chaturv. & Moaakum, Folia Malaysiana: 9(2): 134. 2008.

(*Figure 55; Plate 26. F – I*)

Terrestrial, perennial rhizomatous herbs. *Rhizome* 2.6–3 cm wide, creamy white internally, pale pink externally, slightly aromatic, covered by brown scales.

Leafy shoot 135–180 cm high, slanting with erect inflorescence, robust. *Leaves* 12–16 in number, 5.3–9.5 cm apart, spreading, sessile; sheath 1.6–1.8 cm wide, margins green, membranous, translucent, pubescent; ligule 2.3–3 × *c.* 1.4 cm, ovate, single-lobed, rounded-truncate at tip, pink, sericeous externally, membranous, translucent, papery, closely appressed to the stem; lamina 36.5–45 × 6.6–9.5 cm, lanceolate, dark green and glabrous above, pale green and sericeous below; margin undulate, membranous, translucent, white tinged, non-ciliate; tip long caudate, twisted; base cuneate-obtuse; midrib densely sericeous below. *Inflorescence* 15.5–22 cm long, cylindrical, lax, erect. *Bracts* 4.7–5.5 × 2–2.4 cm, obovate, green with red tinge, pubescent, densely pubescent towards tip margins, coriaceous, convolute; margin non-ciliate, translucent, membranous, white, tip obtuse, cincinnus 5–8 -flowered. *Bracteoles* 2.4–3.3 × 1.2–1.6 cm (outer tubular), slightly translucent, obscurely 2-lobed at tip, pale red with green tinge, white towards base, pubescent externally, sparsely hairy towards base, outer one completely encircles the cincinnus, membranous. *Flower* 11.8–12 cm long, creamy yellow, 8–14 flowers open at a time, ascending, slightly fragrant. *Calyx* 4–4.3 cm long, *c.* 2.5 mm wide at mouth, pale green, white towards base, pubescent externally, membranous, translucent, closely appressed to corolla tube, unilaterally split upto 5–8 mm deep, 3-toothed at tip. *Corolla tube* 5.8–6 cm long, *c.* 3 mm wide at mouth, white, slightly yellowish towards tip, slightly arching, hairy internally. *Corolla lobes* oblanceolate, pale green, creamy-yellow tinged towards base, membranous, drooping from flower, glabrous; dorsal lobe 3.7–3.9 × *c.* 0.35 cm, 2.5–3 mm long beaked at tip; lateral lobes 3.5–3.6 × *c.* 0.3 cm, very minutely beaked at tip. *Lateral staminodes* 2.9–3 × 0.4–0.45 cm, sword-shaped, creamy-yellow, spreading on flower, reflexed back, outer margin undulate, tip obtuse. *Labellum* 2.9–3 × 1.5–1.7 cm, obovate, creamy-yellow, slightly deep coloured at centre, spreading on flower, upper half reflexed back, gradually clawed at base; claw 3–3.5 mm wide; sinus 1–1.4 cm deep; outer margin undulate, lobes tip rounded. *Stamen* 5.5–5.7 cm long. *Filament* 4.7–4.9 cm long, *c.* 2 mm wide at base, creamy-yellow, slightly arching. *Anther* 1–1.5 × *c.* 0.25 cm, elliptic, yellow at

openings, split opens from top to bottom, attached with the filament at *c.* 2.5 mm above from base, thecae axis at an angle of *c.* 25° with the filament; connective creamy-yellow, glabrous, non-crested, tip truncate-slightly notched. *Ovary* 3.5–4 × *c.* 2.5 mm, oblong, white, pubescent externally. Style filiform, white, glabrous, green tinged towards stigma. *Stigma c.* 2 mm wide, green, cup-shaped, slanting with a depression at center, pubescent, hairs hook-like, *c.* 1.5 mm exserted from the anther. *Epigynous glands* two, 4.5–5 mm long, oblong, yellow.

Notes: Allied to *H. marginatum* in having dense hairs at the tip of bracts, but mainly differs from it in having larger lamina, longer and cylindrical inflorescence, convolute bracts, longer and creamy-yellow flowers with longer calyx and stamen.

Rao and Verma (1972) misidentified this taxon as *H. luteum*. On critical examination of the specimen, *D.M. Verma 34646* (ASSAM!), an introduced material in Woodlands, revealed that it as a new species.

Flowering: August–November, so far no fruiting has been observed.

Distribution: Endemic to Nagaland, India. Reported only from the type locality, one introduced material at the Woodlands, Meghalaya and Ungma, Mokokchung District of Nagaland (Chaturvedi & Moaakum 2008). (*Figure 58. A*)

IUCN Red list Category: The species is known only from the type locality and another introduced plant at Woodland with unknown locality, most probably from Nagaland. It is facing high threats due to construction of roads, mining and landslides. Due to the rarity and very restricted distribution of *Hedychium* sp. No. 1, it is assessed here as Critically Endangered (CR B1ab(i,ii,iv)+ 2ab(i,ii,iv); E) according to IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Specimens examined: **INDIA**. **MEGHALAYA**. EAST KHASI HILLS Dt.: Woodlands, cultivated, 16 Aug 1971, *D.M. Verma 34646* (ASSAM).

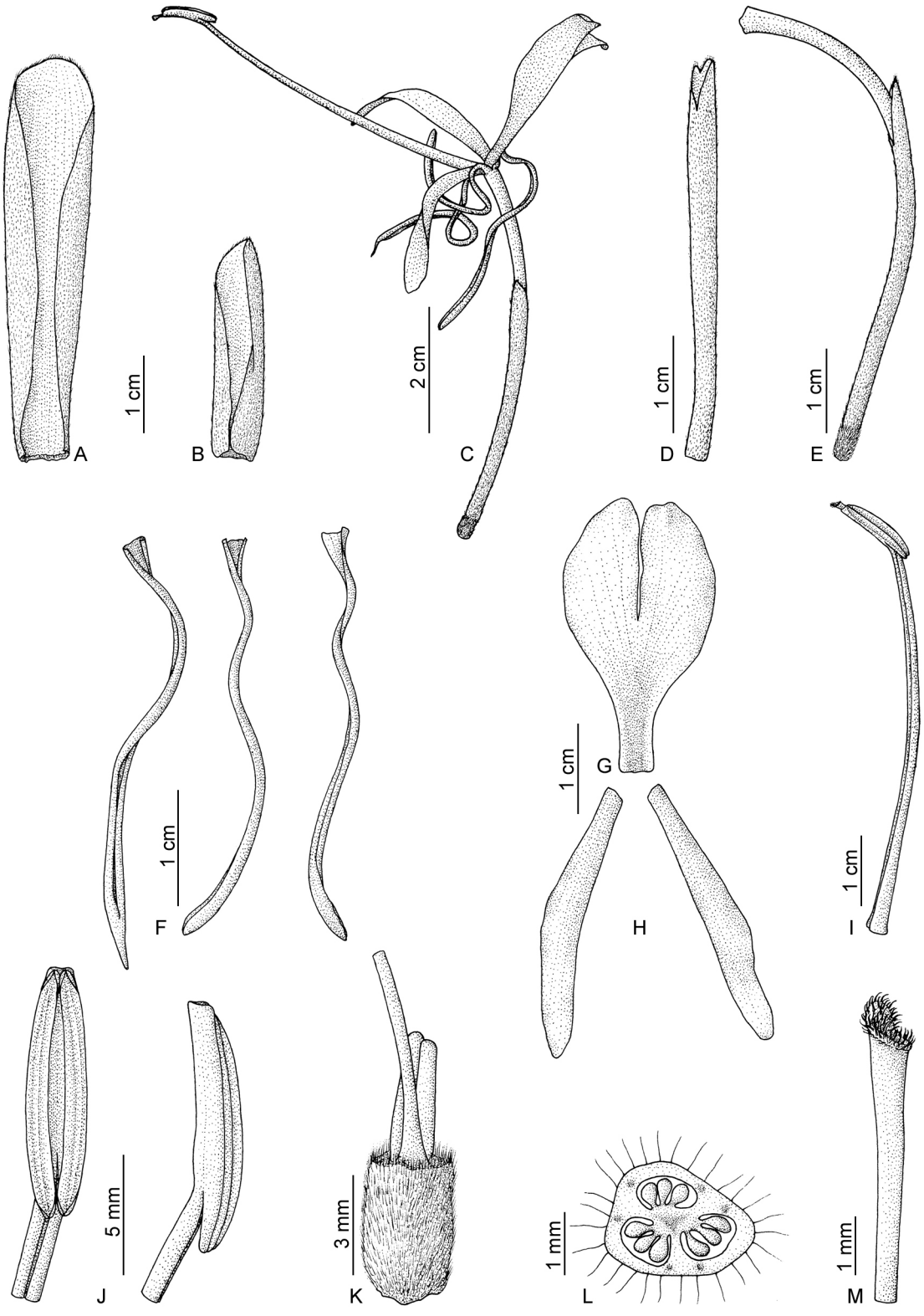

Figure 55. ***Hedychium*** sp. **No. 1**: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, front view (left) and lateral view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

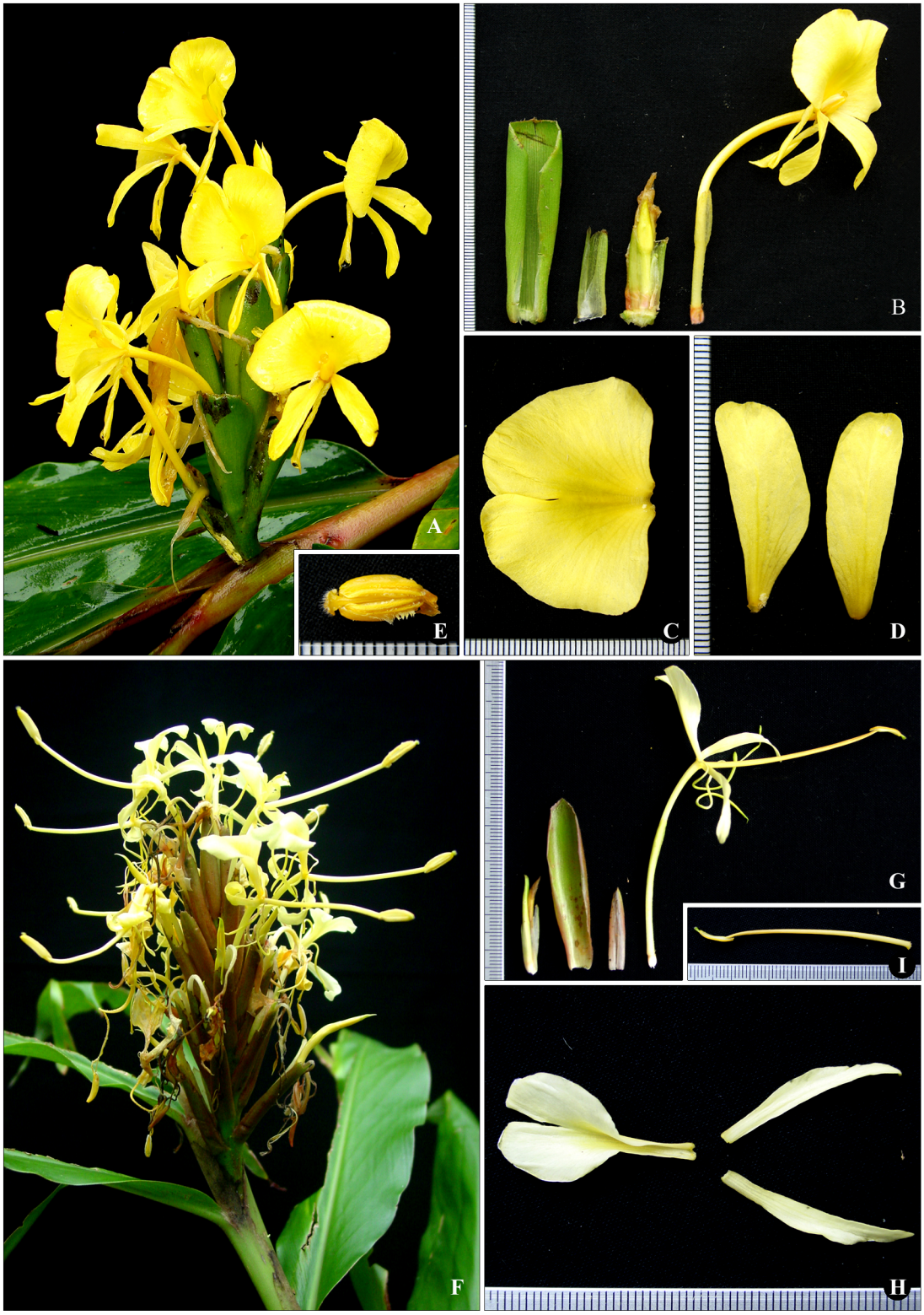

Plate 26. **A-E.** ***H. wardii*****: A.** inflorescence; **B.** single flower, bract, bracteole and cincinnus; **C.** labellum; **D.** lateral staminodes; **E.** stamen. **F-I.** ***Hedychium*** sp. **No. 1: F.** inflorescence; **G.** single flower, bract, bracteole and cincinnus; **H.** labellum and lateral staminodes; **I.** stamen.

Hedychium sp. No. 2

Type: KERALA. Calicut University Botanic Garden (CUBG), Cultivated, Originally collected from Arunachal Pradesh, 2003, *M. Sabu & A.K. Pradeep 92563* (CALI).

