

Conservation of Indian Gingers in the Calicut University Botanical

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The Calicut University Botanical Garden (CUBG) was established in 1971 in the lush green panoramic, undulating, lateritic hummock land of the Calicut University Campus in Kerala state, the southernmost part of India. Now, it has developed into an excellent center of biodiversity and *ex situ* conservation of tropical Indian flora and exotic species.

The garden sprawls over 19.5ha. with a shallow basin encompassed by the sloping terrain except a narrow gap on the southern side where it slides down to a small transitory reservoir, providing diverse habitat and niche for a variety of plants. The central shallow region is provided with a graceful placid pool and an octagonal green house and avenues of royal palms and oil palms. The motorable ring road from the main entrance on the western side touching the medicinal plant house, green house, ginger house, bamboo setum and ginger zone enabling a quick walk through the exquisite and luxuriant vegetation of myriads of hues and fragrance.

Ex situ conservation of the rare, endangered and threatened (RET) plants of south India, Indian gingers, Indian aroids, ferns and medicinal plants are the major thrust area of the garden.

The word 'gingers' refers to the members of the family Zingiberaceae whereas 'ginger' refers to the commercial ginger, *Zingiber officinale* Roscoe. This is a family of medicinal and economic significance that occurs chiefly in the tropical region of the world. The members are generally perennial rhizomatous herbs. The inflorescence is usually a spike or raceme. The flowers are delicate and fleshy so that they wither and form a gummy mass soon after collection, making it difficult to study floral morphology.

The Zingiberaceae form an important group with considerable economic potential, with plants such as *Amomum*, *Curcuma*, *Elettaria*, *Kaempferia*, *Hedychium* and *Zingiber*. Many members of this group have been used in Ayurvedic and other native systems of medicines from time immemorial and some are well known spices or ornamentals.

The family *Zingiberaceae* consist of about 53 genera and about 2000 species, distributed mainly in tropics and subtropics (Kress *et al* 2002). In India, the family is represented by 21 genera and about 200 species. The West coast of South India, Northeast India, Andaman and Nicobar islands are the richest floristic regions of India. These parts have warm and humid climate with heavy rainfall which supports the luxuriant growth of gingers. However, intense human interference during the present century is slowly depleting the vegetation particularly along the ghats giving way to agricultural land and plantation. Studies have shown that a thorough investigation of the floristic wealth of these fertile region is overdue as most of the forests are fast disappearing due to encroachment of man and conversion of it into townships, and agricultural lands or plantations. Moreover, many manmade activities such as over exploitation of rhizomes for medicinal use and food have placed many taxa such as *Kaempferia elegans* Wall., *K. rotunda* L., *Curcuma aromatica* Salisb., *C. angustifolia* Roxb., *C. bhatii* (R.M.Sm.), *Hedychium wardi*, *H. spicatum* Hamilt. *ex Smith Rhynchanthus longiflorus* Hook. f., *Zingiber wightianum* Thwaites, etc. are under severe threat.

The studies on Indian *Zingiberaceae* at the Department of Botany, Calicut University were initiated in 1980. The main objectives of the study include:

- Taxonomic and morphologic studies on the family *Zingiberaceae*, which is considered as taxonomically one of the most difficult families of monocotyledons.
- To develop a gene bank of all Indian gingers including the wild relatives of turmeric, cardamom, ginger etc.
- To carryout other studies such as anatomy, cytology, palynology, embryology, tissue culture, molecular, bioprospecting etc.
- Assessment of the rare, endangered and threatened status of the taxa.
- *Ex situ* conservation of gingers (endemic and endangered) in the CUBG.
- *In situ* conservation of threatened taxa in their natural habitat.
- To develop an herbarium of Indian gingers.
- Organization of awareness campus for teachers, students and farmers.
- To develop a database of Indian gingers.
- To create a website on gingers of India – www.gingersofindia.com.

A project entitled “Additions to the existing Zingiberaceae collections in the CUBG” was sanctioned in 2004 and supported by the Investing in Nature Programme, a partnership between Botanic Gardens Conservation International (BGCI), Earthwatch, HSBC and WWF through the National Botanical Research Institute (NBRI), Lucknow. Though this, the total ginger collection has been raised from 10 genera, 50 species and 400 accessions to 17 genera, 145 species and over 1200 accessions (Plate 1).



