Etymological histories of all names in *Hedychium* (Zingiberaceae), Part I

Ajith Ashokan [a, b], Vinita Gowda [a]

[a] Tropical Ecology and Evolution (TrEE) Lab, Department of Biological Sciences, Indian Institute of Science Education and Research (IISER) Bhopal, Madhya Pradesh 462066, India. credit for most of the photos. Email: ajithashoksridhar@gmail.com

[b] The Muchhala Lab, Department of Biology, University of Missouri - St. Louis, MO 63121, USA. Email: gowdav@iiserb.ac.in

Abstract

Hedychium (ginger-lilies: Zingiberaceae), a genus that is known for its ornamental value and invasive potential, is undoubtedly one of the most taxonomically challenging groups within the monocot order Zingiberales. Most of the taxonomic confusions in *Hedychium* have been caused due to the presence of several natural hybrids and polyploids that occur throughout the distribution of this genus. A small part of the taxonomic complexity in *Hedychium* is also contributed by the proposal of superfluous names for the same taxa across different geographic areas within the Indo-Malayan Realm resulting in many synonyms that remain understudied. Here is the first part of the article that compiles etymologies of nearly all taxonomic names so far published in the genus *Hedychium* and provide notes on some remarkable instances where the specific and/or varietal epithets complement the description for these taxa.

Keywords: binomial nomenclature, floral characters, ginger-lilies, protologues, synonyms, type localities

Introduction

The common name “lily” usually refers to herbaceous plants that belong to the genus *Lilium* L. (Liliaceae) for their large showy trumpet-shaped flowers and the aroma that they emit (Gledhill 2008). Several other plant groups that are not closely related to *Lilium* are also known as “lilies”, that include cobra-lily (*Darlingtonia californica* Torr.; Sarraceniaceae or *Arisaema speciosum* Mart.; Araceae), mariposa-lily (*Calochortus* Pursh; Liliaceae), peace -lily (*Spathiphyllum* Schott; Araceae), water-lily (multiple genera within Nymphaeaceae), and ginger-lily or butterfly -lilies (*Hedychium* J. Koenig; Zingiberaceae), to name a few. All of these plants are highly valued for their ornamental potential and cultivated across the globe as horticultural favorites.

Ginger-lilies (*Hedychium* J.Koenig) belong to Zingiberaceae, a monocot family known for its great ecological, economic, and ethnobotanical importance (Wood et al. 2000; Sanoj 2011; Ashokan & Gowda 2017). Within Zingiberaceae, *Hedychium* is the only genus that has fragrant flowers, denoted in both its Latin as well as vernacular names (e.g., Suruli Sugandhi [ಸುರುಳಿ ಸುಗಂಧಿ] in Kannada; Kalyana Sougandhikam [കല്യാണ സൗഗന്ധികം] in Malayalam; Vasa Vasanthi [వాసా వాసంతి] in Telugu; https://indiabiodiversity.org/species/show/229897). The generic name *Hedychium* is derived from two Greek words hedys meaning "sweet" and chios meaning "snow" which describe the fragrance and color, respectively, of the type species, *H. coronarium* J.Koenig. *Hedychium* is also known as butterfly-lilies due to its characteristic floral morphology, especially the labellum that resembles expanded lepidopteran wings (butterflies and moths). The first-ever description of the genus *Hedychium* by Johann Gerhard Koenig was based on the Rumphian name *Gandasulum* (erroneously recorded as *Gandasulium* in several instances; Ashokan & Gowda 2019; Ashokan 2020). *Gandasulum* originated from "Gandasuli", Javanese name for *Hedychium* which was derived from ganda (smell or odor) and suli (modified from suri, meaning a woman of queen’s rank). Notably, *Gandasuli* is also the name of a village in Parakan district in the Temanggung regency, Central Java Province, Indonesia, that could also have inspired Rumphius to derive its name (K. Gandhi pers. comm.).