(*Figure 56; Plate 27. A–E*)

Terrestrial, perennial rhizomatous herbs. *Rhizome* 1.8–2.4 cm wide, monopodial branching, creamy white internally, slightly aromatic. *Leafy shoot* 102–116 cm high, slanting. *Leaves* 15–18 in number, 5–8 cm apart, spreading on plant, sessile; sheath pink towards base, margins translucent, red tinged, densely pubescent; ligule 0.8–0.9 x 1.3–1.5 cm, single-lobed, rounded at tip, red tinged, densely pubescent externally, translucent, closely appressed to the stem, brittle on aging; lamina 23–27 x 6–6.7 cm, lanceolate, dark green and glabrous above, pale green and pubescent at midrib below; margin highly undulate, membranous, translucent, white tinged, pale red while aging, non-ciliate, pubescent below; tip long caudate, twisted; base obtuse; midrib sparsely pubescent below. *Inflorescence* 9–9.5 cm long, conical, erect, moderately lax. *Bulbils* absent. *Bracts* 4–4.2 x 1.5–1.8 cm, ovate, green, puberulent externally, pubescent at tip only, moderately coriaceous, loosely imbricate; margin non-ciliate, translucent, membranous, pale red tinged; tip obtuse; cincinnus 3–5 - flowered. *Bracteoles* 2–2.1 x 1.3–1.5 mm, widely ovate, pale yellow, pale red tinged at margins, puberulent, pubescent at tip only, non-tubular (outer one c. 1.5 mm long tubular at base, completely encircles the cincinnus), membranous, translucent; margin non-ciliate, pale red tinged. *Flower* 9–9.2 cm long, orange (turn to red on second day), spreading, 1–3 flowers open at a time. *Calyx* 2.8–2.9 cm long, *c*. 2.5 mm wide at mouth, pale yellow, pale red tinge at extreme base, densely pubescent, membranous, moderately translucent, inflated on upper half, lower half closely appressed to corolla tube, unilaterally split upto 6–6.5 mm, 3-toothed at tip, lobes equal. *Corolla tube* 5.2–5.3 cm long, c. 3 mm wide at mouth, orange, paler and white towards base, glabrous externally, hairy internally, tube slightly curved towards tip. *Corolla lobes* orange-yellow, membranous, drooping from flower, glabrous, margins rolled inside; dorsal

lobe 3.5–3.7 x *c.* 0.7 cm, elliptic, *c.* 1.5 mm long beaked at tip, 5 or 6 -nerved; lateral lobes 3.2–3.5 x *c.* 6 cm, non-beaked at tip, 4 or 5 nerved. *Lateral staminodes* 2.8–3 x 0.3–0.45 cm, narrowly oblanceolate, sword-shaped, orange, orange-red towards base, spreading on flower, reflexed back, margin undulate, tip truncate or minutely notched, margins irregular. *Labellum* 3.4–3.7 x 2.5–2.6 cm, very widely ovate, orange, deep red patch at centre and claw, spreading on flower, reflexed back on upper half, gradually clawed at base, obtuse; claw 5–6 mm wide; sinus 1–1.3 mm deep; margin undulate, non-crumpled. *Stamen* 3.8–3.9 cm long, erect. *Filament* 2.8–2.9 cm long, *c.* 2 mm wide at base, red, erect, slightly arching. *Anther c.* 1.1 x 0.3 cm, narrowly elliptic, orange, attached with the filament at *c.* 2.5 mm above from base at an angle of 25° with the filament; connective orange, glabrous, prolonged in to a crest of *c.* 1mm long, truncate at tip. *Ovary c.* 3.4 x 2.5 mm, barrel-shaped, pale red, densely pubescent externally. *Style* filiform, white, glabrous, yellow tinged towards stigma. *Stigma* yellow, stigmatic head flat, slanting with a depression at center, hairy, hairs hook-like, *c.* 1 mm exserted from the anther. *Epigynous glands* two, *c.* 3 mm long, oblong, finger-shaped, yellow.

Notes: It was collected from Arunachal Pradesh in 2003, precise locality is unknown, and planted in Calicut University Botanic Garden (CUBG). Which was flowered in 2008 and identified as a new species closely allied with *H. greenii*. But it differs in having bulbil-less bracts; 3-5 -flowered cincinnus; orange flowers with red stamen; longer and orange-coloured flowers; less wider, obovate and non-crumpled labellum; narrow lateral staminodes; shorter stamen and filament; orange anther and densely pubescent ovary (Table 03).

Flowering: August–October.

Distribution: Endemic, known only from the type locality, i.e., Arunachal Pradesh. (*Figure 58. B*)

IUCN Red list Category: As it is known only from the type locality and is having a limited number of mature individuals, it is assessed against the Critically Endangered

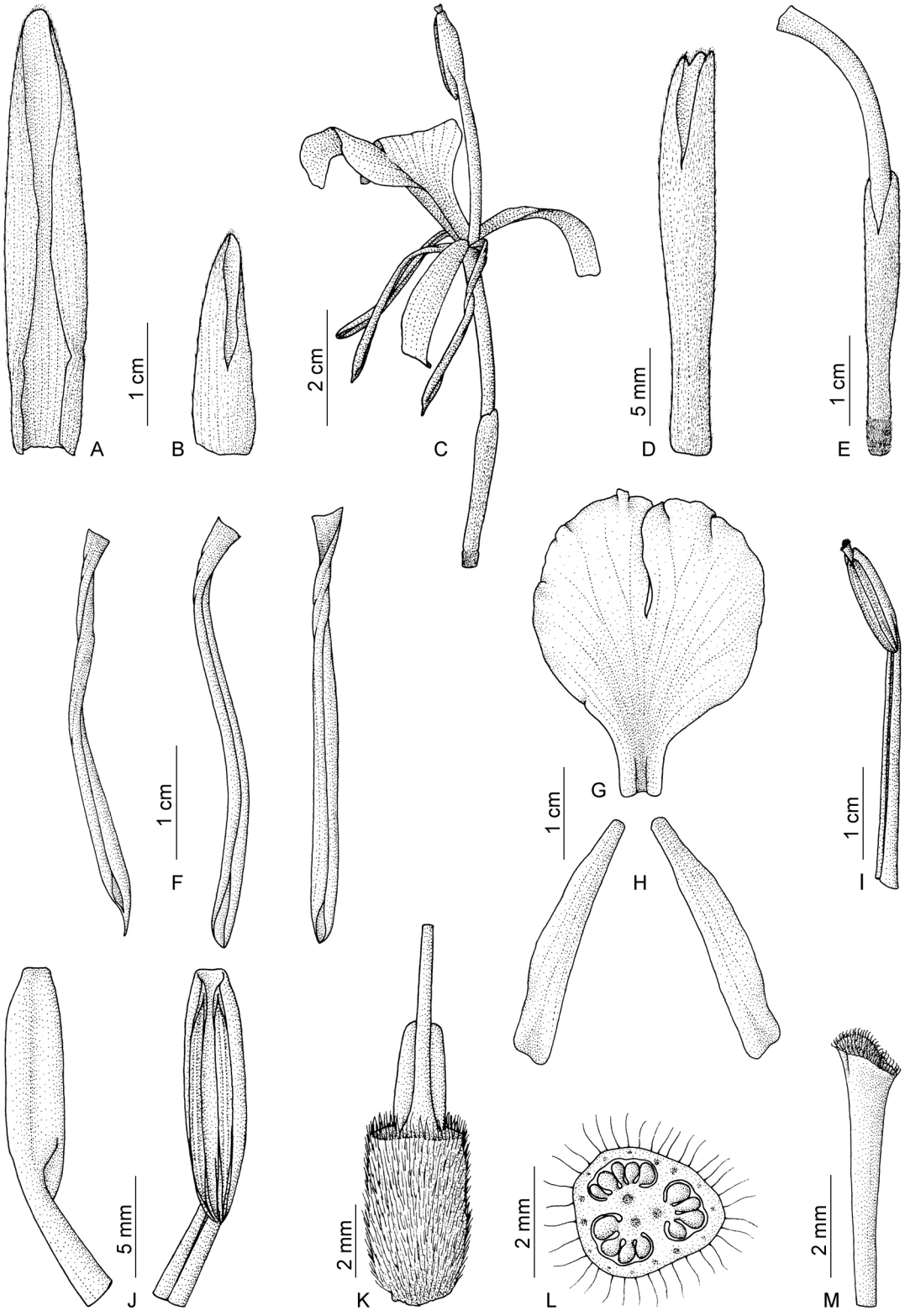

Figure 56. ***Hedychium*** sp. **No. 2**: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** dorsal and lateral corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, back view (left) and front view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

(CR B1ab(i,ii,iv)+ 2ab(i,ii,iv); E) category as per IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

Table 03. Main differential characters of *H. greenii* and *Hedychium* sp. No. 2.

Characters	***H. greenii***	***Hedychium*** sp. No. 2
Bulbils	Present	Absent
Cincinnus	1 or 2 -flowered	3-5 -flowered
Flower	8.1-8.3 cm long, brick-red	9-9.2 cm long, orange
Calyx length	3.1-3.2 cm	2.9-2.8 cm
Corolla tube	3.9-4 cm, pale brick red	5.2-5.3 cm, orange towards tip
Labellum	3.9-4 x 4.4-4.5 cm, brick-red with yellowish at centre, very widely obovate, highly crumpled	3.4-3.7 x 2.5-2.6 cm, orange with red patch at centre, obovate, non-crumpled
L. staminodes	3.5-3.6 x 0.9-1 cm, brick-red	2.8-3 x 0.3-0.45 cm, orange
Stamen length	4-4.3 cm	3.8-3.9 cm
Filament length	3.3-3.4 cm, deep red	2.8-2.9 cm, red
Anther	deep red	orange
Ovary	3.5-4 x *c.* 3.5 mm, glabrous	*c.* 3.4 x 2.5 mm, densely pubescent

31 **Hedychium** sp. No. 3

Hedychium sp. No. 3

Type: INDIA. Arunachal Pradesh, East Kameng Dt., 5 km from Seppa towards Bomdila, 1 Aug 2003, *M. Sabu & A.K. Pradeep 92551* (CALI).

H. spicatum auct. non Buch.-Ham. ex Sm.: Sims, Bot. Mag. 49: t. 2300. 1822; Lodd., Bot. Cab.: 7(6): t. 653. 1822; Hook., Exot. Fl.: 1: t. 46. 1823; Roscoe, Monandr. Pl. Scitam.: 7/8: t. 48. 1826. (*Figure 57; Plate 27. F – K*)

Terrestrial, perennial rhizomatous herbs. *Rhizome* 2.6–3 cm wide, creamy white internally, slightly aromatic, covered by brown scales. *Leafy shoot* 107–130 cm high, slanting with erect inflorescence, robust. *Leaves* 12–16 in number, 3.5–

6.8 cm apart, spreading, sessile; sheath 1.2–1.6 cm wide, margins membranous, translucent; ligule 0.6–1.2 x *c.* 1 cm, oblong, single-lobed, truncate at tip, pale green, pubescent externally, membranous, translucent, papery, closely appressed to the stem; lamina 27–28 x 8–10 cm, oblong-lanceolate, dark green and glabrous above, pale green and sparsely hairy below; margin undulate, membranous, translucent, white tinged, non-ciliate; tip long caudate, twisted; base cuneate-obtuse; midrib pubescent below. *Inflorescence* 12–13 cm long, cylindrical, lax, erect. *Bracts* 3.6–3.8 x 2.4–3 cm, widely ovate, green, glabrous, ciliate at tip margins, coriaceous, laxly imbricate; margin non-ciliate, translucent, membranous, white, tip obtuse, cincinnus 1 or 2-flowered. *Bracteoles* 2–2.3 x 1.5–2 cm, non-tubular, slightly 2-lobed at tip, pale green, white towards base, glabrous, ciliate at tip, outer one completely encircles the cincinnus. *Flower* 10–10.3 cm long, white, 2–4 flowers open at a time, ascending, slightly fragrant. *Calyx* 3.3–3.5 cm long, 4–4.5 mm wide at mouth, greenish-yellow, glabrous, membranous, translucent, gradually inflated towards tip, unilaterally split upto 6–8 mm deep, 3-toothed at tip. *Corolla tube* 6–6.3 cm long, *c.* 4 mm wide at mouth, yellow, whitish towards base, hairy internally, slightly arching. *Corolla lobes* oblanceolate, yellow, pale greenish tinged towards tip, membranous, drooping from flower, glabrous; dorsal lobe 3–3.2 x 0.75–0.8 cm, *c.* 4 mm long beaked at tip; lateral lobes 2.7–2.9 x 0.75–0.8 cm, non-beaked at tip. *Lateral staminodes* 3.3–3.6 x 0.75–0.8 cm, oblanceolate, gradually clawed towards base, white, yellow at base, spreading on flower, reflexed back, margin undulate, slightly notched at tip. *Labellum* 3–3.2 x 3–3.2 cm, very widely ovate, white, yellow at centre, spreading on flower, reflexed back on upper half, base cuneate, gradually clawed at base; claw 4–4.5 mm wide; sinus 1.4–1.5 cm deep; margin undulate, lobes acute at tip. *Stamen* 3.1–3.2 cm long, straight, yellow. *Filament* 2–2.2 cm long, *c.* 2 mm wide at base, yellow, straight. *Anther* 1.1–

1.2 cm x *c.* 3 mm, oblong, yellow, ciliate along thecae margins, split opens from top to bottom, attached with the filament at *c.* 2.5 mm above from base, thecae axis parallel with the filament; connective yellow, glabrous, non-crested, tip slightly notched. *Ovary* 3.5–4 x 2.5–3 mm, barrel-shaped, pale green, glabrous. *Style* filiform, white, glabrous, yellow tinged towards stigma. *Stigma c.* 2 mm wide, yellow, cup-shaped, stigmatic head hairy, hairs hook-like, *c.* 1 mm exserted from the anther. *Epigynous glands* two, 2–2.5 mm long, linear, yellow.

Notes: H. spicatum was described by Smith (1811) on the basis of a taxon gathered by Buchanan-Hamilton from Upper Nepal. Which is characterized by having long slender spike with distant convoluted single-flowered bracts, deeply divided white corolla and much shorter stamen with inflexed filament. Subsequently, *H. spicatum* was wrongly described by Sims (1822), Loddiges (1822b), Hooker (1823) and Roscoe (1826), all based on the plant collected by Wallich in 1819 and 1820 from Nepal. They described it as a species with laxly imbricate bracts, wider and white labellum with yellow blotch at centre and yellow erect stamen. Recently we could collect live plant of this taxon from Bomdila, Arunachal Pradesh and on detailed morphological studies it is identified as a new species yet to be described.

During the search for any earlier collection of this species in major herbaria, we could locate one collection at Kew, which was annotated as *H. spicatum* and is imported by Wallich. It is also annotated with “Hook. in Fl. Exot. 46” and “Roscoe tab 48”.

The current collection of this taxon from Arunachal Pradesh is a relocation of a Walllichian specimen after a lapse of about 190 years and its correct identity is revealed.

It is an allied species of *H. spicatum*, but differs from it in having laxly imbricate bracts, multi-flowered cincinnus, much broader (3–3.2 x 3–3.2 cm) white labellum with yellow blotch at centre and straight yellow stamen.

Flowering: March–October.

Distribution: Known to be distributed only in the type locality, Upper Nepal and Sylhet of Bangladesh. (*Figure 58. C*)

IUCN Red list Category: As it is known only from three geographically distant localities and could not been recorded since 1820, it is assessed against Critically Endangered (CR B1ab(i,ii,iv)+ 2ab(i,ii,iv); E) category with very restricted area of occupancy and geographically distant subpopulations as per IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010).