"Ginger House" - the largest in India



Curcuma germplasm collections in ginger house



Gingers in natural habitat



Inauguration of One-day Workshop



Field class for farmers, Demonstrating the Budding and grafting in Rose

Plate 1. The Calicut University Botanical Garden (CUBG) collection of gingers and the Workshop on Agri-horticultural Practices supported by the Investing in Nature Programme, a partnership between BGCI, Earthwatch, HSBC and WWF and NBRI.

	Name of Taxa	Sl. No.	Name of Taxa	Sl. No.	Name of Taxa
1	<i>Aframomum</i>	51	<i>C. brog</i>	101	<i>H. Cocci. var angustifolia</i>
2	<i>Alpinia abundiflora</i>	52	<i>C. caesia</i>	102	<i>H. Cocci. var longifolia</i>
3	<i>A. blepharocalyx</i>	53	<i>C. comosa</i>	103	<i>H. coronarium</i>
4	<i>A. calcarata</i>	54	<i>C. coriacea</i>	104	<i>H. ellipticum</i>
5	<i>A. conchigera</i>	55	<i>C. decipiens</i>	105	<i>H. flavescens</i>
6	<i>A. fax</i>	56	<i>C. ecalcarata</i>	106	<i>H. gardnerianum</i>
7	<i>A. galanga</i>	57	<i>C. elata</i>	107	<i>H. gracile</i>
8	<i>A. hypoleucum</i>	58	<i>C. ferruginea</i>	108	<i>H. greenii</i>
9	<i>A. luteocarpa</i>	59	<i>C. haritha</i>	109	<i>H. hypoleucum</i>
10	<i>A. malaccensis</i>	60	<i>C. inodora</i>	110	<i>H. larsenii</i>
11	<i>A. manii</i>	61	<i>C. karnatakensis</i>	111	<i>H. longipedunculatum</i>
12	<i>A. mutica</i>	62	<i>C. latifolia</i>	112	<i>H. rubrum</i>
13	<i>A. nigra</i>	63	<i>C. leucorrhiza</i>	113	<i>H. speciosum</i>
14	<i>A. novalis</i>	64	<i>C. longa</i>	114	<i>H. spicatum</i>
15	<i>A. ovoidocarpa</i>	65	<i>C. malabarica</i>	115	<i>H. Spic. var acuminatum</i>
16	<i>A. purpurata</i>	66	<i>C. mangga</i>	116	<i>H. stenopetalum</i>
17	<i>A. sanderac</i>	67	<i>C. montana</i>	117	<i>H. thyriforme</i>
18	<i>A. smithiae</i>	68	<i>C. mutabilis</i>	118	<i>H. urophyllum</i>
19	<i>Amomum aculeatum</i>	69	<i>C. neilgherensis</i>	119	<i>Heliconia (sexy pink)</i>
20	<i>A. cannaecarpum</i>	70	<i>C. oligantha</i>	120	<i>Kaempferia elegans</i>
21	<i>A. dealbatum</i>	71	<i>C. Oligantha var lutea</i>	121	<i>K. galanga</i>
22	<i>A. ghatium</i>	72	<i>C. parviflora</i>	122	<i>K. maginata</i>
23	<i>A. hypoleucum</i>	73	<i>C. prakasha</i>	123	<i>K. rotunda</i>
24	<i>A. masticatorium</i>	74	<i>C. pseudomonatum</i>	124	<i>K. scaposa</i>
25	<i>A. maximum</i>	75	<i>C. raktakanta</i>	125	<i>K. stamensis</i>
26	<i>A. muricatum</i>	76	<i>C. reclinata</i>	126	<i>Mantisia spatholata</i>
27	<i>A. pterocarpum</i>	77	<i>C. roscoeana</i>	127	<i>Plagiostachys</i>
28	<i>A. subulatum</i>	78	<i>C. rubrobracteata</i>	128	<i>Scaphochlamys kantsleri</i>
29	cv Dzungu Golsey	79	<i>C. soloensis</i>	129	<i>Hitchenia careyana</i>
30	cv Green Golsey	80	<i>C. sulcata</i>	130	<i>H. caulina</i>
31	cv Madhusey	81	<i>C. thalakaveriensis</i>	131	<i>Curcuma capitatum</i>
32	cv Sawney	82	<i>C. thoreli</i>	132	<i>C. cernuum</i>
33	cv Seremna	83	<i>C. vama</i>	133	<i>C. cernuum</i>
34	cv Varlangey	84	<i>C. zanthorrhiza</i>	134	<i>C. ligulatum</i>
35	var Ramsey	85	<i>C. zedoaria</i>	135	<i>C. montanum</i>