Hedychium (~90 spp; Zingiberaceae) is naturally distributed in the Indian Subcontinent (India, Sri Lanka, Bhutan, Nepal, Bangladesh), Southwest and Southcentral China, and Southeast Asia (Myanmar, Thailand, Lao PDR, Vietnam, Cambodia, Malaysia, Indonesia, and Philippines; Ashokan & Gowda 2020; Ashokan et al. 2022b). More than half of the global *Hedychium* diversity is concentrated in the northeastern states of India (NE India) that are represented by the seven sisters (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura), and a brother (Sikkim; Ashokan & Gowda 2017). Although *Hedychium* distribution is exclusive to the Indo-Malayan Realm (IMR) or Asian Paleotropics, many species such as *H. coronarium* J.Koenig (Fig. 1a), *H. gardnerianum* Sheph. ex Ker Gawl. (Fig. 1b), and *H. flavescens* Carey ex Roscoe have been introduced as ornamentals across all tropical and subtropical regions of the world (Anderson & Gardner 2004; Pereira et al. 2021). Both *H. coronarium* and *H. gardnerianum* (Figs. 1A, 1B) are widely cultivated as ornamentals across the islands of Indian Ocean, Atlantic Ocean, and Pacific Ocean and, in a few instances, they are culturally critical to the customs and festivals of the island inhabitants, especially in the islands of Polynesia and Hawai’i (Minden et al. 2010; Pereira et al. 2021). The *ginger lei,* a garland that is made up of the unopened flower buds of *H. coronarium*, are worn by the women on their weddings and on other special occasions (Brown 1931). Some of these introduced taxa have also escaped into natural ecosystems and may be deemed to be invasive in many countries in the tropical and/or subtropical regions of Africa, America, Australia, and Europe (Anderson & Gardner 2004).

Flowers of *Hedychium* are comparable to those of orchids (Orchidaceae Juss.) because of their highly specialized, flamboyant labellum which represents fused staminodes, reduced petals, and strongly fragrant, bilateral flowers (Ashokan et al. 2022a). Among those who were attracted to *Hedychium* flowers included some of the popular figures in science, especially Charles Darwin, who in his letters to his botanist and zoologist colleagues predicted that *Hedychium* flowers were moth pollinated (Darwin Corre-

Table 1. A comprehensive list of species and varietal epithets, along with their etymology in the genus *Hedychium*.

Sl no.	Epithet	Synonym*	Meaning	Describing	Original publication (Author, Journal, Volume, Page no., Year)
1	*acuminatum*	*H. spicatum* Buch.-Ham. ex Sm.	acuminate	central labellum lobes	Roscoe, Monandr. Pl. Scitam. 1–2: t. 47 (1824)
2	*album*	*H. coronarium* J.Koenig	white-colored	flowers	Buch.-Ham. ex Wall., Hooker's J. Bot. Kew Gard. Misc. 5: 325 (1853)
3	*angustifolium* (Fig. 1E)	None	narrow-leaved	leaves	Roxb., Fl. Ind. 1:11 (1820)
4	*aurantiacum* (Fig. 1D)	None	orange-colored	flowers	Roscoe, Monandr. Pl. Scitam. 5–6: t. 61 (1825)
5	*aureum*	None	golden yellow colored	flowers	C.B.Clarke & G.Mann ex Baker, in Hooker's Fl. Brit. India 6: 229 (1892)
6	*barbatum*	*H. stenopetalum* G.Lodd.	with tufts of hair, bearded	stigma	Wall., Numer. List [Wallich] n. 6544 (1832)
7	*bicornutum*	*H. spicatum* Buch.-Ham. ex Sm.	two horned	anther	Wall., Fl. Brit. India 6: 227 (1892)
8	*biflorum*	None	two flowered	flowers	Sirirugsa & K. Larsen, Nordic J. Bot. 15: 303 (1995)
9	*bijiangense*	*H. gardnerianum* Sheph. ex Ker Gawl.	from Bijiang Xian, NW Yunnan, China	type locality	T.L.Wu & S.J.Chen, Acta Phytotax. Sin. 16: 26–27 (1978)
10	*bipartitum*	*H. flavum* Roxb.	that is divided in two parts	central labellum lobes	G.Z.Li, Guihaia 5: 86–87 (1985)
11	*bolovenioorum*	None	from Plateau de Bolaven, Lao PDR		K.Larsen, Bot. Tidsskr. 61: 71 (1965)
12	*bordeloni-anum*	None	after Mr. Michael W. Bordelon (horticulturist and manager of the National Museum of Natural History Botany Research Greenhouses at the Smithsonian Institution)	plant collector	W.J.Kress & K.J.Williams, Edinb. J. Bot. 60: 43 (2003)
13	*borneense*	None	from Borneo (Sabah, Crocker Range, Sinsuran Road)	type locality	R.M.Sm., Edinb. J. Bot. 47: 372 (1990)
14	*bousigoni-anum*	None	after Commandant Bousigon, an ornithologist in Cochinchina (present day, Vietnam)	biologist	Pierre ex Gagnep., Bull. Soc. Bot. France 51: 457 (1904)
15	*brevicaule*	None	short-stemmed	habit	D.Fang, Acta Phytotax. Sin. 18: 225 (1980)
16	*burttii*	*H. wardii* C.E.C.Fisch.	after Brian Laurence Burtt (Prolific plant taxonomist at Kew and Edinburgh who described 637 species new to science)	botanist	Srivastava S.C. 1984: A Taxonomic Study of Genus Hedychium Koen. (Zingiberaceae) in India and its Vicinity. PhD Thesis, University of Calcutta, West Bengal.
17	*calcaratum*	*H. gracile* Roxb.	spurred (anther)	anther	A.S.Rao & Verma, Bull. Bot. Surv. India 11: 120 (1971)
18	*candidum*	None	shining-white	flowers	Wall. ex Voigt, Hort. Suburb. Calcutt. 570 (1845)