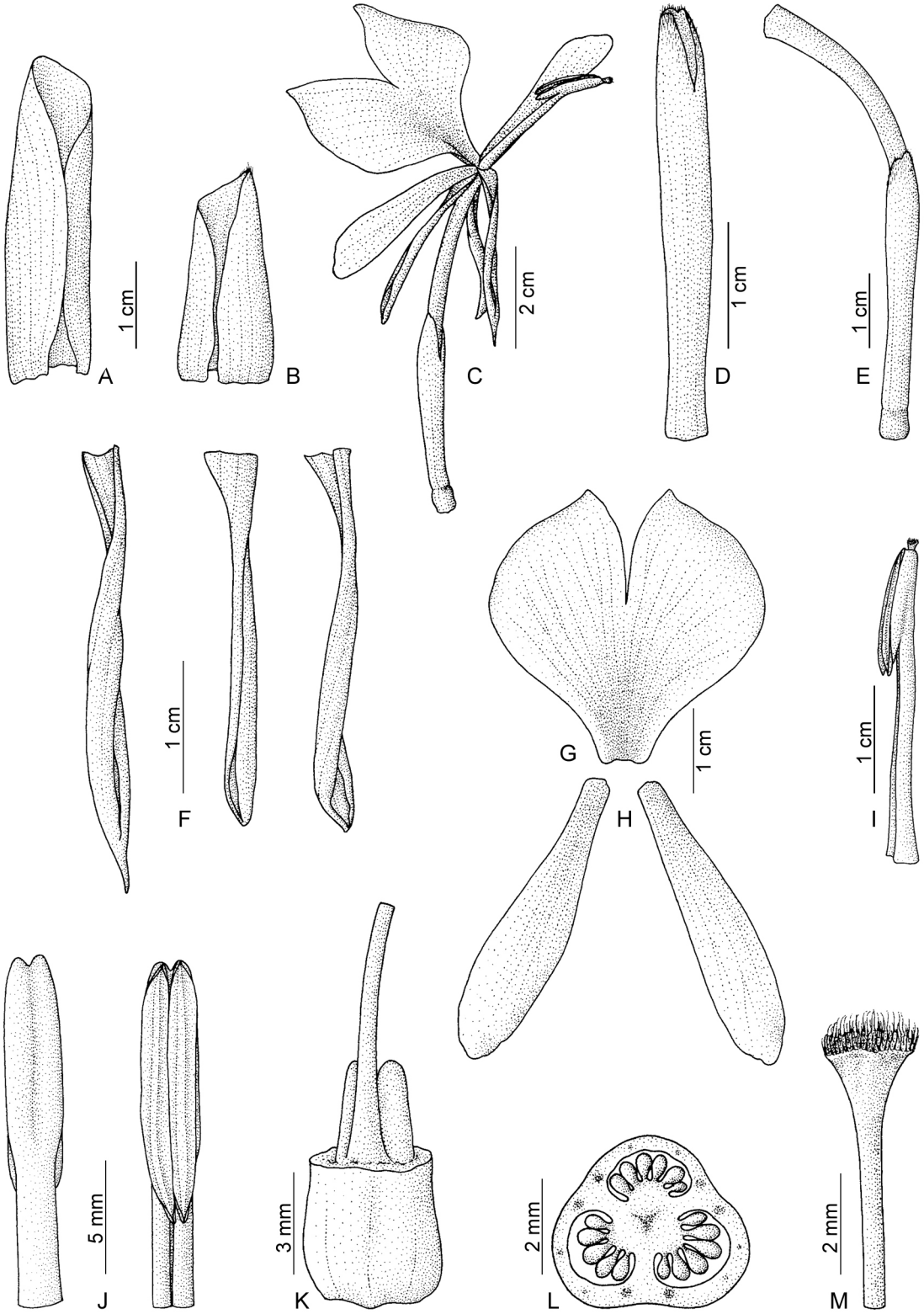

Figure 57. ***Hedychium*** sp. **No. 3**: **A.** bract; **B.** bracteole; **C.** single flower; **D.** calyx; **E.** corolla tube with calyx and ovary; **F.** corolla lobes; **G.** labellum; **H.** lateral staminodes; **I.** stamen; **J.** anther, back view (left) and front view (right); **K.** ovary with epigynous glands and base of style; **L.** cross section of ovary. **M.** stigma with a part of style.

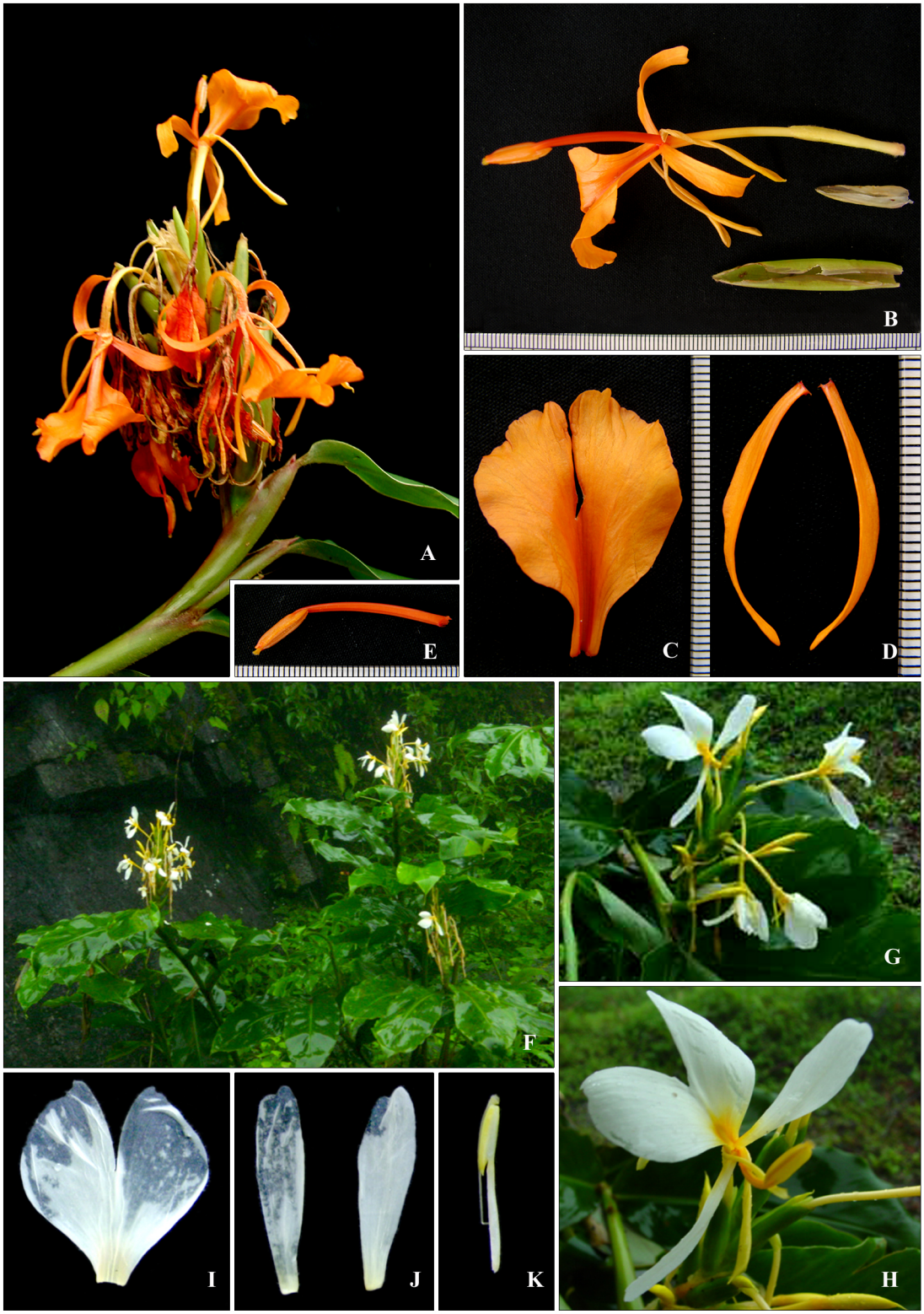

Plate 27. **A-E.** ***Hedychium*** sp. **No. 2: A.** inflorescence; **B.** single flower, bract and bracteole; **C.** labellum; **D.** lateral staminodes; **E.** stamen. **F-K.** ***Hedychium*** sp. **No. 3: F.** population; **G.** inflorescence; **H.** single flower close-up; **I.** labellum; **J.** lateral staminodes; **K.** stamen (**I, J & K** - from pickled specimens).

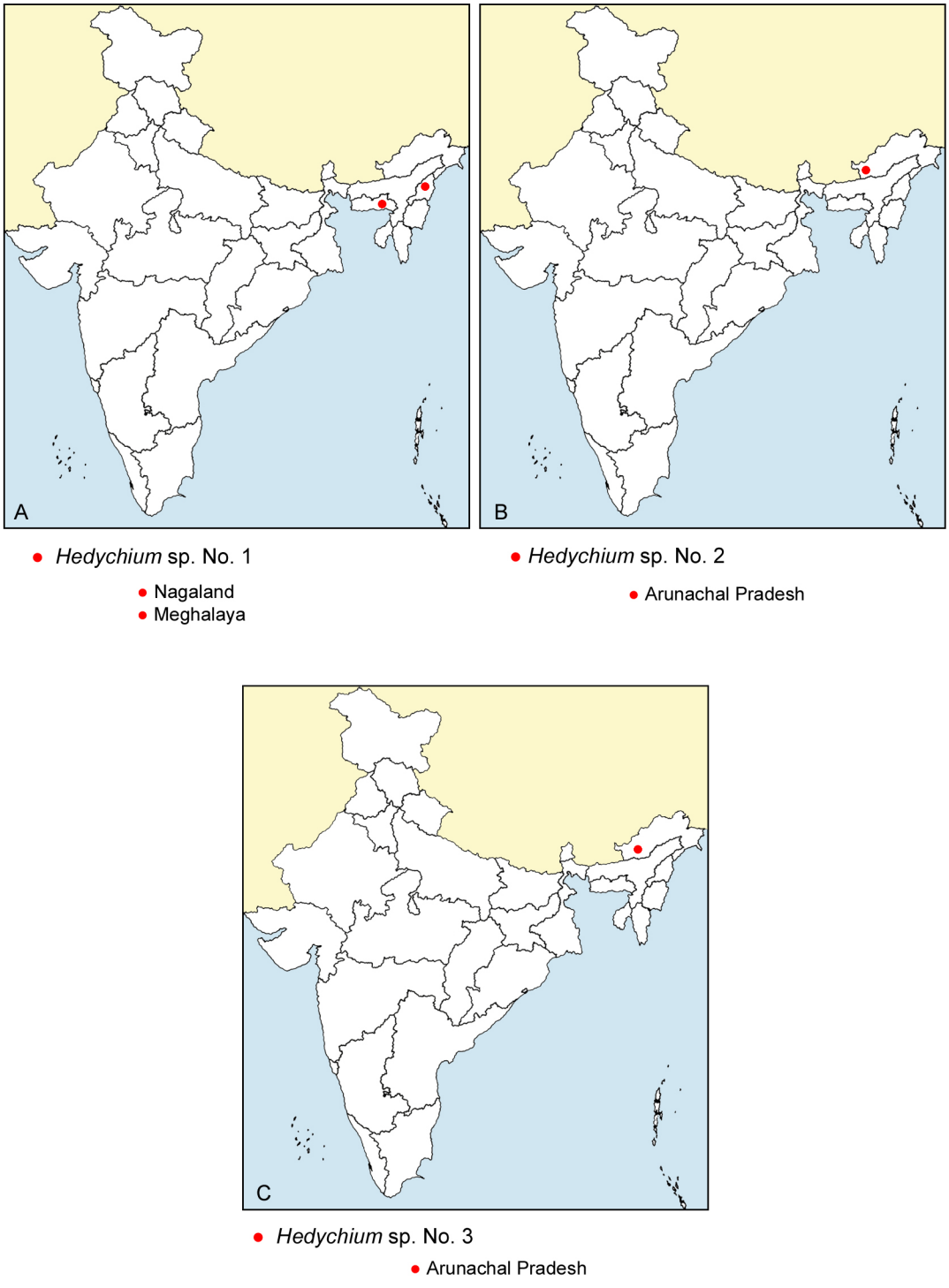

Figure 58. Distribution maps of ***Hedychium*** sp. No. 1**,** ***Hedychium*** sp. No. 2 and ***Hedychium*** sp. No. 3

The genus *Hedychium* is morphologically distinct from other related genera, hence can be identified easily upto generic level. However the identification upto species level is very difficult, especially from herbarium specimens. Hence we made every effort to collect live specimens of all taxa, from all over India for various taxonomic studies. In order to study the variability within the species, the population from different locations were compared. Apart from these, the herbarium specimens at various Indian and foreign herbaria were also studied in detail. The live collections maintained in the CUBG were also used to study the plants in detail at different stages of growth, flowering, fruiting *etc*. Every effort has been taken to prepare detailed descriptions of different organs of all accessions, to know the variability within the species. The height of vegetative plant, length of lamina and inflorescence, number of bracts per inflorescence, number of flowers per cincinnus *etc.* are the most variable characters in *Hedychium*.

Habitat

Hedychium prefer to grow in open, semi shade or under full shade environments, and warm moist climate in wet evergreen forests. Mostly they are distributed at an altitude of 1,000–3,000 m., and some taxa have very limited altitudinal range. But there are some taxa which are adapted to a wide range of altitudinal difference, *e.g., H. coccineum* (450–2,000 m.)*, H. flavum* var. *flavescens* (400–2,000 m.)*, H. gracile* (1,200–2,500 m.)*, H. gracile* var. *calcaratum* (1,100–2,400 m.)*, H. greenii* (600–1,800 m.)*, H. spicatum* (700–3,000 m.)*, H. stenopetalum* (255–1600 m.) *etc.* The only species that is distributed in very lowland area (±15–1400 m.) is *H. coronarium*. *Hedychium* spp. may form dense growth in native forests, it also occurs in agricultural areas, coastland, natural forests, planted forests, grasslands, riparian zones, ruderal and disturbed areas, urban areas and wetlands.

Habit

The plants are perennial rhizomatous herbs. In India, plants size ranges from 25 cm to 3 meters. The plants are usually terrestrial with some epiphytes like *H. longipedunculatum, H. villosum* and *H. villosum* var. *tenuiflorum*. The species like *H. spicatum, H. ellipticum* and *H. gomezianum* are facultative epiphytes or grow in the crevices of moss covered rocks. Leafy shoots are unbranched, aerial stem with nodes and inter nodes, which are covered by distichous leaves and unilaterally split leaf sheaths.

Rhizome and roots

Hedychium, invariably possess a rhizome, though their size varies from 1.3–5 cm. They act as the primary mode of propagation. Even small pieces of the rhizome with a bud can grow into a new plant. Fleshy, slightly aromatic rhizomes with light creamy colour internally are commoner in this genus and are covered by brown scales. The rhizomes of *H. larsenii, H. robustum* are much massive (4–5 cm), but in *H. aureum, H. gracile*, *H. hookeri etc.* rhizomes are small (1.3–2.6 cm). Rhizomes are subterranean and luxuriantly grow at soil level or above. The growth of the rhizome is sympodial. The main axis is developed from the apical bud, which later becomes an aerial shoot and terminates in an inflorescence. The subsequent growth of rhizome is due to the growth of axillary buds from the nodes. This results the formation of a successively connected rhizome.

Roots are produced directly from rhizome and are long and fleshy, but never modified in to tubers. The roots of epiphytic species like *H. villosum* and *H. villosum* var. *tenuiflorum* are very fleshy. (*Plate 28. A–E*)

Leafy shoots

Leafy shoots height ranges from 25–30 cm (*H. hookeri* and *H. longipedunculatum*) to a maximum height of 3 m (*H. elatum* and *H. stenopetalum*).



Plate 28. **A-E. Rhizomes: A.** *H. coronarium*; **B.** *H. coronarium* var. *chrysoleucum*; **C.** *H. deceptum*; **D.** *H. greenii*; **E.** *H. villosum* var. *tenuiflorum.* **F. Bulbil** -*H. greenii.*

It is covered by many overlapping, unilaterally split sheaths and sessile or shortly petioled leaves. Usually leafy shoots are erect or slightly slanting, but in *H. densiflorum* they are reclined with an erect inflorescence.