Table 1. List of ginger collections in Calicut University Botanical Garden

	Name of Taxa	Sl. No.	Name of Taxa	Sl. No.	Name of Taxa
36	<i>Boesenbergia siphonantha</i>	86	<i>Elettaria cardamomum</i>	136	<i>C. nemmonii</i>
37	<i>B. tiliaefolia</i>	87	<i>Etlingera elatior</i>	137	<i>C. nissanum</i>
38	<i>Costus dubius</i>	88	<i>E. fenzlii</i>	138	<i>C. odoriferum</i>
39	<i>C. erythrophyllus</i>	89	<i>E. fulgens</i>	139	<i>C. officinale</i>
40	<i>C. malartianus</i>	90	<i>E. linguiformis</i>	140	<i>C. ottensi</i>
41	<i>C. pictus</i>	91	<i>Globba expansa</i>	141	<i>C. rubens</i>
42	<i>C. speciosus</i>	92	<i>G. macroclada</i>	142	<i>C. spectabile</i>
43	<i>C. stenophyllus</i>	93	<i>G. marantina</i>	143	<i>C. squarrosum</i>
44	<i>Curcuma aeruginosa</i>	94	<i>G. multiflora</i>	144	<i>C. wightianum</i>
45	<i>C. alismatifolia</i>	95	<i>G. orixensis</i>	145	<i>C. zerumbet</i>
46	<i>C. amada</i>	96	<i>G. pauciflora</i>		
47	<i>C. amarissima</i>	97	<i>G. racemosa</i>		
48	<i>C. angustifolia</i>	98	<i>G. schomburgkii</i>		
49	<i>C. aromatica</i>	99	<i>Hedychium chrysoleucum</i>		
50	<i>C. bhatii</i>	100	<i>H. coccineum</i>		

Table 1 (cont.). List of ginger collections in Calicut University Botanical Garden

This from the largest live gene bank of Indian gingers. The ginger garden has been designed to show case the diversity of Indian gingers along with ginger relatives from the tropical region of the world. A number of exotic taxa from Thailand, Malaysia, Singapore, Sri Lanka are also grown in the ginger garden.

Recent studies have revealed that one monotypic genus, *Parakaempferia* and 75 species are endemic to India. Many of them are rare or threatened and deserves special attention for their conservation. The species targeted for conservation and propagation include *Curcuma angustifolia* Roxb., *C. vamana* M. Sabu & Mangaly, *C. bhatii*, *Boesenbergia siphonantha* (Baker) Sabu *et al.*, *Amomum fenzlii* (S. Kurz) K. Schum., *Plagiostachys sp.*, *B. albolutea* (Baker) Schlechter, *Rhynchanthus longiflorus* Hook. f., *C. mutabilis* Skornickova *et al.*, *C. rubrobracteata* Skornickova *et al.*, *Hedychium greeni* W.W. Smith, *H. rubrum* A.S.Rao & D.M.Verma, *Kaempferia scaposa* (Nommo) Benth., *Zingiber wightianum*, *Hemiorchis rhodorrhachis* etc. of which, *C. vamana*, *C. bhatii*, *Rhynchanthus longiflorus* Thw., *Hemiorchis rhodorrhachis* K. Schum., were selected for reintroduction in the field due to their severe threat in nature (Plate 2).



Plate 2. A. *Cucuma bhatia* (R.M. Sm.) Skornickova & M. Sabu; B. *Curcuma vama* M. Sabu & Angaly; C. *Kaempferia scaposa* (Nimmo) Benth.; D. *Rhynchanthus longiflorus* Hook. F.; *Hedychium eeni* W.W. Sm.; F. *Hedychium rubrum* A.S. Rao & Rao & D.M. Verma; G. *Curcuma rubrobracteata* Skornickova et al.; H. *Curcuma mutabilis* Skornickova et al.

As a part of conservation, a minimum 5 accessions of each species were grown in pots or in the field. Those targeted for *in situ* conservation about 150-200 accessions were grown with utmost care in the CUBG. After a growth of one year they were transplanted to their natural habitat. This directly support the conservation of the target species, and to establish one or more self sustaining populations capable of surviving both short and long

term. About 50% survival is noticed in the care of *in situ* conservation. The guidelines suggested by Valle *et al.* (2004) is followed for *in situ* conservation of gingers. We are also planning to multiply the highly endangered species through micropropagation. During the course of study, 8 new species, 3 new combinations, one new generic record and several new species records for India were established. One book entitled “Zingiberaceae and Costaceae of South India was also published (Sabu, 2006) (Plate 3).