.

Table 1. Continued. A comprehensive list of species and varietal epithets, along with their etymology in the genus *Hedychium*.

19	*carneum* (Fig. 1C)	None	flesh-colored	flowers	G.Lodd., Bot. Cab. 7: t. 693 (1823)
20	*cernuum*	*H. venustum* Wight	drooping, curving forward	inflorescence	Wight, Icon. Pl. Ind. Orient. t. 2011 (1853)
21	*champasakense*	None	from Champasak Province (Bolaven Plateau) in Southern Lao PDR	type locality	Picheans. & Wongsuwan, Taiwania 54: 145 (2009)
22	*chayanianum*	*H. villosum* Wall.	to honor Dr. Chayan Picheansoonthon, fellow of the Royal Institute of Thailand	botanist	Wongsuwan, Taiwania 53: 401 (2008)
23	*chingmeianum*	None	from Chingmei village, Barhong forest reserve, Tuensang district, Nagaland, India	type locality	Odyuo & D.K.Roy, Telopea 20: 194 (2017)
24	*chrysoleucum* (Fig. 1H)	None	golden-yellow (chryso-); white (-leucum)	flowers	Hook., Bot. Mag. 76, pl. 4516 (1850)
25	*coccineum* (Fig. 1F)	None	scarlet-colored	flowers	Buch.-Ham. ex Sm., in Rees, A. Cycl. 17 (1811)
26	*collinum*	None	growing on hills	habitat	Ridl., J. Straits Branch Roy. Asiat. Soc. 32: 103 (1899)
27	*convexum*	None	humped, bulged outwards, convex	labellum	S.Q.Tong, Acta Bot. Yunnan. 8: 41–42 (1986)
28	*coronarium* (Fig. 1A)	None	garlanding, forming a crown	inflorescence	J.Koenig, in Retz., Observ. Bot. 3: 73–74 (1783)
29	---- var. *baimao*	*H. coronarium J.Koenig*	probably, refers to a location in China	type locality	Z.Y.Zhu, Bulletin of the Sichuan School of Chinese Materia Medica 2: 28 (1992)
30	*crassifolium*	*H. longicornutum* Griff. ex Baker	thick or fleshy-leaved	leaves	Baker, in Hooker's Fl. Brit. India 6: 228 (1892)
31	*cylindricum* (Fig. 1G)	None	long and round, cylindrical	inflorescence	Ridl., J. Malayan Branch Roy. Asiat. Soc. 1: 98 (1923)

*Invalid name. Name no longer in use, so it is now a synonym of the current scientific name;

spondence Project 2023). In his letter, Darwin also suspected that the wings of moths would help in pollen transfer and in the eventual pollination of the flower. In *Hedychium*, the floral display is mainly contributed by its sterile stamens or staminodes (central labellum or lip and lateral staminodes), fertile stamen (anther, connective, and filament), floral tube, and petals (dorsal and lateral corolla lobes; Kirchoff 1997; Wood et al. 2000; Ashokan et al. 2022b).

