BULLETIN

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A few hybrid *Heliconia* in Western Colombia

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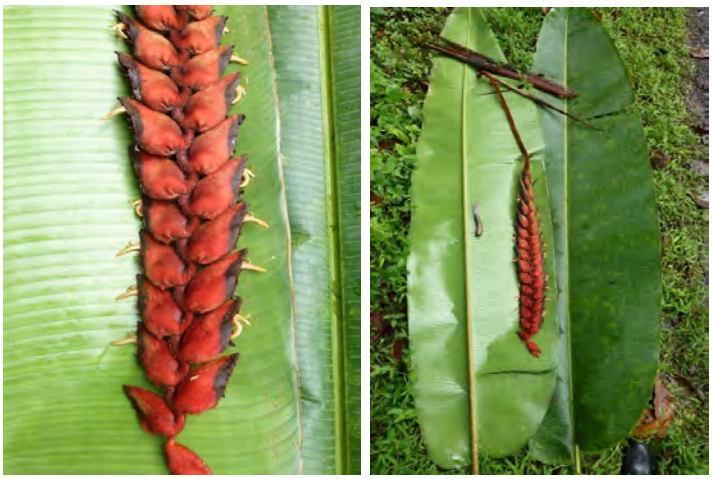
Travelling last July in the Cordillera Occidental of Colombia with Carla Black and Angel Rodriguez we came across a few plants that appear to be hybrids. It was also interesting to see the same hybrid combinations in different locations, suggesting the hummingbird pollinators are busy spreading pollen into unsuspecting flowers. If these resultant individuals were fertile it would help explain the rapid speciation and diversity of *Heliconia* in Colombia.



Images of *H. rhodantha* x *H. nigrapraefixa*

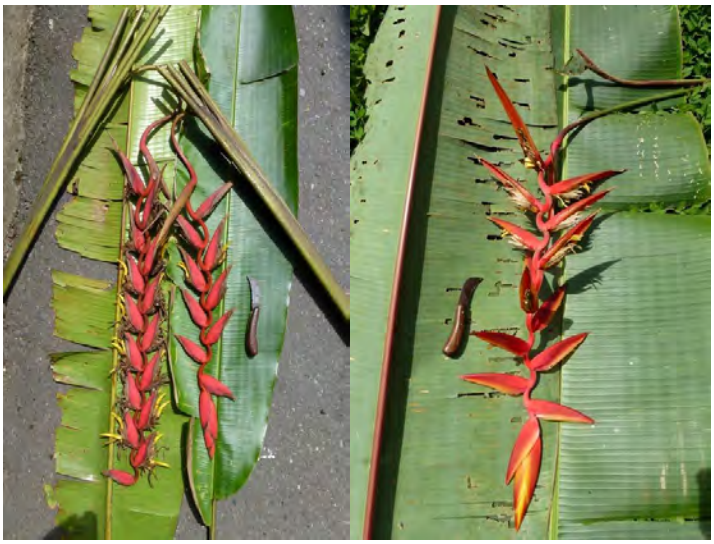
The first plant spotted that we hadn't seen before was what appeared to be *H. nigripraefixa* x *rhodantha*, growing on the old Cali – Buenaventura road below El Danubio in Valle de Cauca. It shared the large asymmetrical leaf blade of *H. rhodantha* - a good identification character as you are speeding along through the Anchicaya. The inflorescence was slightly spiral from the *H. nigripraefixa* side of the cross. Interestingly the flowers were a pinkish-orange, pretty much what you would expect from a hybrid of red- and orange-flowered parents.

H. rhodantha x *H. nigrapraefixa*

The next plant was growing on the ridge on the Apía to Pueblo Rico road in Risaralda. When Carla and I were on the same road in 2011 we saw the same thing just on the other side of the ridge. This replication of hybrids is something I hadn't come across before. This plant appears to be a result of *H. huilensis* and *H. combinata*. This plant was fertile, and Carla has a handful of seedlings coming along.