Leaves

Leaves are distichous and the plane of distichy is parallel to the rhizome. Leaf blades exhibit a wide range of morphological variation in structure, shape, texture *etc.* Leaves lower surfaces are usually pale green, glabrous or pubescent, but in *H. speciosum, H. speciosum* var. *gardnerianum* leaves are characteristically glaucous below. In *H. flavum* var*. flavescens* leaves lower surface are brown hairy. Leaf blades towards the base of the aerial shoot are rudimentary or absent. In some cases lower leaves are pink coloured beneath (*H. coccineum, H. stenopetalum, H. deceptum etc.*), but in *H. greenii* all leaves are persistently purple-red tinged below. Leaf sheath is opened for its entire length on one side, opposite to lamina. Leaves are usually sessile, but sub-sessile or shortly petiolate (0.4–2.3 cm) in species like *H. aureum, H. ellipticum, H. ellipticum* var. *radiatum, H. flavum* var. *flavescens, H. gracile* var. *calcaratum, H. gracile* var. No. 1, *H. griffithianum, H. hookeri, H. longipedunculatum* and *H. speciosum.* Among them, *H. ellipticum* var. *radiatum* possess longest petiole (upto 2.3 cm). At the junction of petiole and sheath a conspicuous ligule is present. Which is single-lobed with rounded, obtuse, truncate or slightly notched tip. It may be membranous, translucent, papery and closely appressed to the stem. The size of ligules varies from 0.2–5.8 cm. Ligules are least lengthed in *H. gracile, H. gracile* var. No. 1, *H. griffithianum etc.* (0.2–0.4 cm) and reached upto 5–5.8 cm in *H. coronarium, H. forrestii, H. larsenii, H. robustum etc*. Ligules may be dried off early and become brittle when plant gets older and can be separable only in young condition. It forms an important character in the delimitation of the species. (*Plate 29. A–E*)

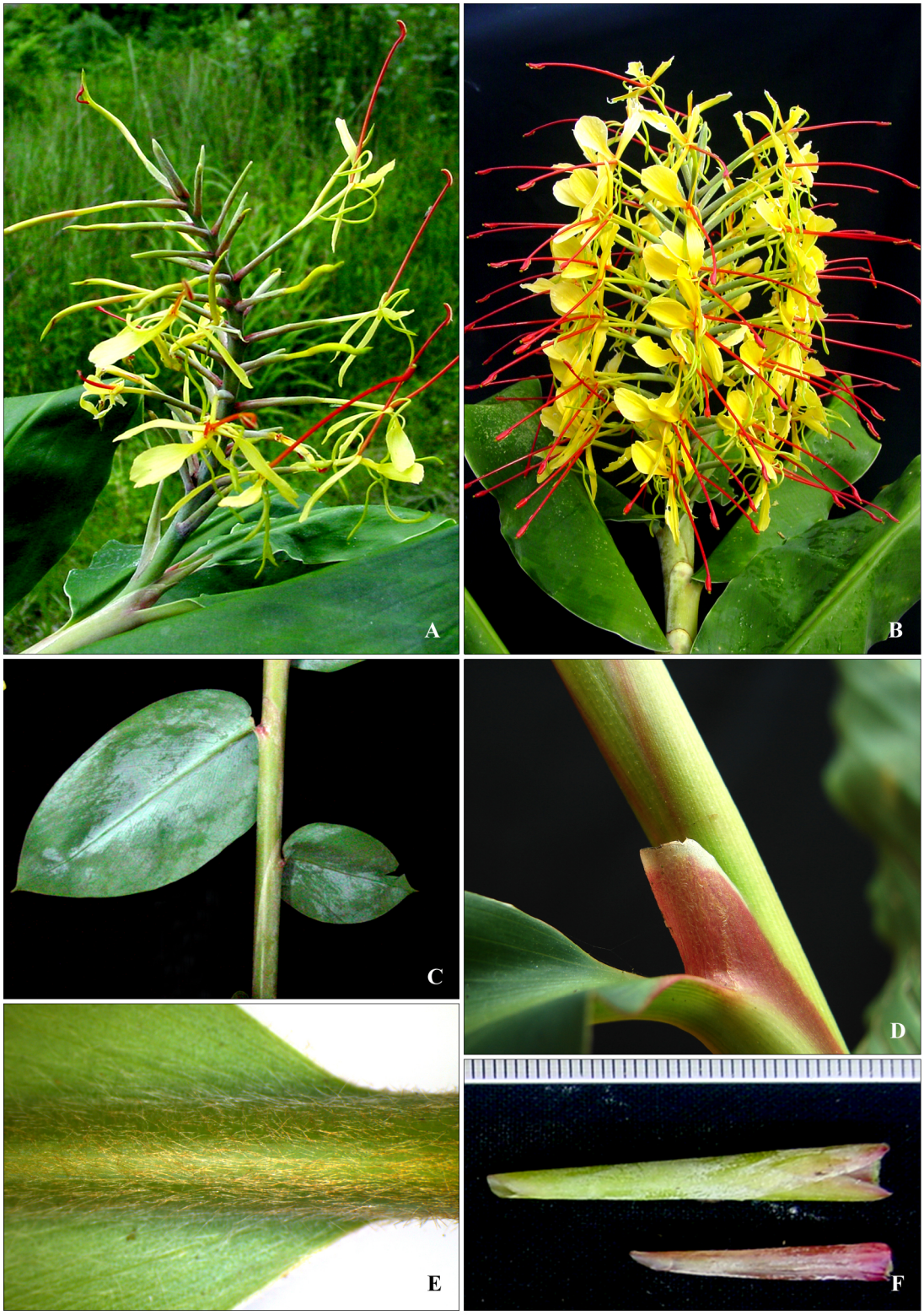

Plate 29. **A.** *H. speciosum* -inflorescence; **B.** *H. speciosum* var. *gardnerianum* -inflorescence; **C.** *H. speciosum* -lower surface of leaves; **D.** *H. ellipticum* -ligule; **E.** *H. flavescens* -lower surface of leaf; **F.** *H. speciosum* var. *gardnerianum* -bract and bracteole.

Inflorescence

The true stem, which passes through the leafy sheaths, always ends in a terminal unbranched inflorescence or spike. Among Indian species, inflorescence is shortest in *H. hookeri* (2.5–6.5 cm) and longest in *H. stenopetalum* (upto 52 cm) and *H. elatum* (upto 60 cm). The inflorescence is always erect or semi-erect. Based on the arrangement of bracts there are mainly two types of inflorescences. They may be elliptic and dense (*H. coronarium, H. maximum, H. flavum, H. urophyllum etc.*) or cylindrical and lax (*H. coccineum, H. stenopetalum, H. forrestii, H. elatum etc.*). In species like *H. spicatum*, inflorescence is much elongated and the bracts are well separated. The size and number of bracts of the inflorescence vary depending on the age of rhizome or plant, *e.g.,* in *H. coccineum* young plant produces *c.* 11 cm long inflorescence with about 19 bracts and when the plant becomes older the spike length and number of bracts also increases to *c*. 28 cm long and about 62 bracts respectively. (*Plate 30 & 31*)

In *Hedychium*, the inflorescence is always terminal on a leafless shoot, and are developed spirally from bottom to top. It is the primitive form in Zingiberaceae (Holttum 1950), with a cincinnus in the axil of each primary bract and the secondary or flowering bracts (bracteole) of tubular shape. The cincinni remain almost sessile, and the primary bracts are always rather large. The flowers in each bract are arranged in normal order of an axillary cincinnus (the first secondary bract being at right angles to the primary bract *etc.*), the overlapping edges of the bracts provide a more efficient protection to the flower buds.

Bracts and bracteoles

The bracts are usually coriaceous, and subtend bracteoles and solitary flower or cincinni in their axil. Bracts may be imbricate or convolute. It is considered as one of the major characters for the division of the genus into two groups. In elliptic or ovate spikes, bracts are large, closely packed, overlapping and



Plate 30. **A-D. Inflorescences in *Hedychium* spp.: A.** *H. coronarium*; **B.** *H. maximum*; **C.** *H. flavum*; **D.** *H. urophyllum.*

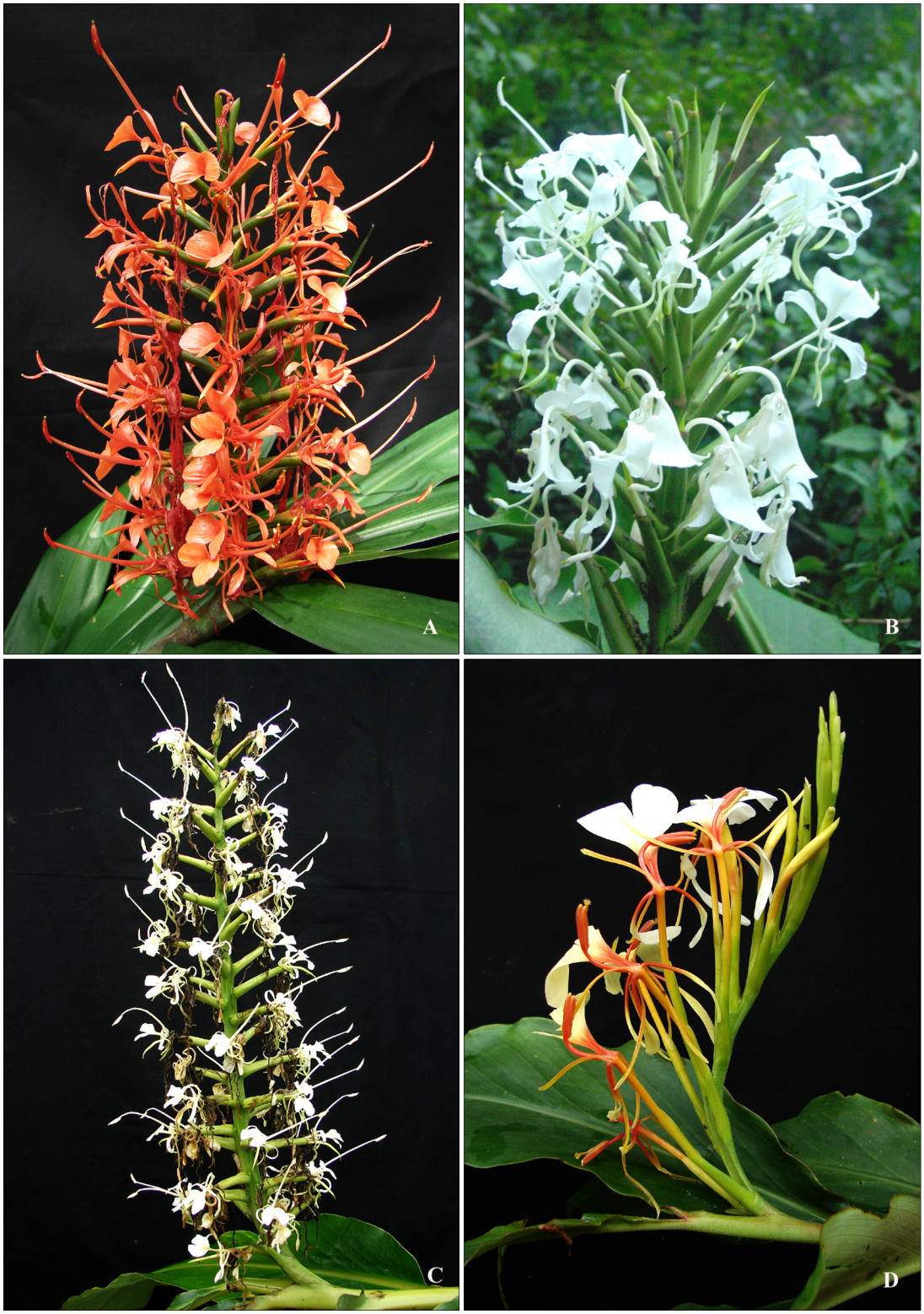

Plate 31. **Inflorescences in *Hedychium* spp.: A.** *H. coccineum*; **B.** *H. forrestii*; **C.** *H. stenopetalum*; **D.** *H. spicatum.*

imbricate on a condensed rachis, *e.g., H. coronarium, H. ellipticum, H. flavum, H. gratum, H. marginatum, H. maximum etc.* In cylindrical spikes, bracts are convolute, cylindrical and distantly placed on a long rachis, *e.g.*, *H. coccineum, H. elatum, H. forrestii, Hedychium* sp. No.1*, H. speciosum etc.* Bracts are usually non-glaucous, but in species like *H. speciosum* and *H. speciosum* var. *gardnerianum* bracts are characteristically glaucous externally. (*Plate 29. F*)

Bracteoles are smaller in size than the bracts; usually outer one tubular and encircles the entire cincinnus. Each bracteole subtends a single flower, and the size gradually decreases towards inside in a cincinnus. The cincinnus may be one to many-flowered. Each bract subtends a single flower in *H. densiflorum, H. ellipticum, H. ellipticum* var*. radiatum, H. gomezianum, H. gracile, H. gracile* var*. calcaratum, H. gracile* var. No. 1, *H. griffithianum, H. hookeri, H. longipedunculatum* and *H. spicatum*, where as in remaining taxa the number of flowers vary from 1 to 10 flowered (8–10 -flowered in *H. robustum*). The number of flowers per cincinnus can be considered as a reliable character only when they are invariably uni-flowered. The number of flowers in a cincinnus vary depending on the age of rhizome or plant, *e.g.,* in *H. coccineum* young plant produces a cincinnus with 1 or 2 flowers and older with 3–6 flowers. (*Plate 32. A–J*)

Bulbils

In most of the Indian Hedychiums the bulbils are absent and the rhizomes act as the primary mode of propagation. But in *H. greenii*, bulbils are produced in the axil of lower sterile bracts, and also act as the mode of propagation, they produce shoots from the mother plant itself and only one shoot is developed from the tip. (*Plate 28. G*)

Flowers

The flower in Zingiberaceae is derived from the ancestral liliferous type of three sepals, three petals, six stamens in two whorls each and a gynoecium of



Plate 32. **A-F. Single flowered cincinnus: A.** *H. densiflorum*; **B.** *H. ellipticum*; **C.** *H. ellipticum* var. *radiatum*; **D.** *H. gomezianum*; **E.** *H. griffithianum*; **F.** *H. gracile* var. *calcaratum*; **G.** *H. spicatum.* **H-J. Multi-flowered cincinnus: H.** *H. coccineum*; **I.** *H. coronarium* var. *chrysoleucum*; **J.** *H. wardii.*

three fused carpels. The sepals are always joined to form a tube, *i.e.* calyx, and are relatively inconspicuous. The petals are conspicuous at the corolla lobes, and thus look rather like the sepals of a lily or orchid (Holttum 1950).