Here, we present a comprehensive list of 162 published names of *Hedychium* spp. from India and SE Asia which includes some of the varietal forms, and synonyms whose phylogenetic positions have been asserted in recent studies (Table 1; Ashokan et al. 2022a, 2022b). We discuss the nomenclatural history for a total of eight *Hedychium* species and briefly discuss their specific epithets and their etymological relevance.

Materials and methods

We examined all available *Hedychium* protologues, including monographs and revisions, spanning from Koenig (1783) to Thomas (2015; a detailed list is provided in Table 1). Herbarium collections, including type specimens, were consulted at various institutions such as ARUN, ASSAM, BHPL, BM, BO, BSA, BSHC, BSI, CAL, E, K, LINN, LIV, MH, QBG, SING, and TBGT. Additionally, we made use of online databases, including the Chinese Virtual Herbarium (https://www.cvh.ac.cn/), Global Plants (https://plants.jstor.org/), Kew Herbarium Catalogue (http://apps.kew.org/herbcat/), Muséum national d'Histoire naturelle (https://science.mnhn.fr/), Smithson-

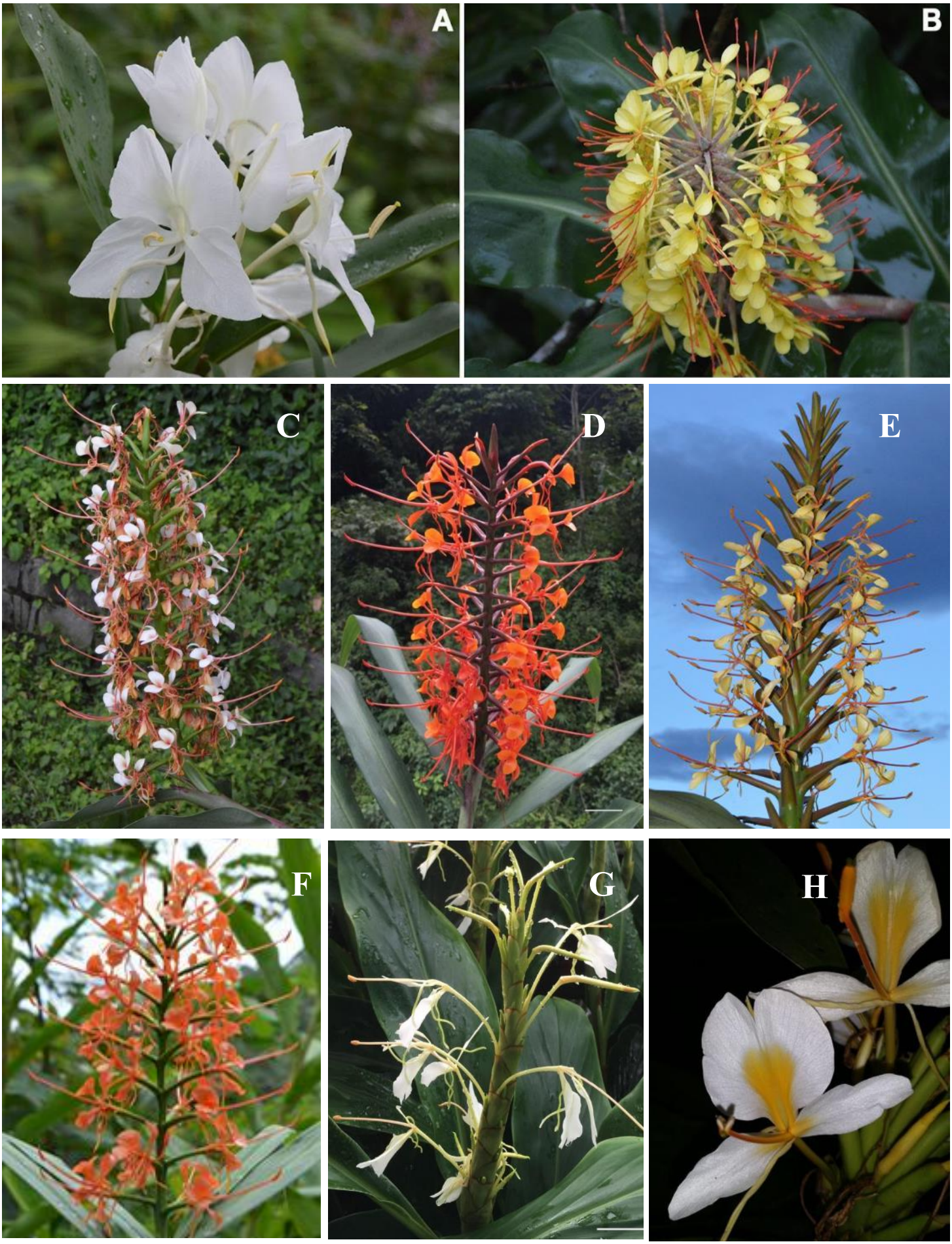

Figure 1A, *H. coronarium* J. Koenig B, *H. gardnerianum* Sheph. Ex Ker Gawl., C, *H. carneum,* D, *H. aurantiacum,* E, *H. angustifolium* F, *H. coccineum* G, *H. cylindricum,* H, *H. chrysoleucum* photo credit Saket Shrotri

ian Institution (https://www.si.edu/), The Linnean Collections (http://linnean-online.org/), and Zingiberaceae Resource Centre (http://padme.rbge.org.uk/ZRC/).

Field collection trips were meticulously planned and carried out in Northeast India over a five-year period, from 2015 to 2019, and continue to this day. The collection of metadata involved the recording of morphological, phenological, and ecological characteristics, as described by Ashokan et al. in 2022a. Morphological measurements were conducted using both traditional rulers and digital calipers. Our collections included dried specimens, spirit samples, and leaf tissues preserved in silica for further research.