Continuing over the ridge towards Pueblo Rico we revisited a plant we saw in 2011 that appears to be *H. griggsiana* x *combinata* - surely one of the prettiest hybrids I have seen. It could have huge ornamental potential, although the enormous size of the plant would preclude it from small gardens. We also saw this hybrid growing much farther north on the El Carmen – Quibdó road, on the border of Choco and Antioquia departments. In 2012 I saw a plant in this region at a distance across the Rio Atrato that was too far away to photograph, but through the binoculars it was obviously something quite different to everything else locally. My curiosity was partially satisfied last year when I spotted something as we were coming back up the hill from the Rio Atrato and heading back to our lodgings in Ciudad Bolivar. It was the same hybrid combination of *H. griggsiana* x *combinata*, now growing on the northern side of the Rio Atrato.

Colombia continues to be full of surprises, and I look forward to what I'll see on my next trip.



H. rhodantha x *H. nigrapraefixa* at left,
and *H. griggsiana* x *combinata* at right

Growing heliconia for cut flowers in Holland in greenhouses

By Peter van Luijk (now living in Jogjakarta, Indonesia)
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My history with heliconias in Holland

More than 30 years ago it seems that my uncle purchased some heliconia rhizomes but nobody knows anymore where they came from. After several years his nursery was bought for building houses so my brother bought some of the plants to put in a small part of his greenhouse which was heated very well, including the soil. He grew the heliconias for more than a year but none produced flowers, except for one small variety. He took only a few plants from our uncle, because they were so small and did not look very promising. That was *H. stricta* 'Dwarf Jamaican' and after several years it filled an area of approximately 1000 square meters.

In 1986 he renewed his greenhouse and also increased his heliconia planting with another 1000 square meters. Later he started to make trials in large containers with peat and drip irrigation because in the past he was a sweet pepper grower with all equipment for growing in soilless culture.

The other part of the greenhouse of the total of 1 ha was with strelitzias in large containers, watered via drip irrigation. Over the years he took out some strelitzias and

Starting container culture of heliconia

planted heliconias in containers but they didn't do too well. Later we found that the substrate and fertilizers had to be different from what he was used to.

In 1996 another of my brothers took over the nursery and ran it for 10 years, at which time he sold all the plants to another grower and the land to the neighbour.

The Purpose of HSI

The purpose of HSI is to increase the enjoyment and understanding of *Heliconia* (Heliconiaceae) and related plants (in the families Cannaceae, Costaceae, Lowiaceae, Marantaceae, Musaceae, Strelitziaceae, and Zingiberaceae) of the order Zingerberales through education, research and communication. Interest in Zingiberales and information on the cultivation and botany of these plants is rapidly increasing. HSI will centralize this information and distribute it to members.

The **HELICONIA SOCIETY INTERNATIONAL**, a nonprofit corporation, was formed in 1985 because of rapidly developing interest around the world in these plants and their close relatives. We are composed of dues-paying members. Our officers and all participants are volunteers. Everyone is welcome to join and participate. HSI conducts a Biennial Meeting and International Conference.

Membership dues are (in $US): Individual $40, Family $45, PDF $25, Student $10, Contributing $50, Corporate $100, Sustaining $500, Lifetime Member $1000. Membership fees constitute annual dues from 1 July through 30 June. All members receive the BULLETIN (usually published quarterly) and special announcements. Join or renew your membership at www.heliconia.org.

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Website: www.heliconia.org

I bought some heliconia plants in 1997 from a grower in Aalsmeer and started my own nursery of 6000 square meters. However, I sold the land in 2007 to the neighbour who wanted to enlarge his nursery. So at that time I joined with another grower who stopped growing sweet peppers and moved all the heliconias to his nursery where we produced flowers for 2 years.

Glasshouse culture of heliconia

About that time the economic crisis in Europe started and also energy costs went up a lot. Labour costs were already very expensive, so we decided to quit. In those years several of the total of seven heliconia growers quit production and now there is only one commercial grower left, with a few that still grow some heliconias as a hobby.