Flowers are white, yellowish, orange or red. Corolla tube is slender, long exserted or equal with bracts. Lobes are narrow, usually reflexed. Staminodes and labellum are petaloid and conspicuously coloured. Lip has a narrow basal part, claw, and a broad distal blade. The brightly coloured and highly flavored flowers of this genus open in evening and being at their best for no more than 24 hours. Like most other gingers, several flowers develop at the same time. Among Indian *Hedychium* the flowers in *H. aureum, H. densiflorum, H. longipedunculatum* and *H. hookeri* are much smaller (2.8–3.5 cm) and flowers in *H. flavum, H. forrestii* var. *palaniense* and *H. maximum* are much longer (15–15.7 cm). Fresh flowers are usually ascending, but in species like *H. coronarium, H. coronarium* var. No. 1, *H. gratum, H. urophyllum, H. urophyllum* var. *elwesii etc.* have drooping flowers. Flowers are slightly fragrant, but the flowers of *H. coronarium* are highly fragrant among Indian Hedychiums. (*Figure 33. A–H*)

Although the labellum is initiated in an abaxial position, the mature flowers in species like *H. coronarium, H. coronarium* var. *chrysoleucum, H. coronarium* var. No. 1, *H. flavum, H. flavum* var. *flavescens, H. gratum, H. maximum, H. urophyllum, H. urophyllum* var. *elwesii etc.* resupinate and the labellum is oriented adaxially. However the flower of *H. coccineum, H. coccineum* var. *angustifolium, H. coccineum* var. *carneum, H. gracile, H. gracile* var. *calcaratum, H. gracile* var. No. 1, *H. gomezianum, H. griffithianum, H. marginatum, H. speciosum, H. speciosum* var. *gardnerianum*, *H. spicatum, H. cernuum etc.* there is no resupination.

Calyx and corolla

Calyx forms a slender tube above the ovary and is composed of three fused outer tepals. It is three toothed and are unequal, middle lobe is larger and

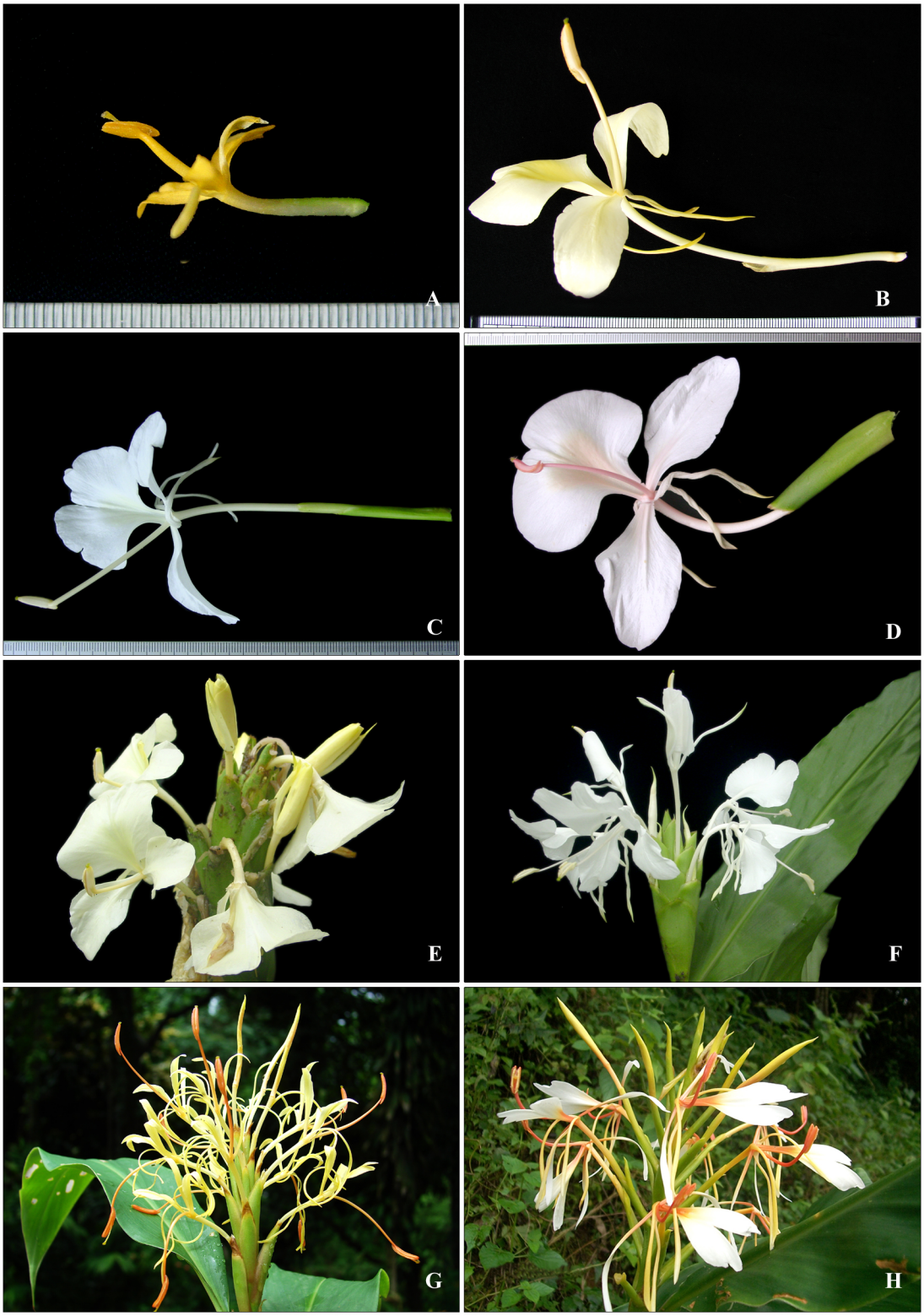

Plate 33. **A-D. Single flowers: A.** *H. aureum*; **B.** *H. flavum*; **C.** *H. forrestii* var. *palaniense*; **D.** *H. maximum.* **E-H. Inflorescences: E.** *H. coronarium* var. No. 1; **F.** *H. gratum*; **G.** *H. gomezianum*; **H.** *H. cernuum.*

prominent than others. The calyx may be closely appressed to the corolla tube throughout its length or upper half is inflated. They are membranous and translucent. Calyx never exceeds the corolla tube and usually half or more than half the length of corolla tube. Rarely in species like *H. gracile, H. gracile* var. No. 1, *H. larsenii* and *H. stenopetalum* calyx is equal or sub-equal with corolla tube.

The corolla is composed of three inner tepals, they are fused to form a slender corolla tube towards base. Tube separate distally in to three long, narrow elliptic, oblong or oblanceolate corolla lobes. Which are membranous and drooping. Dorsal corolla lobe is pouched at tip and act as the protective cap over the developing anther in the bud. Unlike the laterals, dorsal lobe is beaked at tip, usually beak is 1.5–3 mm long, whereas in *H. coronarium* var. No. 1 and *H. larsenii,* it reaches a length of 6–9 mm.

Lateral staminodes

In *Hedychium,* lateral staminodes are modified in to petaloid structures on both side of labellum and are free. Along with labellum they also form an the attractive part of the flower. They are white or conspicuously coloured and vary in size and shape according to the species. In species like *H. coronarium, H. coronarium* var. No. 1 and *H. maximum,* lateral staminodes are broader (2.4–3.4 cm) with a slight notch at the tip. But usually lateral staminodes are very narrow with an obtuse or rounded tip and less than 1 cm broad. Usually lateral staminodes are sub-equal or slightly shorter than the labellum, where as in *H. ellipticum* and *H. ellipticum* var. *radiatum* lateral staminodes are characteristically longer than the labellum. (*Plate 34; 35*)

Labellum

The most attractive part of the flower of ginger is the ‘lip’ or ‘labellum’. Labellum in *Hedychium* is relatively large, petaloid, bilobed and rarely entire (*H. robustum*). Labellum is abruptly or gradually narrowed towards the base to form a



Plate 34. **Lateral staminodes: A.** *H. cernuum* (from pickled specimen); **B.** *H. coccineum*; **C.** *H. coccineum* var. *angustifolium*; **D.** *H. coronarium*; **E.** *H. coronarium* var. *chrysoleucum*; **F.** *H. coronarium* var. No. 1; **G.** *H. deceptum*; **H.** *H. densiflorum*; **I.** *H. elatum*; **J.** *H. ellipticum*; **K.** *H. ellipticum* var. *radiatum*; **L.** *H. flavum*; **M.** *H. flavum* var. *flavescens*; **N.** *H. forrestii* var. *palaniense*; **O.** *H. gomezianum.*



Plate 35. **Lateral staminodes: A.** *H. gracile*; **B.** *H. gracile* var. *calcaratum*; **C.** *H. gratum*; **D.** *H. greenii*; **E.** *H. griffithianum*; **F.** *H. larsenii*; **G.** *H. marginatum*; **H.** *H. maximum*; **I.** *H. speciosum* var. *gardnerianum*; **J.** *H. spicatum*; **K.** *H. stenopetalum*; **L.** *H. thyrsiforme*; **M.** *H. urophyllum*; **N.** *H. villosum* var. *tenuiflorum*; **O.** *H. wardii*; **P.** *Hedychium* sp. No. 1; **Q.** *Hedychium* sp. No. 2; **R.** *Hedychium* sp. No. 3. (**A, M & N** -from pickled specimens)

distinct claw. But in species like *H. aureum, H. densiflorum, H. greenii etc.* the claw is inconspicuous and labellum is cuneate at base, where as in *H. wardii* the claw is more or less absent. In species like *H. cernuum*, *H. ellipticum*, *H. ellipticum* var. *radiatum*, *H. gomezianum, H. gracile, H. gracile* var. *calcaratum*, *H. gracile* var. No. 1, *H. griffithianum, H. spicatum, H. villosum, H. villosum* var. *tenuiflorum etc.* labellum length is greater than the breadth (ratio is greater than 1). But in species like *H. coronarium, H. coronarium* var. *chrysoleucum, H. coronarium* var. No. 1, *H. maximum, H. urophyllum, H. urophyllum* var. *elwesii, H. wardii etc.* length is lesser than breadth (ratio is less than 1). Between these two extremes there is continuous range of variation. Very rarely the length and breadth of labellum are equal (*e.g., H. urophyllum* var. *elwesii* and *Hedychium* sp. No. 3). Labellum is compromising with the lateral staminodes in length (except *H. ellipticum,* in which labellum is 0.8–1 cm shorter than lateral staminodes) and colour. Only in *H. greenii*, labellum and lateral staminodes are characteristically crumpled. The colour may vary from white, yellow, orange or red, with a little darker patch at the centre. The petaloid and conspicuously coloured labellum could act as the platform of insects for pollination as in Orchidaceae. (*Plate 36; 37; 38*)

Fertile stamen

Zingiberaceous taxa are characterized by a single fertile anther. Usually in *Hedychium*, the stamen is very long filamentous, but in species like *H. wardii* stamen is invariably sub-sessile with 1–1.5 mm long filament. Among Indian species the longest stamen is present in *H. stenopetalum* (7.6–7.8 cm). The relative length of stamen and labellum is much relevant in species delimitation of *Hedychium* than the mere length of the stamen. Usually stamen is erect or slightly arching, but in *H. spicatum*, stamen is characteristically 'L'-shaped, bend at center to 90°. The anther is divided at its base up to middle or 1/2, which feel as a small spur at the base. Usually anther is parallel to the filament axis, but in some species like *H. coronarium, H. coronarium* var. *chrysoleucum, H. coronarium* var. No. 1,

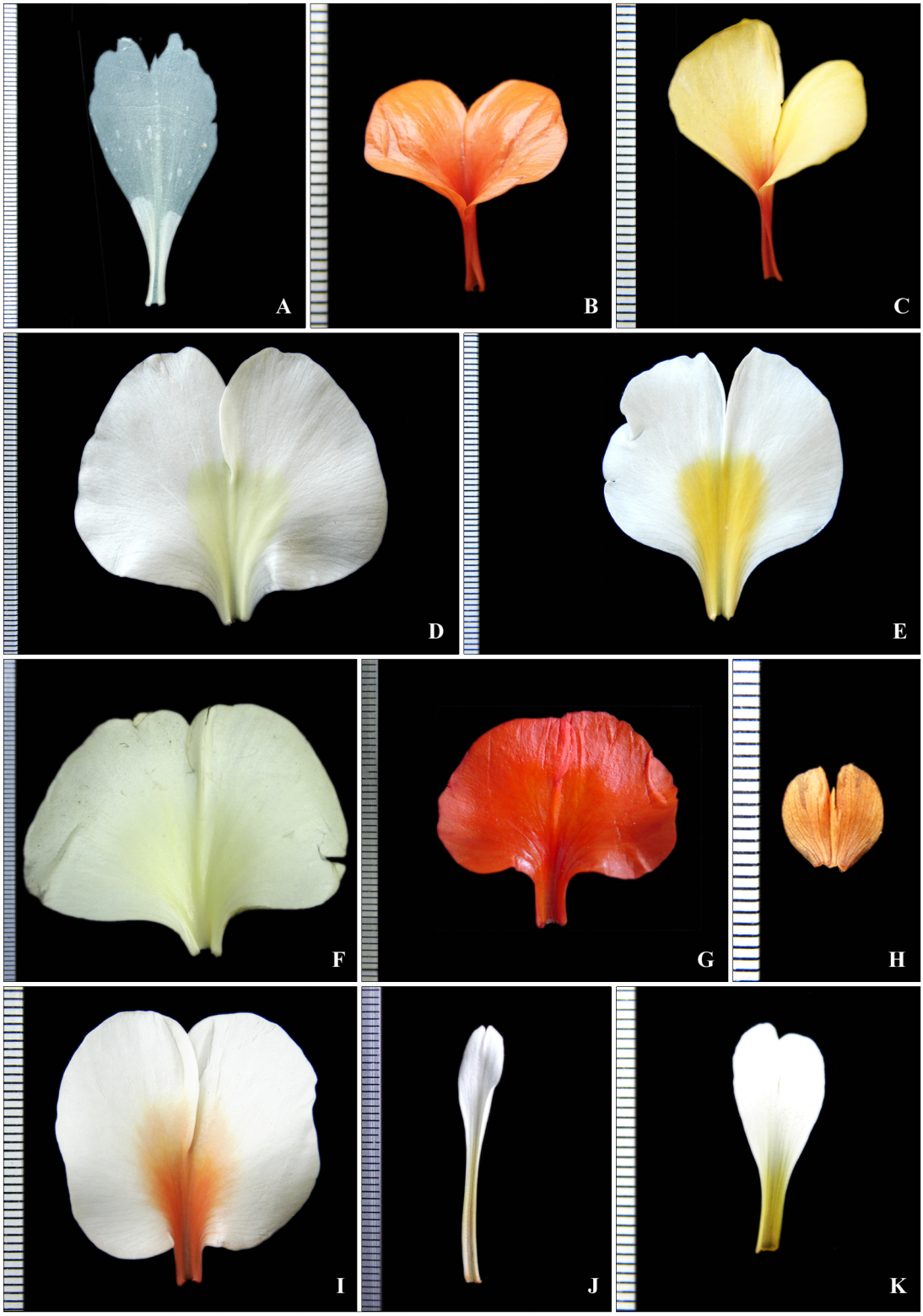

Plate 36. **Labellum: A.** *H. cernuum* (from pickled specimen); **B.** *H. coccineum*; **C.** *H. coccineum* var. *angustifolium*; **D.** *H. coronarium*; **E.** *H. coronarium* var. *chrysoleucum*; **F.** *H. coronarium* var. No. 1; **G.** *H. deceptum*; **H.** *H. densiflorum*; **I.** *H. elatum*; **J.** *H. ellipticum*; **K.** *H. ellipticum* var. *radiatum*.