Results and discussion

The discovery of a new species of *Hedychium* from the Indian state of Arunachal Pradesh in 2019, enticed us to search for the etymological origins of all species and varietal epithets so far recorded in the genus (Ashokan & Gowda 2019; Table 1). A total of 162 names were validly published in this genus over a period of 240 years (Newman *et al.* 2023; Mou *et al.* 2023; see also Table 1). In our current list (Table 1), we omitted *H. denticulatum* Ridl., *H. lanatum* Scheff., *H. palembanicum* Miq., and *H. scaposum* Nimmo as these species are transferred to other genera such as *Alpinia* [*A. denticulata* (Ridl.) Holttum], *Riedelia* [*R. lanata* K.Schum. ex Valeton], *Nanochilus* [*N. palembanicum* K.Schum.], and *Kaempferia* [*K. scaposa* (Nimmo) Benth. & Hook.f.], respectively. From Table 1, we estimated that nearly 40% (55 synonyms for species and five for varieties) of the proposed names in *Hedychium* are synonyms, making it a nomenclaturally complex genus. In conclusion, we listed a sum of 92 recognized species and two varieties within the genus, with nine invalid names (Table 1).

The nomenclatural categories within the genus can be divided into three types in decreasing order of their value: names that describe floral and inflorescence characteristics, names that honor collectors and botanists, and names that recognize the locality of the collection. Thus far, all major subgeneric classifications of *Hedychium* were based only on floral characters, and clades identified in the first-ever molecular based phylogenetic reconstruction of *Hedychium* were distinguished only on the basis of the number of flowers borne on an inflorescence bract (cincinnus capacity; Wood *et al.* 2000).

Since floral and inflorescence characters are important characters in the taxonomic identity within this genus, in sections 3.1 through 3.5, we discuss some *Hedychium* epithets that are associated with floral traits or names that have unique taxonomic or nomenclatural history within the genus.