Growing conditions

The conditions in a greenhouse all year round are different from those in nature. They must be heated most of the year and that makes it also very expensive. The humidity must be high enough, but too much humidity is also a big problem, especially in winter. The plants must be in active growth each day, otherwise the plant stops growing which results immediately in dying of the stems inside. So sometimes we had to open the windows even when it was cold outside to lower humidity.

Then the light levels in summer are very high because of 16 hours of daylight but in winter we only have 8-9 hours with also very low light intensity. The growing period of heliconia starts in March and April and we harvested inflorescences from October through March. But because everything was growing so well in summer we actually had too many stems in winter. This was a problem for quality: The stems were long and thin and the colour was not bright enough. Only after harvesting 50% we got better quality again. In fact, not enough light reached inside the plant so we also cut 2/3 of each leaf every month, not cutting the petiole to avoid problems with fungus.

We used drip irrigation and the water was always mixed with fertilizer. We did monthly monitoring of the fertilizer in the cocopeat in the containers to see if we had to change things. In the vegetative period we gave more sodium nitrate and later we lowered that and increased potassium nitrate. The pH levels were normally between 5 and 6.

Sometimes we had problems with diseases such as *Phytophthora* and *Pythium*, as well as insects. We tried to work with biological controls but in the end we had to change to chemical pest control. The last year, however, we had *Fusarium* on a larger scale which also made the decision to quit easier. We had had *Fusarium* for several years, but we could control it. But with my new partner things changed and working without cleaning the greenhouse every week of leaves and other debris made it worse. So at the end 30% of our plants were infected.

Dutch container culture of heliconia

Tests of varieties, substrates and spacing
We also made trials with other heliconia varieties such *H. latispatha* which I took to Holland from Indonesia. In Indonesia it was growing well in full sunlight and the stems were approximately 70-80 cm high. But in Holland with low light levels we got stem lengths up to 2,5 m. The same thing happened with *H. rostrata* and both of these only produced 10-12 stems per square meter.

In the past we could buy tissue culture (TC) plants of 'Dwarf Jamaican' from the US. They also had *H. angusta* 'Red Christmas' and I planted 500 square meters of these. These also grew to at least 2 m, but the production was up to 20 stems per square meter and had a reasonable price. However the 'Dwarf Jamaican' was the best. Production was good, but depended on many circumstances and was different every year. At the end we had trials where we produced 60 stems per square meter but the quality was not 100%. The total turnover per square meter was of course very high with such a production, but the lower quality (long thin stems and pale colour) was not desirable.

Substrate research
We compared several substrates and a mix.
1 – Cocopeat
2 – Coarse perlite
3 – Chopped coconut husk
4 – Mix of 50% cocopeat and 50% coarse perlite

We used a pot size of 24 cm diameter with a volume of approximately 25 liters.

	Weight dry	Weight soaked	Water held after 24 hr draining
1 –	7.200 gr	13.100 gr	5,9 liter
2 –	3.900 gr	9.400 gr	5,5 liter
3 –	Inadequate for heliconia (good for orchids)		
4 –	5.900 gr	11.700 gr.	5,8 liter

After wetting the substrates a few more times we looked at the speed of draining. This was prior to planting with heliconias in the pots; with roots drainspeed will be slower. All three substrates got 1 litre of water. After 30 minutes, #1 was drained out 90%; #2 was 60% and #4 was 80% drained. After 1 hour #1 was drained out 100%, while #2 was only 70% and #4 was 90% drained.

Conclusion
In fact the mix #4 is the best because in the long term the structure will remain almost the same, while with 100% cocopeat after several years the structure might be a little less open. But to make a mixture is more work, and when you're done using it, it might be more difficult to dispose the material, at least in some countries. Therefore we use cocopeat, and we use only good coarse quality, because with too much fine material the oxygen content in the substrate will be too low. The drainspeed is the highest which also means we have to irrigate more frequently, especially in our summer time.

Yield of 'Dwarf Jamaican' with different plant densities
A is 34 m long and with 66 plants on a row.
B is 34 m long and with 84 plants on a row.

Two rows of each were counted, which is an area of 55 square meters.