Plate 37. **Labellum: A.** *H. flavum*; **B.** *H. flavum* var. *flavescens*; **C.** *H. forrestii* var. *palaniense*; **D.** *H. gomezianum*; **E.** *H. gracile* (from pickled specimen); **F.** *H. gracile* var. *calcaratum*; **G.** *H. gratum*; **H.** *H. greenii*; **I.** *H. griffithianum*; **J.** *H. larsenii*; **K.** *H. marginatum.*

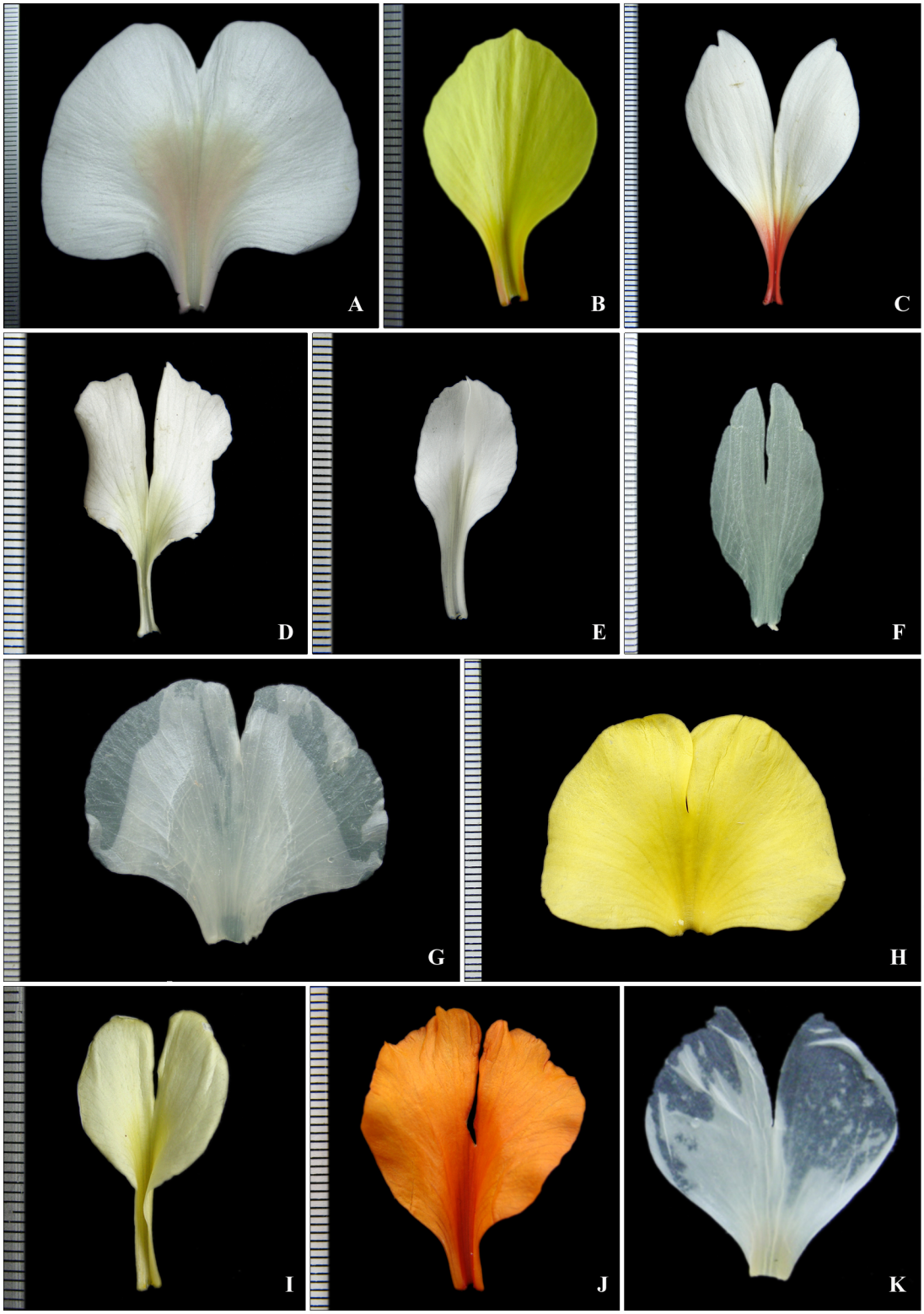

Plate 38. **Labellum: A.** *H. maximum*; **B.** *H. speciosum* var. *gardnerianum*; **C.** *H. spicatum*; **D.** *H. stenopetalum*; **E.** *H. thyrsiforme*; **F.** *H. villosum* var. *tenuiflorum*; **G.** *H. urophyllum*; **H.** *H. wardii*; **I.** *Hedychium* sp. No. 1; **J.** *Hedychium* sp. No. 2; **K.** *Hedychium* sp. No. 3 (**F, G & K** -from pickled specimens).

H. deceptum, H. flavum, H. flavum var. *flavescens, H. maximum, Hedychium* sp. No. 1*, H. urophyllum, H. urophyllum* var. *elwesii etc.* anther is positioned at an angle of 25°–70° with the filament axis. Where as in species like *H. larsenii* and *H. thyrsiforme*, thecae are placed at right angles (90°) with the filament axis.

(*Plate 39*)

Anther in *Hedychium* is usually elliptic or oblong, but in two Indian taxa, *H. villosum* and *H. villosum* var. *tenuiflorum* anther is sagittate and are 1–3.5 mm long. In others, size varies from 0.5 cm (*H. aureum*) to 1.9 cm (*H. maximum*). The pollen sacs of the anther normally dehisce through longitudinal slits. The connective of the anther is commonly truncate or slightly notched without any crest at tip, but rarely *c.* 1 mm long crest is also found. In *H. spicatum* and *H. cernuum* the connective is divided halfway from top or more length of anther. (*Plate 40. A–C*)

Ovary

In *Hedychium*, ovary is sessile, tricarpillary, trilocular, syncarpous, and each locule having many ovules on axile placentae. Ovary wall is usually smooth and variously vestitured, but it is glabrous in *H. cernuum, H. coronarium, H. coronarium* var. *chrysoleucum, H. densiflorum, H. gracile* var. *calcaratum, H. speciosum, H. speciosum* var. *gardnerianum, H. spicatum* and *Hedychium* sp. No. 3.

(*Plate 40. G*)

Epigynous glands

Two conical structures produced directly above the two antero-lateral carpels of the ovary, are the epigynous glands. They are fused at the base in early stage, but grow as two separate distinct conical organs as the flower bud enlarges. They are about 1–6 mm long structures and sheathed by a floral tube.

(*Plate 40. G*)

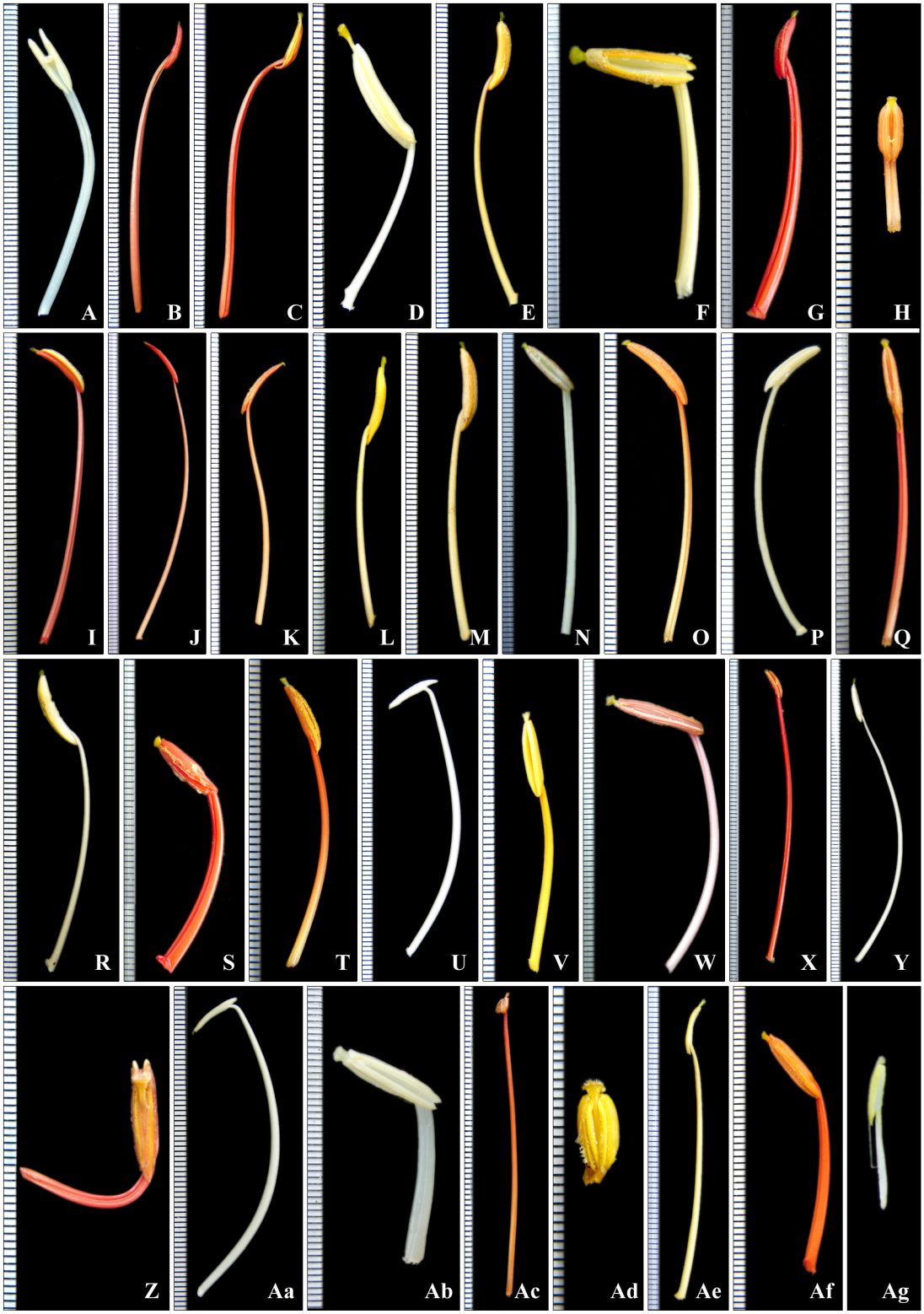

Plate 39. **Stamens: A.** *H. cernuum* ; **B.** *H. coccineum*; **C.** *H. coccineum* var. *angustifolium*; **D.** *H. coronarium*; **E.** *H. coronarium* var. *chrysoleucum*; **F.** *H. coronarium* var. No. 1; **G.** *H. deceptum*; **H.** *H. densiflorum*; **I.** *H. elatum*; **J.** *H. ellipticum*; **K.** *H. ellipticum* var. *radiatum*; **L.** *H. flavum*; **M.** *H. flavum* var. *flavescens*; **N.** *H. forrestii* var. *palaniense*; **O.** *H. gomezianum*; **P.** *H. gracile*; **Q.** *H. gracile* var. *calcaratum*; **R.** *H. gratum*; **S.** *H. greenii*; **T.** *H. griffithianum*;**U.** *H. larsenii*; **V.** *H. marginatum*; **W.** *H. maximum*; **X.** *H. speciosum* var. *gardnerianum*; **Y.** *H. stenopetalum*; **Z.** *H. spicatum*; **Aa.** *H. thyrsiforme*; **Ab.** *H. urophyllum* ; **Ac.** *H. villosum* var. *tenuiflorum*; **Ad.** *H. wardii*; **Ae.** *Hedychium* sp. No. 1; **Af.** *Hedychium* sp. No. 2; **Ag.** *Hedychium* sp. No. 3 (**A, P, Ab & Ag** -from pickled specimens).

Style and stigma

In *Hedychium*, mature style is white, turn to yellow or green towards tip, filiform, slender and usually extends to the entire length of flower. In corolla tube style passes through a narrow furrow which is lined by minute hairs. That reduces the risk of damage of style by the pollinating insects or nectar feeding ants. The style passes through the anther thecae and the stigma protrudes at the top or rarely emerges at the middle of the anther thecae (*H. cernuum* and *H. spicatum*). Stigma is always cup-shaped, and entire stigmatic head is ciliate, but in species like *H. aureum*, *H. coccineum*, *H. coccineum* var. *angustifolium* and *H. coccineum* var. *carneum* only margins of stigma are ciliate. The hairs are usually curved at tip and are hook-like. (*Plate 40. D–F*)

Fruits

The fruit is an oblong-cylindrical, globose, sub-globose, ovoid or elliptic, fleshy, capsule, which is tardy dehiscent, and having a size of 0.8–6 x 0.8–3 cm. The valves separate at the apex and divide the capsule into three parts that fold back to reveal the seeds. Usually the inner surface of fruit wall is brightly orange coloured, but in *H. hookeri*, they are red in colour. The seeds are spherical, ovoid, elliptic or angled and are deep red while dehiscence, but it is black in *H. hookeri*, and turn to brown or blackish when dry. Each seed has a fleshy, lacerate red aril, but in *H. hookeri* it is black. In *H. hookeri* the seeds aggregate as a black spherical mass along with black aril in each locule. Which is the characteristic feature of the species in fruiting stage. (*Plate 40. H–K*)

In some species like *H. flavum* var. *flavescens, H. deceptum etc.*, fruit setting is never been observed. But in species like *H. coronarium, H. thyrsiforme, H. larsenii, H. coccineum, H. stenopetalum etc.* profuse fruiting is observed.