3.1. Ellipticum and Cylindricum: two extreme inflorescence shapes in *Hedychium* -The names of species are often derived from the geometry of plant parts, both vegetative and reproductive. The epithet "cylindricum" refers to cylindrical inflorescence shape whereas "ellipticum" refers to elliptical inflorescence shape. In *Hedychium*, the appearance of inflorescence can be either longer than wide or wider than long. *Hedychium cylindricum* has a cylindrical inflorescence that appears more long than wide, whereas *H. ellipticum* has an elliptical inflorescence that is more wide than long. In the last major revision of Scitamineae (now, the order Zingiberales) by Schumann (1904), the appearance of inflorescence was employed as a major character to classify species of *Hedychium*.

Funding

AA acknowledges Council of Scientific and Industrial Research (CSIR) and Science and Engineering Research Board (SERB) for the Senior Research Fellowships, Heliconia Society International (HSI) for the Field Research Grant and Royal Botanic Garden Edinburgh (RBGE) for the Sibbald Trust Grant; VG received funds from SERB, Ministry of Human Resource Development (MHRD), National Geographic Society (NGS), and Department of Biotechnology (DBT) towards this study, and we thank IISER Bhopal for the infrastructure.

Acknowledgments

We thank the respective Indian state forest departments for field research permits- Arunachal Pradesh, Kerala, Manipur, Meghalaya, Mizoram and Nagaland. We also thank the following herbaria and associated botanic gardens- ARUN, ASSAM, BHPL, BM, BO, BSA, BSHC, BSI, CAL, E, HLA, K, LINN, LIV, MH, QBG, SING, and TBGT for letting us access all the specimens in their care. We further extend our sincere gratitude to Dr. Jana Leong-Škorničková (SBG), Dr. Kanchi Gandhi (HUH), Dr. Mark Newman (RBGE), and Dr. Piyakaset Suksathan (QSBG) for their valuable scientific inputs. We express our gratitude for the contributions made by Dr. Colton Collins (Plant Group Hawai'i) during the initial stages of our research on *Hedychium*. Further, we thank Biodiversity Herita Heritage Library (BHL), International Plant Names Index (IPNI), Padme (Zingiberaceae Resource Centre, RBGE), RBGE Herbarium Catalogue, Herbarium Catalogue of Royal Botanic Gardens, Kew for generously hosting information on historical collections of *Hedychium* including protologues and type specimens.

Editor's note. This article, including the continuation of Table 1, will continue in the next issue of the Bulletin.

Literature citations

Anderson R.C. & Gardner D.E. 2004: Battling the fragrant invader: mass production, application, and implementation of biological control for kahili ginger (*Hedychium gardnerianum*).--- In: *XI International Symposium on Biological Control of Weeds*. 471.

Ashokan A. 2020: Phylogenetic systematics, historical biogeography, and character evolution in the taxonomically complex genus *Hedychium* J.Koenig (Zingiberaceae). Doctoral dissertation. Indian Institute of Science Education and Research Bhopal, Madhya Pradesh.

Ashokan A. & Gowda V. 2020: Diversity of the Genus *Hedychium* J.Koenig (Zingiberaceae) in Northeast India- III: Arunachal Pradesh. --- *HSI Bulletin* 26: 1–5.

Ashokan A. & Gowda V. 2019: *Hedychium ziroense* (Zingiberaceae), a new species of ginger lily from Northeast India. --- *PhytoKeys* 117: 73–84. https://doi.org/10.3897/phytokeys.117.24951

Ashokan A. & Gowda V. 2018: Describing terminologies and discussing records: More discoveries of facultative vivipary in the genus *Hedychium* J. Koenig (Zingiberaceae) from Northeast India. --- *PhytoKeys* 96: 21–34. https://doi.org/10.3897/phytokeys.96.23461

Ashokan A. & Gowda V. 2017: Diversity of the genus *Hedychium* J.Koenig (Zingiberaceae) in the Northeast of India- I. --- *HSI Bulletin* 23: 1–11.

Ashokan A., Leong-Škorničková J., Suksathan P., Newman M., Kress W.J. & Gowda, V. 2022a: Floral evolution and pollinator diversification in *Hedychium*: Revisiting Darwin's predictions using an integrative taxonomic approach. --- *Am. J. Bot.* 109: 1410–1427.