Results	Inflorescence production	
Date of harvest	A	B
31-8-1999	31	23
21-9	46	32
5-10	92	64
22-10	94	83
4-11	68	78
19-11	108	96
2-12	112	98
16-12	121	156
5-1-2000	156	201
21-1	188	177
7-2	288	302
22-2	305	254
10-3	364	417
28-3	180	218
Total	2155	2202
	= 38,5 / m^2	= 39,3 / m^2

Conclusion
Plants need enough space and light, so increasing the numbers per square meter can cause problems and actually lower production. Tight spacing can cause disease problems such as fungus because the air circulation is bad and the leaves don't dry properly in the morning. Also the temperature can be too low inside the plants between the leaves, even when the temperature above the leaves appears to be good.

Young Plants
In the first years we had some poor plants so we took the best plants and divided and replanted them. From one container full with rhizomes we could plant at least five containers.

Later after some search on the internet I found a company in the USA that multiplied the 'Dwarf Jamaican' by TC (tissue culture). So I bought those and also some 'Red Christmas' and that was very good. Already in the first year we got a production of approximately 30 flowers per square meter.

We also noticed that the plants would not stay healthy for many years so the idea was to change 20% of the pots every year and keep production and quality on a good level. Just take out all the bad plants, along with some others, and replace them with new TC plants. That worked very nicely but then they had problems in the TC lab and the man in charge left, so the knowledge for heliconia was gone. They still managed to deliver some plants later but it was not so good.

Later I found a lab in Thailand with experience in heliconia and they produced some for us in 2008. We planted two young TC plants in one container and later in the larger containers of 85 liters we put four plants. They immediately got drip irrigation, but because those plants were still small with almost no roots, we also watered three times a week by hand. After just one month those plants started making new stems and all flowered within a year.

Production results
The production of flowers in general was quite good but with too many flowers the quality went down because most flowers were harvested in winter with low light levels.

The production varied a little each year, mainly due to the weather situation outside. When light levels were low the growth and the number of stems could be less but in general that was not the problem. Because growth was in springtime and summer, sometimes the number of stems was actually too high and that caused problems in quality later. So we tried to start harvesting in October in order to get stems out early in the season.

The total production varied between 36/m^2 up to 45/m^2 although we had special trials where production went up to 60 stems/m^2.

The average prices were quite good in the beginning in the late 1990s but went down a little every year, so in 2009 we were getting only €0,95/stem while 5-8 years before that was €1,28/stem. Perhaps our price also went down because of the lower quality with such a high plant density.

After harvesting we sometimes still had many empty stems with a black and dead flower inside. It was difficult to find the ideal quantity of stems and it was not possible to cut away stems at the base because of potential diseases that come into the plant when stems are cut too short.

Future
The future of heliconia in Holland is not good and only one or two growers will survive. All the larger heliconia varieties have been imported for a long time from countries such as Surinam, Costa Rica and Colombia, but also the smaller varieties such as 'Dwarf Jamaican' will be grown in other countries such as those and Ghana. There are no heating bills and labour costs are low. They will have other problems with diseases on plants grown outdoors of course, but heliconia as a cut flower is still profitable in tropical countries.

For any question or discussion you can contact me by e-mail: ppeval@hotmail.com

Heliconia stricta 'Dwarf Jamaican'

From my side I have one question:
I am still working on growing heliconia as a pot plant for using indoors. The flowers must be visible in a good way and the plants can't be too tall. Perhaps some of you already have experience and can advise me about what varieties can best be used for this, and how to grow heliconia as a pot plant in the best way.

Evaluation of Costaceae species for ornamental use.

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This report is condensed from a longer scientific article that appeared in Rev. Brasil Hort. Ornamental 17(1): 63-74 (2011).