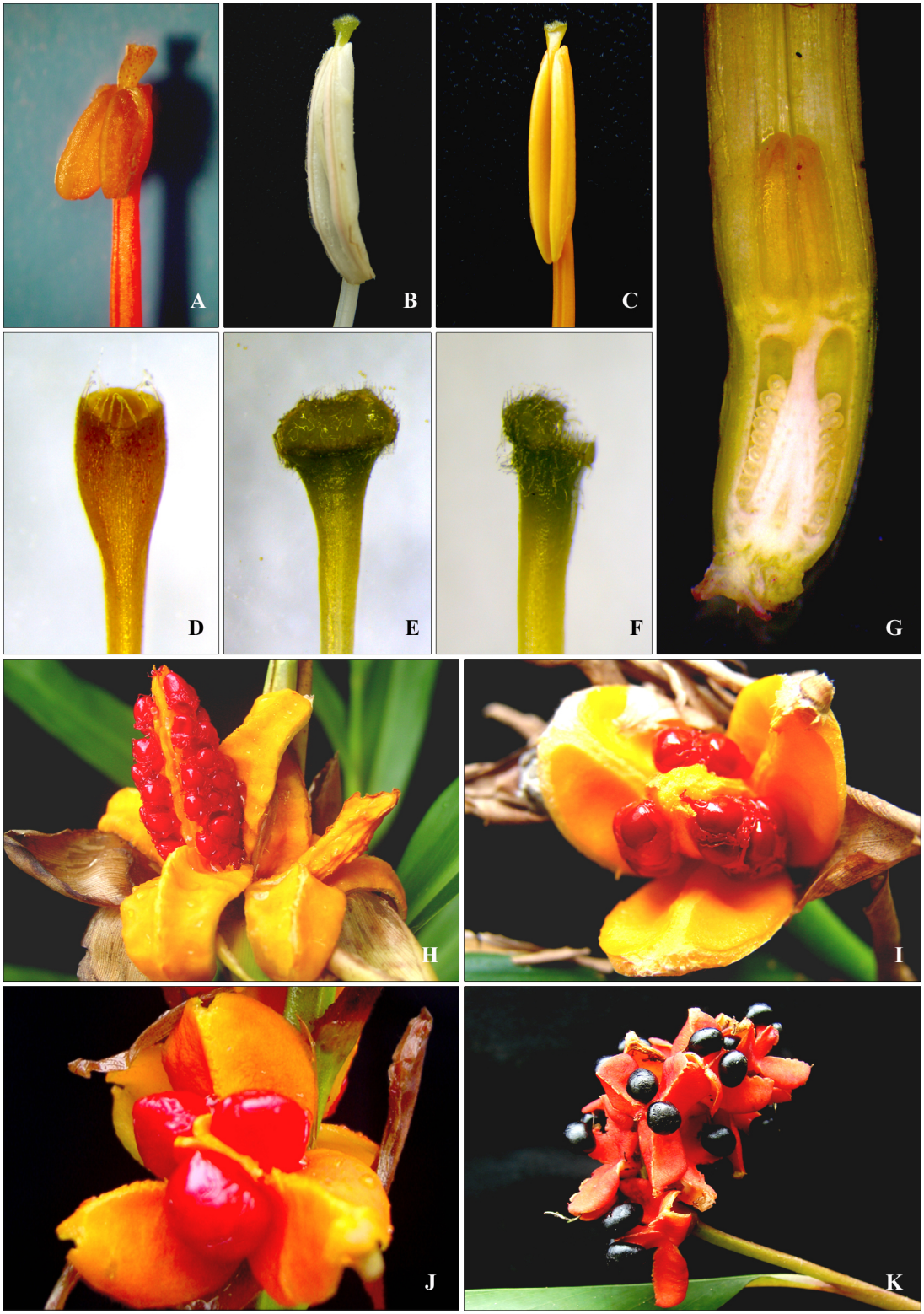

Plate 40. **A-C. Anthers: A.** *H. villosum* var. *tenuiflorum*; **B.** *H. coronarium*; **C.** *H. marginatum.* **D-F. Stigma: D.** *H. coccineum*; **E.** *H. coronarium*; **F.** *H. flavescens.* **G. L.S. of ovary with epigynous glands and base of corolla tube and style** -*H. chrysoleucum.* **H-K. Dehisced fruits with seeds:** *H. coronarium*; **I.** *H. forrestii* var. *palaniense*; **J.** *H. spicatum*; **K.** *H. hookeri.*

SUMMARY

Zingiberaceae, are the largest of the eight families of the order Zingiberales, with 53 genera and over 1377 species (Kong *et al.* 2010). They are mainly distributed in the South and South-east Asia with a few representations in Africa and South America. In India, it is represented by 20 genera and about 200 species and is mainly represented in North-eastern, Peninsular and Andaman and Nicobar regions. The genus *Hedychium* belongs to the tribe Zingibereae of the subfamily Zingiberoideae. The most prominent vegetative feature that is universal in the subfamily is the parallel orientation of distichy of the leafy shoots with respect to the rhizome. Another vegetative trait that characterizes the subfamily is the capacity of the members to go into dormancy during dry season in monsoon climates. The most recognizable floral feature of the subfamily is the conspicuous and often well developed lateral staminodes (Kress *et al. l.c.*). The tribe Zingibereae possesses a trilocular ovary with axile placentation, which in some genera may be incompletely closed towards the apex with axile or rarely basal placentation.

Hedychiums are popularly called 'ginger lily' or 'butterfly lily', owing to the resemblance of its labellum and lateral staminodes with that of the wings of the butterflies. The taxonomy of the horticulturally important genus *Hedychium* has been controversial since the middle of the nineteenth century. At least 115 names have been published in the genus, of which, about 65 are biologically valid (Wood *et al.* 2000). The genus forms the most beautiful gingers of the family Zingiberaceae.

Conventionally the circumscription of the genus was mainly based upon the Inflorescence and bract nature. Since Wallich (1853) several classifications were proposed by various authors. The infrageneric classification of Schumann (1904) based on the morphological characters of Inflorescence and bracts, and divided the genus into two subgeneric groups is accepted here. As the recent phylogenetic

classification of Wood *et al.* (*l.c.*) is not supported by the morphological affinity of many Indian taxa, is not accepted in this treatment.

There are different opinions regarding the total number of *Hedychium* spp. in India. But the present studies revealed that some of the taxa described till date are conspecific or misidentification. During the present study it is identified that only 44 taxa, which includes 31 species and 13 varieties, occur in India. Among them, 19 taxa are endemic to India, with 2 south Indian representations. The genus is mainly distributed in Northeast and South India.

Every effort have been taken to collect live plants from all over India, and the descriptions provided here are prepared on its basis. Detailed illustrations of most of the taxa are prepared by using Rotring isograph pen on Gateway paper. All the collected specimens were made into herbarium and are deposited in Calicut University Herbarium (CALI), with about 42 taxa with 230 accessions. Spirit collections are also prepared and are kept with proper labelling for further studies. Live materials from natural habitats were transplanted to Calicut University Botanic Garden (CUBG) and developed the largest germplasm of *Hedychium* in India and has about 38 taxa and 180 accessions. Herbarium collections in major Indian and foreign herbaria like ARUN, ASSAM, BM, CAL, CALI, E, FRC, K, MH, PBL, PPCH *etc.* were studied.

Protologues of all names were examined. If holotypes and isotypes were already mentioned, there were located and their validity was confirmed or excluded. During the present study seven new taxa (three species and four varieties) were identified and one new distributional record was identified from India. Nine names have been reduced to synonymies and five names to new status for the first time and many misidentifications were corrected. Many old taxa were described without any types, hence, every effort have been taken to typify them based on the collections at BM, E, K and CAL. For names where no holotype was designated, lectotypes were selected from syntypes, paratypes or other relevant original materials. If no original materials could be found, neotype was designated.

Table 04. *Hedychium* in India: Endemism, IUCN status and Novelties in the present treatment

Sl. No.	*Species*	Endemism	*IUCN Status*	Novelty
1	*H. aureum*	MG	CR	
2	*H. cernuum*	WG*	CR	
3	*H. coccineum*		LC	
4	*H. coccineum* var. *angustifolium*		CR	
5	*H. coccineum* var. *carneum*	MG	CR	
6	*H. coronarium*		LC	
7	*H. coronarium* var. *chrysoleucum*		EN	
8	*H. coronarium* var. No. 1	MG	CR	Var. Nov.
9	*H. deceptum*	MG, NG	VU	
10	*H. densiflorum*		EN	
11	*H. elatum*		CR	
12	*H. ellipticum*		VU	
13	*H. ellipticum* var. *radiatum*	AR	CR	Stat. Nov.
14	*H. flavum*		LC	
15	*H. flavum* var. *flavescens*		EN	Stat. Nov.
16	*H. forrestii*		EN	New Record
17	*H. forrestii* var. *palaniense*	TN*	CR	Var. Nov.**
18	*H. forrestii* var. No. 1	MZ	CR	Var. Nov.
19	*H. gomezianum*		CR	
20	*H. gracile*		LC	
21	*H. gracile* var. *calcaratum*		EN	Stat. Nov.
22	*H. gracile* var. No. 1	SK, WB, AR	CR	Var. Nov.
23	*H. gratum*		CR	
24	*H. greenii*		EN	
25	*H. griffithianum*	MG, SK, WB	CR	
26	*H. hookeri*	WB, MG, AR	CR	
27	*H. larsenii*	MZ,MN	CR	
28	*H. longipedunculatum*	AR, NG	CR	
29	*H. marginatum*	MG, MZ, TR, NG	VU	
30	*H. maximum*	MG, NG	CR	
31	*H. robustum*		CR	
32	*H. speciosum*		CR	
33	*H. speciosum* var. *gardnerianum*		LC	Stat. Nov.
34	*H. spicatum*		LC	
35	*H. stenopetalum*		NT	
36	*H. thyrsiforme*		NT	
37	*H. urophyllum*	MG	EN	
38	*H. urophyllum* var. *elwesii*	MG, MZ	CR	Stat. Nov.
39	*H. villosum*		CR	
40	*H. villosum* var. *tenuiflorum*		VU	
41	*H. wardii*		EN	

42	*Hedychium* sp. No. 1	NG	CR	Sp. Nov.
43	*Hedychium* sp. No. 2	AR	CR	Sp. Nov.
44	*Hedychium* sp. No. 3	AR	CR	Sp. Nov.

Endemism: * South India; AR- Arunachal Pradesh; MG- Meghalaya; MN- Manipur; MZ- Mizoram; NG- Nagaland; SK- Sikkim; TN- Tamil Nadu; TR- Tripura; WB- West Bengal; WG- Western Ghats. ** Recently published in Journal of Botanical Research Institute of Texas.

Among the 44 Indian Hedychiums, 19 taxa are endemics, with only 2 South Indian representations, *i.e.*, *H. cernuum* and *H. forrestii* var. *palaniense* -endemic to Western Ghats and Tamil Nadu respectively. The remaining 18 are endemic to Northeast India. As per the latest IUCN guidelines (IUCN 2001, IUCN Standards and Petitions Subcommittee 2010), threat status of all the Indian taxa has been assessed. Majority of taxa are under Critically Endangered (CR) category with twenty four taxa, next comes the Endangered (EN) category with eight taxa, then the Least Concern (LC) category with six taxa, then the Vulnerable (VU) category with four taxa and at last the Near Threatened (NT) category with two taxa (Table 04).

H. spicatum is well known for its medicinal and phytochemical properties and much valued in Folk and Ayurvedic preparations. The genus also has much horticultural importance and many with great ornamental potential. At present, over 100 horticultural varieties have been bred and marketed world-wide. Besides, *H. coronarium* is widely cultivated in Brazil for paper making. Flowers are valued as a perfume and used for the worship of God. It is also used for the decoration of hair and as a symbol of love.

ENUMERATION – INDIAN HEDYCHIUM

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H. squarrosum Buch.-Ham. in W. Herbert, Banks.

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A

Achasma: 33

Aframomum: 2, 263

Alpinia: 21, 22, 23, 25, 33, 39, 50, 51, 52, 53, 54, 55, 56, 57, 80

A. racemosa: 50

Alpiniaceae: 24, 52

Alpiniae: 53, 54

Alpinieae: 28, 32, 33, 34, 54, 55, 56, 58, 59, 60

Alpiniees: 53

Alpinioideae: 3, 59, 60

Amoma: 27, 58

Amomaceae: 28, 54

Amomae: 24, 52, 53

Amomeae: 27, 28, 54, 55

Amomum: 2, 21, 25, 27, 33, 39, 50, 51, 52, 53, 54, 55, 56, 57

A. cardamom: 50

A. granparad: 50

A. zerumbet: 50

A. zingiber: 50

Ananas: 21, 51

Aulotandra: 263

B

Bihai: 21, 51

Boerhavia: 20, 50, 52

Boesenbergia: 1, 3, 33, 35, 50, 57

B. rotunda: 50

Brachychilum: 28, 48, 54, 63

Brachychilus: 56, 64

Bromelia: 21, 50, 51

C

Camptandra: 57

Canna: 23, 50, 51, 52, 53, 55

Cannaceae: 1, 24, 25, 27, 28, 29, 31, 34, 48, 49, 52, 53, 54, 55, 56, 58, 59

Cannae: 20, 22, 26, 50, 51

Cannariae: 34, 58, 59

Cannarieae: 25, 53

Canneae: 29, 53, 55

Caraguata: 21, 51

Catimbium: 50

Cautleya: 29, 48, 55, 57

Cenolophon: 54

Chenopodiaceae: 20, 50

Chromolaena odorata: 203

Clinogyne: 55

Coronariae: 28, 62

Costaceae: 28, 54, 55

Costeae: 28, 54, 55

Costi: 53, 54

Costoideae: 30, 31, 32, 33, 55, 56, 57, 58

Costoidees**:** 53

Costus: 1, 21, 23, 25, 30, 31, 33, 50, 51, 52, 53, 54, 55

Cryptocotyledoneae: 24, 52

Curcuma: 1, 2, 3, 21, 23, 25, 27, 28, 29, 30, 33, 35, 50, 51, 52, 53, 54, 55, 56, 57, 63

C. longa: 50

*C. rotunda***:** 50

Curcumaceae: 25, 53

Curcumees: 53

Curcumorpha: 1, 35

Cyphostigma: 55

D

Diracodes: 27, 54

Donacodes: 27, 52, 53, 54

E

Eichhornia crassipes: 203

Elettaria: 2, 25, 27, 50, 52, 53, 54, 55

E. cardamom: 50

Elettariopsis: 55

Embryonate: 23

Endorhizae: 23, 51

Epigynae: 29, 55

Euosmianthus: 31, 56, 64, 65, 157

Exembryonate: 23

Exorhizae: 23, 51

G

Gagnepainia: 33, 56

Galanthus: 21, 50

Gamochilus: 27, 54, 62, 67, 69, 195, 197, 267, 270

G. speciosus: 27, 67, 195, 270

Gandasulium: 20, 21, 28, 29, 30, 31, 54, 56, 60, 61, 62, 63, 64, 65, 67, 69, 99, 101, 135, 140, 187, 267, 268

G. coronarium: 29, 62, 69, 99, 268

Gastrochilus: 29, 54, 55

Gethyra: 25, 53

Globba: 1, 3, 23, 25, 33, 50, 51, 52, 53, 54, 55, 56, 178

G. bulbifera: 178

Globbae: 53, 54

Globbeae: 3, 29, 30, 32, 33, 34, 54, 55, 56, 57, 58, 59, 60

Guillainia: 55

Gynandrae: 24, 52

Gynotepalae: 53

H

Haniffia: 57

Haplochorema: 56

Hedychieae: 3, 28, 29, 30, 32, 33, 34, 54, 55, 56, 57, 58, 59

Hedychium: 3, 4, 5, 6, 9, 10, 12, 15, 18, 19, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 43, 44, 45, 46, 48, 50 51, 52, 53, 54, 55, 56, 57, 60, 61, 62, 64, **66**, 69, 70, 80, 101, 102, 121, 140, 141, 146, 168, 171, 175, 178, 188, 189, 197, 203, 239, 253, 254, 256, 258, 259, 260, 261, 262, 263, 264, 265, 267