Plate 3. A. *Alpinia ovoidcarpa* H. Dong & G.J. Xu; B. *A. abundiflora* B.L. Burrt & R.M.Smith; C. *Amomum masticatorium* Thw.; D. *A. subulatum* Roxb.; E. *Boesenbergia siphonantha* (Baker) M. Sabu *et al.*; F. *Curcuma karnatakensis* Amalraj *et al.*; G. *C. angustifolia* Roxb.

Importance of gingers

Spices: The important spices include *Elettaria cardamomum* (L.) Maton, *Amomum subulatum* Roxb., (Large cardamom), *Curcuma* spp; *Boesenbergia* sp., *Zingiber* spp. etc. *Elettaria cardamomum* (L.) Maton, is far more important economically than others and constitutes the second most important ‘national spice’ of India and is known as ‘Queen of spices’ and it forms one of the most valuable crops of South India. In India, state of Kerala has the largest area under cardamom cultivation. *Zingiber officinale* also constitute one of the five most important major spices of India. *Curcuma longa* L. is another very important spice of India and a traditional item of export from ancient times. Large cardamom (*Amomum subulatum*.) is an other important spice crop of Northeast India with many uses.

Food: Many members are used raw or cooked. The East Indian arrowroot or Travancore starch prepared from *Curcuma aeruginosa* Roxb., *C. haritha* Mangaly & M. Sabu, *C. zanthorrhiza* Roxb. is used for the preparation of various dishes.

Medicinal gingers: The important medicinal gingers include *Alpinia galangal* (L.) Sw., *A. calcarata* Roscoe., *Curcuma longa*, *C. aeruginosa*, *C. caesia* Roxb., *Elettaria cardamomum*, *Hedychium spicatum*, *Kaempferia galanga* L., *K. rotunda*, *Zingiber officinale*, *Z. zerumbet* (L.) Smith, etc.

Ornamental gingers: The gingers are relatively new as ornamentals or landscape plants. They are mostly plants with attractive foliage, showy inflorescence and often brightly coloured branch and floral bracts. Some varieties have fragrant flowers and others have spicy foliage. More than 250 species are cultivated as ornamentals throughout India.

- The leaves exhibit shades of light to dark green colour or white. Some are flushed with purple or silver underwath (*Amomum* spp., *Alpinia* spp., *Kaempferia* spp. etc.). These make them commercially popular as foliage plants. The attractive inflorescence of some species are widely used as cut flowers.
- Though a few ornamental gingers are cultivated in India, a wide range of species with ornamental potential are present in the wild. Many endemic taxa of the genera such as *Alpinia* (2), *Amomum* (2), *Cautleya* (2), *Curcuma* (9), *Etingera* (2), *Globba* (3), *Hedychium* (20), *Hitchenia* (2), *Kaempferia* (1), *Mantisia* (1), *Rhynchanthus* (1), *Roscoea* (1) and *Zingiber* (4) are of great ornamental value. Present study also aims domestication improvement and development of agrotechniques of these wild potential ornamental gingers. The important group of ornamental gingers include: *Alpinias* (shell gingers), *Curcumas* (hidden gingers), *Etingeras* (torch gingers), *Globbas* (dancing ladies), *Hedychiums* (butterfly gingers), *Kaempferias* (peacock gingers) and *Zingibers* (Plate 4).
- Excepting a few, a majority of the members are recommended for tropical climate. However, *Cautleya* and *Roscoea* are well suited for temperate climates. It is estimated that about 59 species of wild Indian gingers apart from commonly cultivated species can be domesticated for ornamental purpose.



Plate 4. *Amomum fenzlii* (S. Kurz) K. Schum.; B. *Globba schomburgkii* Hook. F.; C. *Hedychium coccineum* Buch-Ham ex Sm.; D. *H. spicatum* var. *acuminatum* (Roscoe) Wall.; E. *Alpinia manii* King ex Baker; F. *Costus pictus* D.Don; G. *Zingiber neesatum* (J. Graham.) Ramamoorthy; H. *Z. capitatum* Roxb.

Cultural practices and ritual: Many taxa especially turmeric plays an important role in the cultural practices and religious ceremonies of Hindus throughout India.

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