The aim of this work was to measure and evaluate morphological and agronomic characteristics of 12 Costaceae species from the Instituto Agronomico de Campinas (IAC) Ornamentals Zingiberales Germplasm Bank. For morphological characterization 28 characters were used, and the inflorescence was evaluated for post-harvest longevity. After characterization, this work indicated Costaceae species for ornamental purposes such as cut flower, cut stem, pot plant, and landscape design. Under field conditions, 10 one-year-old plants of the following species were installed and evaluated: *Costus lasius* Loes., *C. productus* Mass, *C. malortieanus* Wendl., *C. pictus* D. Don., *C. arabicus* L., *C. arabicus* L. *variegata, C. stenophyllus* Standley & Williams, *C. pulverulentus* Pressl., *C. comosus* (Jacquin.) Roscoe var *bakeri* (K. Schumann Maas, *C. scaber* Ruiz & Pavon, *Cheilocostus speciosus* (Koenig) J.E.Smith *variegata* and *Dimerocostus strobilaceus* Kuntze. Indicated species for landscape design are: *C. lasius, C. productus, C. malortieanus, C. pictus, C. arabicus variegata, C. stenophyllus, C. pulverulentus, C. comosus* var. *bakeri, Cheilocostus speciosus variegata,* and *Dimerocostus strobilaceus.* Appropriate species for potted plants: *C. lasius, C. productus, C. malortieanus* and *C. arabicus variegata. C. pictus, C. stenophyllus, Cheilocostus speciosus variegata* and *Dimerocostus strobilaceus* can be used in the landscape and in large pots. For cut flowers the following may be used: *C. lasius, C. productus, C. arabicus,C. stenophyllus, C. comosus* var.*bakeri, C. scaber, Cheilocostus speciosus variegata,* and *D. strobilaceus. C. stenophyllus, C. pictus, Cheilocostus speciosus variegata,* and *Dimerocostus strobilaceus* could be commercialized as cut stems.

Costus arabicus, A. inflorescence B. Overview of plant

Table 1. General characteristics of in-ground plants of Costaceae species. Means of 10 plants.

Species	Height (M)	Habit	Inflorescences per plant (No.)	Stems per plant (No.)
Costus lasius	0.67 – 0.7	Spreading	High	> 40
Costus productus	0.97 – 1.0	Spreading	High	28-37
Costus malortieanus	0.59 – 1.32	Spreading	Medium	5-7
Costus pictus	1.3 – 2.0	Upright	Medium	18-40
Costus arabicus var *variegata*	0.32 – 0.58	Spreading	Medium	4-8
Costus arabicus	1.0 – 1.6	Upright	Low	3-5
Costus stenophyllus	1.73 – 2.1	Upright	Low	19-22
Costus pulverulentus	1.38 – 1.96	Upright	Medium	7-11
Costus comosus var *bakeri*	1.2 – 1.88	Dense-upright	Low	7-8
Costus scaber	1.4 – 2.0	Upright	Low	5-8
Cheilocostus speciosus variegata	1.53 – 1.92	Dense-upright	Medium to high	11-25
Dimerocostus strobilaceus	*2.6 – 3.5*	Upright	High	15-19

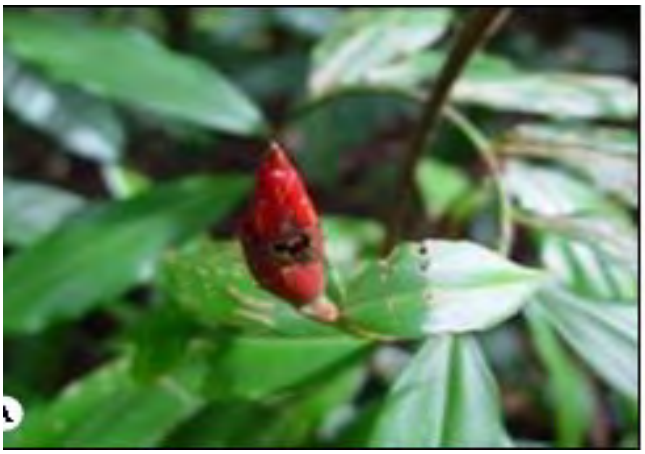
Table 2. Characteristics of inflorescences of Costaceae species