H. acuminatum: 48, 63, 65, 206, 209, 210, 271

H. angustifolium: 24, 25, 26, 32, 63, 82, 85, 86, 89, 92, 93, 96, 155, 157, 158, 186, 267

H. aurantiacum: 42, 85, 86, 90, 93, 122, 185, 197, 267, 268

***H. aureum*:** 71, **75**, 76, 77, 118, 254, 255, 258, 260, 261, 262, 265, 267

H. barbatum: 122, 216, 271

H. bicornutum: 210

H. calcaratum: 34, 160, 162, 296

H. carneum: 28, 86, 94, 95, 96, 97, 122, 268

H. cernuum: 27, 70, 72, **78**, 80, 81, 260, 261, 262, 265, 266, 267

H. chrysoleucum: 28, 30, 31, 32, 106, 108, 268

H. coccineum: 4, 5, 23, 24, 25, 31, 34, 46, 63, 65, 71, **81**, 85, 86, 87, 89, 92, 93, 97, 114, 121, 122, 168, 186, 253, 255, 256, 257, 258, 262, 265, 267

H. coccineum var. β **:** 95, 120, 216, 268, 271

H. coccineum var***. angustifolium*: 89**, 258, 262, 265, 267

H. coccineum var***. carneum***: 89, **94**, 258, 262, 265, 268

H. coccineum var. *longifolium*: 83, 267

H. coccineum var. *roscoei*: 82, 267

H. coccineum var. *squarrosum*: 83,267

H. coronarium: 4, 5, 21, 22, 23, 24, 25, 30, 31, 32, 42, 43, 44, 45, 46, 47, 61, 62, 63, 67, 69, 74, **98**, 101, 105, 108, 111, 135, 139, 140, 145, 168, 191, 227, 230, 243, 253, 255, 256, 257, 258, 259, 260, 261, 262, 265, 266, 268,

H. coronarium var. γ: 225, 271

H. coronarium var. *angustifolium*: 42

H. coronarium var. ***chrysoleucum***: 105, **106**, 111, 258, 260, 261, 265, 268

H. coronarium var. *elwesii*: 229, 272

H. coronarium var. *flavescens***:** 137, 269

H. coronarium var. *flavum***:** 132, 269

H. coronarium var. *maximum*: 42, 99, 189, 268, 270

H. coronarium var. **No. 1**: 105, **109**, 111, 191, 258, 259, 260, 265, 268

H. coronarium var. *subditum*: 133, 269

H. coronarium var. *urophyllum*: 225, 271

H. coronarium var. *δ*: 189, 270

H. crassifolium: 29

H. deceptum**:** 72, **112**, 113, 114, 115, 255, 261, 262, 265, 268

H. dekianum: 34, 143, 145, 146, 193, 210, 269

H. densiflorum: 5, 46, 63, 71, **116**, 117, 118, 183, 255, 257, 258, 260, 261, 265, 268

H. elatum: 28, 63, 73, 96, 97, **119**, 120, 122, 254, 256, 257, 265, 268, 271

H. elatum var. *β*: 217

H. ellipticum: 23, 62, 63, 73, **123**, 126, 127, 129, 131, 254, 255, 257, 259, 260, 265, 268

H. ellipticum var**.** ***radiatum*****:** **129**, 255, 257, 259, 260, 265, 269

H. elwesii: 30, 65, 114, 228, 230, 231, 271

*H. erythrostemon***:** 77

H. excelsum: 201

H. fastigiatum: 124, 126, 127, 268

H. flavescens: 28, 30, 32, 42, 43, 45, 46, 62, 101, 102, 108, 135, 137, 140, 168, 185, 210, 269

H. flavum: 5, 24, 25, 30, 32, 42, 62, 63, 74, 101, 102, 108, **132**, 134, 135, 136, 138, 139, 140, 143, 225, 227, 256, 257, 258, 261, 265, 269

H. flavum var. ***flavescens*****:** 5, **137**, 143, 253, 255, 258, 262, 265, 269, 297

H. forrestii: 35, 44, 73, **143**, 145, 146, 149, 181, 210, 255, 256, 257, 265, 269

H. forrestii var. *latebracteatum*: 145, 151

H. forrestii var. **No. 1**: 146, **150**, 265, 269

H. forrestii var. ***palaniense***: 35, 70, **147**, 149, 258, 265, 266, 269

H. gardnerianum: 4, 28, 42, 45, 46, 47, 48, 63, 85, 198, 199, 201, 202, 203, 204, 270

H. gardnerianum var. *β*: 196, 270

H. gardnerianum var. *γ*: 82, 85, 90, 267, 268,

H. gardnerianum var. *pallidum*: 199, 270

H. glaucum: 155, 157, 158, 269

H. gomezianum: 63, 73, **152**, 153, 175, 254, 257, 258, 260, 265, 269

H. gracile**:** 24, 25, 26, 32, 42, 63, 73, 118, **154**, 157, 158, 160, 162, 165, 173, 211, 253, 254, 255, 257, 258, 259, 260, 265

H. gracile var. ***calcaratum***: 126, **160**, 163, 253, 255, 257, 258, 260, 261, 265, 269

H. gracile var. *glaucum*: *155, 269*

H. gracile var. **No. 1**: **164**, 255, 257, 258, 259, 260, 265, 270

*H. gracillimum***:** 34, 160, 162, 269

H. gratum**:** 74, **166**, 167, 257, 258, 265, 270

H. greenii**:** 5, 42, 46, 49, 65, 73, 113, 114, **169**, 171, 248, 249, 253, 255, 257, 260, 265, 270

H. griersonianum: 127

H. griffithianum**:** 33, 63, 73, 80, **172,** 175, 255, 257, 258, 260, 265, 270

H. griffithianum var. *glanduligerum*: 173, 175, 270

*H. heteromallum***:** 28, 221, 223, 271

H. hookeri: 71, 118, **176**, 178, 254, 256, 257, 258, 262, 265, 270

H. horsfieldii: 49, 56, 63, 64

H. javoyanum: 154

H. khasianum: 211

H. larsenii**:** 35, 44, 72, **179**, 181, 254, 255, 259, 261, 262, 265, 270

H. longicornutumi: 29, 47

H. longifolium: 83, 86, 96, 267

***H. longipedunculatum*:** 34, 71, **182**, 183, 254, 255, 257, 258, 265, 270

H. luteum: 184, 186, 187, 244, 246, 270

H. marginatum: 73, **184**, 186, 187, 246, 257, 258, 265, 270

***H. maximum*:** 30, 62, 63, 74, 102, 108, **189**, 191, 256, 257, 258, 259, 260, 261, 265, 270

H. neocarneum: 97

H. pallidum: 199, 202, 270

H. pynursulaeanum: 35, 200, 202, 271

H. radiatum: 34, 126, 129, 131, 269

H. raoii: 35, 207, 210, 271

***H. robustum*:** 34, 72, **192**, 210, 254, 255, 257, 259, 265, 270

H. roscoei: 82, 85,86, 267

H. roxburghii: 140

H. rubrum: 34, 112, 114, 268

H. satyanarayanum: 35, 241, 243, 272

H. scaposum: 27, 28, 63

H. sieboldii: 140

H. sino-aureum: 116, 118, 268

H. sirirugsae: 35, 217, 219, 271

Hedychium sp. **No. 1:** 72, **244**, 246, 261, 266, 272

Hedychium sp. **No. 2**: 74, **247**, 249, 266, 272

Hedychium sp. **No. 3**: 74, **249**, 260, 261, 266, 272

H. speciosum: 25, 26, 27, 53,62, 67, 69, 71, 121, **194**, 196, 197, 198, 202, 255, 257, 258, 261, 265, 270

H. speciosum var. ***gardnerianum*:** 45, 102, **199**, 255, 257, 258, 261, 265, 270

***H. spicatum*:** 5, 23, 43, 44, 45, 46, 47, 63, 65, 72, 79, 80, 175, **205**, 209, 210, 211, 212, 249, 251, 252, 253, 254, 256, 257, 258, 260, 261, 262, 265, 266, 271

H. spicatum var. *acuminatum*: 45, 206, 271

H.spicatum var. *khasianum*: 207, 210, 211, 271

H. spicatum var. *trilobum*: 206, 209, 271

H. squarrosum: 82, 86, 267

H. stenopetalum: 28, 31, 72, 97, 122, 162, 181, **216**, 219, 253, 254, 255, 256, 259, 260, 262, 266, 271

H. subditum: 30, 132, 135, 169

H. tavoyanum: 153, 154

H. tenuiflorum: 234, ,237, 238, 239, 272

H. thyrsiforme: 24, 31, 42, 62, 63, 71, **221**, 223, 224, 261, 262, 266, 271

He. trilobum: 206, 209, 210, 271

H. urophyllum: 28, 30, 62, 63, 65, 74, 102, 108, 135, **225**, 227, 228, 230, 231, 243, 256, 258, 260, 261, 266, 271

H. urophyllum var. ***elwesii***: **228**, 258, 260, 261, 266, 271

H. venustum: 27, 32, 33, 45, 48, 63, 78, 80, 81, 175, 207, 267

H. villosum: 25, 42, 45, 63, 70, **231**, 234, 236, 237, 238, 239, 254, 260, 261, 266, 272

H. villosum var. ***tenuiflorum*: 234**, 236, 237, 238, 239, 254, 260, 261, 266, 272

H. viridiflorum: 155, 158, 269

H. wardii: 34, 35, 74, **241**, 243, 244, 260, 266, 272

Heliconia: 22, 51, 52

Heliconiaceae: 1, 31, 34, 48, 56, 58, 59

Heliconieae: 31

Heliconineae: 34, 58, 59

Hellenia: 25, 52, 53, 54

Hellwigia: 56

Hemiorchis: 33, 55, 56, 57

Hippuris: 20

Hippuridaceae: 20

Hitchenia: 29, 33, 35, 54, 55, 57

H. careyana: 1, 35

Hoiriri: 21, 51
Hornstedtia: 52
Hura: 21
Hydrocharides: 50
Hypoxis: 21

K

Kaempferia: 2, 3, 21, 23, 25, 27, 29, 30, 38, 50, 51, 52, 53, 54, 55, 56, 57
K. galanga: 50
K. rotunda: 50
Kaempferiees: 53
Karatas: 21, 51
Katubala: 21, 51
Kolowratia: 54

L

Lantana camara: 203
Larsenianthus: 1, 35, 37
L. careyanus: 1, 35
Leptosolena: 54
Leuconium: 50
Lopezia: 52
Lowiaceae: 1, 31, 34, 48, 49, 56, 58, 59
Lowineae: 34, 58

M

Macrostemium: 28, 30, 54, 56, 63, 64, 187
Mantisees: 53
Mantisia: 1, 25, 33, 53, 55, 56, 57
Maranta: 21, 50, 51, 52, 53
Marantaceae: 1, 20, 28, 29, 31, 34, 49, 54, 55, 56, 58, 59
Maranteae: 29, 55
Mithridatea: 52
Monimiaceae: 52
Monocystis: 54
Monolophus: 27, 54
Musa: 21, 22, 30, 50, 51, 55
Musaceae: 1, 25, 27, 28, 29, 31, 34, 48, 52, 53, 54, 55, 56, 58, 59
Musae: 21, 22, 50, 51
Museae: 29, 55
Musineae: 34, 58
Myrosma: 50, 51

N

Nanochilus: 56
Nyctaginaceae: 20, 50, 52

O

Onagraceae: 52
Orchidarieae: 53
Orchideae: 52
Orchides: 50

P

Pacoseroca: 21, 51
Paracautleya: 1, 35
Parakaempferia: 35
Phrynium: 23, 30, 51, 53, 55
Phylidrum: 51
Pinguin: 21, 51
Plagiostachys: 1, 33, 35
Pommereschea: 48
Pycnonotus jocosus: 203

R

Ralstonia salonacearum: 203
Ravenala: 21, 22, 51
Renealmia: 54, 263
Rhododendron: 9
Rhynchanthus: 48, 55
Rhynchostylis retusa: 118
Riedelia: 56
Roscoea: 25, 29, 48, 52, 53, 54, 55, 57

S

Salicornia: 20, 50
Scaphochlamys: 55, 57
Scitamina: 20
Scitaminaceae: 29, 55
Scitaminae: 55
Scitamineae: 22, 24, 26, 27, 28, 29, 30, 51, 52, 53, 54, 55, 202, 236
Scitaminees: 53
Siphonium: 28, 63

Siphonochileae: 59, 60
Siphonochiloideae: 1, 3, 59, 60
Siphonochilus: 59, 263
Spicatae: 28, 63
Stahlianthus: 1, 35
Staphylococcus aureus: 45
S. epidermis: 45
Strelitziaceae: 1, 31, 34, 48, 49, 56, 58, 59
Strelitzineae: 34, 58
Synorhizae: 23, 51

T

Tamijia: 59
Tamijieae: 59, 60
Tamijioideae: 3, 59, 60
Thalia: 20, 50, 51, 52

U

Ulex europaeus: 203

Z

Zingiber: 2, 3, 21, 23, 25, 33, 50, 51, 52, 53, 54, 55, 56, 57, 58
Z. officinale: 50
Z. zerumbet: 50
Zingibera: 51, 53, 54
Zingiberaceae: 1, 2, 3, 4, 9, 12, 18, 20, 23, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 38, 39, 43, 44, 49, 51, 53, 54, 55, 56, 57, 58 ,59, 60, 175, 181, 256, 257, 263
Zingiberales: 1, 18, 31, 34, 48, 49, 56, 58, 59, 263
Zingiberariae: 34, 58, 59
Zingibereae: 3, 29, 30, 32, 33, 34, 54, 55, 56, 57, 58, 59, 60, 263
Zingiberes: 21, 51
Zingiberineae: 34, 58, 59
Zingiberoideae: 3, 30, 31, 32, 33, 55, 56, 57, 58, 59, 60, 263

APPENDIX

Published papers

1. SABU, M., E. SANOJ AND M.G. PRASANTH KUMAR (2008). *Plagiostachys nicobarica* (Zingiberaceae): New Generic Record and a New Species from Nicobar Islands, India. *Blumea.* 531: 329-334.

2. SABU, M., E. SANOJ AND A. K. PRADEEP (2008). *Alpinia ovoidocarpa* H. Dong & G.J. Xu. (Zingiberaceae): A new record for India. *Acta Botanica Hungarica*. 50(3-4): 391-395.

3. SANOJ, E., V.P. THOMAS, M. SABU AND T. RAJESH KUMAR. (2008). *Stahlianthus involucratus* (King ex Baker) R.M. Smith (Zingiberaceae): A new generic record for India. *Folia Malaysiana*. 9(1): 43-50.

4. THOMAS, V.P., E. SANOJ, M. SABU AND A.V. PRASANTH. (2009). On the identity and occurrence of *Amomum fulviceps* (Zingiberaceae) in India. *Rheedea* 19(1&2): 13-17.

5. SANOJ, E., M. SABU AND T. RAJESH KUMAR. (2010). *Hedychium forrestii* (Zingiberaceae) with a new synonymy and a variety from India. *Journal of the Botanical Research Institute of Texas (Sida).* 4(2): 633-639.

6. KRESS, W.J., J. MOOD, M. SABU, L. PRINCE, S. DEY & E. SANOJ. (2010). *Larsenianthus*, a New Asian Genus of Gingers (Zingiberaceae) with Four Species. *Phytokeys* 1: 15–32.