Ashokan A., Xavier A., Leong-Škorničková J., Suksathan P., Newman M., Kress W.J. & Gowda, V. 2022b. Himalayan orogeny and monsoon intensification explain species diversification in an endemic ginger (*Hedychium*: Zingiberaceae) from the Indo -Malayan Realm. --- *Mol. Phylogenet. Evol.* 170: 107440.
Brown E.D.W. 1931: Polynesian leis. --- *Am. Anthropol.* 33: 615 –619.

Darwin Correspondence Project 2023: "Letter no. 9372." Website: https://www.darwinproject.ac.uk/letter/DCP-LETT-9372.xml [accessed 28 August, 2023].
Gledhill D. 2008: *The names of plants*. --- Cambridge University Press. London.

Kirchoff B.K. 1997: Inflorescence and flower development in the Hedychieae (Zingiberaceae): *Hedychium*. --- *Canad. J. Bot.* 75: 581–594.

Minden V., Jacobi J.D., Porembski S. & Boehmer H.J. 2010: Effects of invasive alien kahili ginger (*Hedychium gardnerianum*) on native plant species regeneration in a Hawaiian rainforest. --- *Appl. Veg. Sci.* 13: 5–14.

Mou F.J., Zhong Y.C., Hu X. & Wang H.S. 2023: *Hedychium wangmoense* (Zingiberaceae), a new species from southwest Guizhou, China. --- *Ann. Bot. Fenn.* 60: 145–150.

Newman M. *et al.* 2023: Zingiberaceae Resource Centre. Online database available from https://padme.rbge.org.uk/ZRC/

Pereira M.J., Eleutério T., Meirelles M.G. & Vasconcelos H.C. 2021: *Hedychium gardnerianum* Sheph. ex Ker Gawl. from its discovery to its invasive status: a review. --- *Bot. Stud.* 62: 11.

Sanoj E. 2011: *Taxonomic Revision of the Genus Hedychium J. Koenig (Zingiberaceae) in India*. Doctoral dissertation. Kerala: University of Calicut. Retrieved from Shodhganga. http://hdl.handle.net/10603/80898

Sanoj E. & Sabu M. 2015. On the Identity and Typification of *Hedychium deceptum* (Zingiberaceae), an Earlier Name for *H. rubrum*. --- *Novon* 24: 46–49.

Schumann K. 1904: Zingiberaceae. --- In: A. Engler (ed.) *Das Pflanzenreich* 4, 46 (Heft 20): 1–458. Engelmann, Leipzig. https://www.biodiversitylibrary.org/item/56528

Tanaka N., Ohi-Toma T., Aung M.M. & Murata, J. 2016: Systematic notes on the genus *Hedychium* (Zingiberaceae) in Myanmar. --- *Bulletin of the National Museum of Nature and Science. Series B, Botany* 42: 57–66.

Wood T.H., Whitten W.M. & Williams N.H. 2000: Phylogeny of *Hedychium* and related genera (Zingiberaceae) based on ITS sequence data. --- *Edinb. J. Bot.* 57: 261–270. https://doi.org/10.1017/S0960428600000196

Wu T.L., Larsen, K. & Turland N.J. 2000: Four new names in Chinese and Vietnamese Zingiberaceae. --- *Novon* 10: 90–91.

Royal Flora Holland Clock Auction, Aalsmeer, North Holland, the Netherlands is the World's Largest Flower Auction

Here are some impressive facts about the Royal Flora Holland auction.

*90% of Dutch flower sales to countries all over Europe take place at this auction house.

*The Aaalsmeer Flower Auction House is the largest building in the world (the size of 120 football fields).

*On an average day, 43 Million flowers are sold .

*There are 35 auction clocks.

*Over 100,000 transactions take place daily.

*Over 50 countries participate in this auction house.

Here are links to three short videos about the Royal Flora Holland flower auction.

https://www.youtube.com/watch?v=av6VFmMckyw

https://www.youtube.com/watch?v=2CZR6vhMsL4

https://www.youtube.com/watch?v=A