	Position on stem	Shape	Size (cm) Length	Diameter	Character of bracts	Bract color	Flower color
Costus lasius	Terminal	Ovoid - Fusiforme	6.5-7.0	2.0-2.5	Tightly overlapping	Yellow	Yellow
Costus productus	Terminal	Wine-glass	5.0-9.0	2.3-4.5	Loose	Orange to Red	Orange
Costus malortieanus	Terminal	Globose	7.5-12.0	3.5-4.0	Tightly overlapping	Green	(1)
Costus pictus	Terminal & basal	Globose	10.0-15.0	3.0-3.3	Tightly overlapping	Green	(2)
Costus arabicus var. *variegata*	Terminal	Ovoid - Fusiforme	3.0-8.0	3.0-4.0	Tightly overlapping	Green	(3)
Costus arabicus	Terminal	Ovoid – Fusiforme	7.0-12.0	3.0-6.0	Tightly overlapping	Green	(4)
Costus stenophyllus	Basal	Fusiforme	10.0-14.0	2.0-3.0	Tightly overlapping	Orange to Red	Yellow
Costus pulverulentus	Terminal	Fusiforme	6.0-7.5	2.3-2.7	Tightly overlapping	Red	(5)
Costus comosus var. *bakeri*	Terminal	Fusiforme	6.0-15.0	4.5-5.5	Tightly overlapping but open on top	Orange to Red	Yellow
Costus scaber	Terminal	Fusiforme	10.0-14.0	2.5-4.0	Tightly overlapping	Orange to Red	(6)
Cheilocostus speciosus variegata	Terminal	Ovoid - Fusiforme	4.5-16.0	2.4-6.0	Tightly overlapping	Purple	(7)
Dimerocostus strobilaceus	Terminal	Fusiforme -Ovoid	18.0-30.0	4.0-6.0	Loose overlapping	Grayish maroon	White

(1) Yellowish pink with red stripes inside and yellow flabellum.
(2) Cream to yellow with reddish labellum.
(3) White with yellow stripes on labellum.
(4) White with pink or green.
(5) Red orange
(6) Orange to red.
(7) White with yellow center.

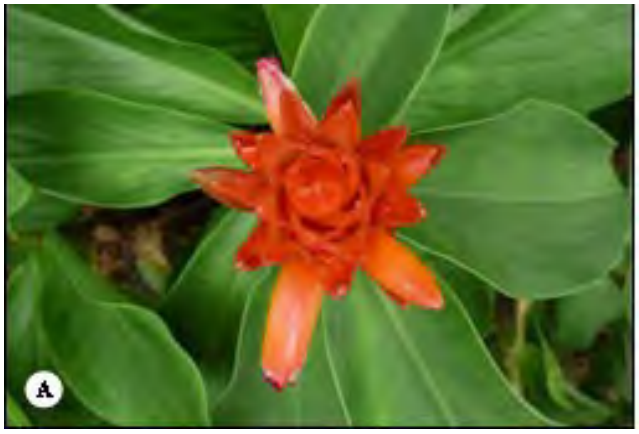
Table 3. Flowering and post-harvest characteristics of Costaceae species.

	Duration of flowering period	Season (Brasil)	Persistence of true flowers on infloresence	Inflorescence requires cleaning?	Inflorescence keeping quality
Costus lasius	Long	Aug-Feb	No	No	Long
Costus productus	Long	Aug.-May	No	No	Long
Costus malortieanus	Long	Aug.-May	Yes	Yes	Short
Costus pictus	Medium	Sep.-Nov.	No	No	Short
Costus arabicus var. *variegata*	Short	Sep.-Nov.	No	No	Short
Costus arabicus	Medium	Aug.-Feb.	No	No	Medium
Costus stenophyllus	Long	Aug.-Dec.	No	No	Medium
Costus pulverulentus	Long	June-Feb.	No	No	Long
Costus comosus var. *bakeri*	Long	Sep.-June	No	No	Long
Costus scaber	Medium	Sep.-Mar.	No	No	Long
Cheilocostus speciosus variegata	Long	Sep.-May	No	No	Long
Dimerocostus strobilaceus	Medium	Sep.-Dec.	No	No	Medium

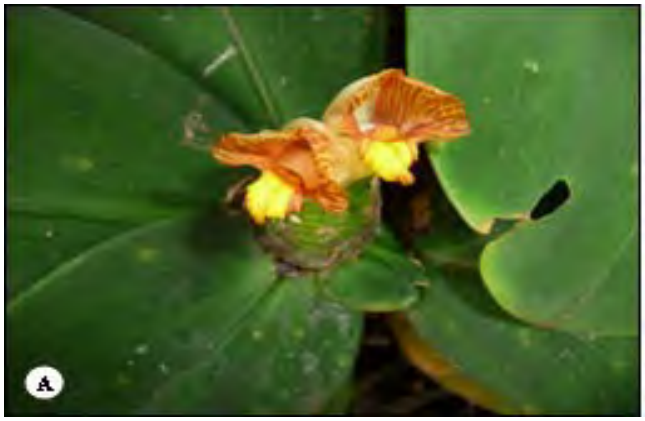


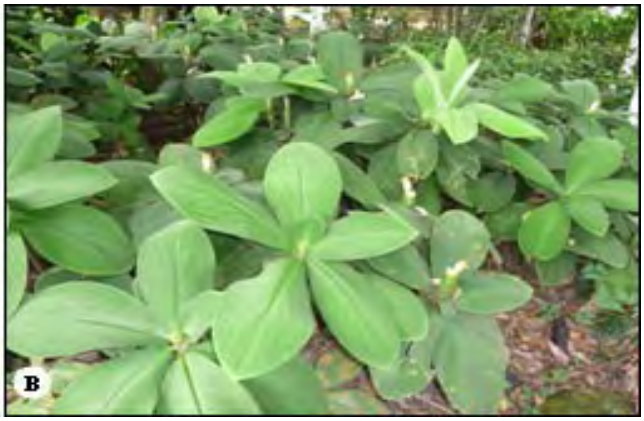
Costus scaber A. overview of plant B. inflorescence

Costus lasius A. inflorescence B. general aspect of plant



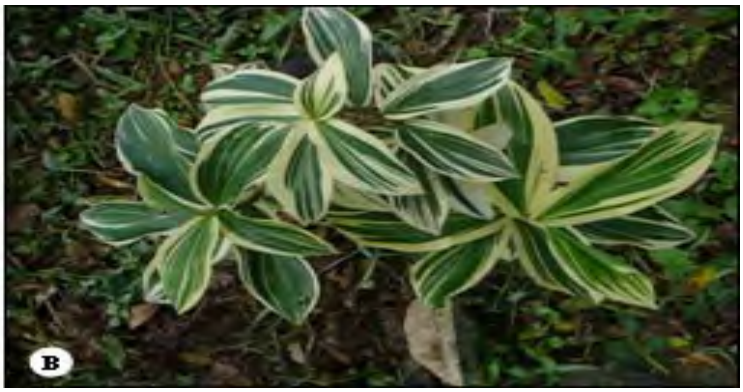
Costus productus A. inflorescence B. general aspect of plant





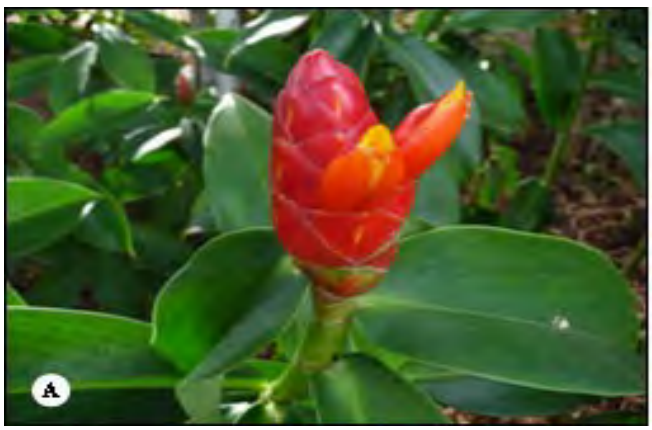
Costus malortieanus A. inflorescence B. general aspect of plant

Costus pictus A. inflorescence B. general aspect of plant



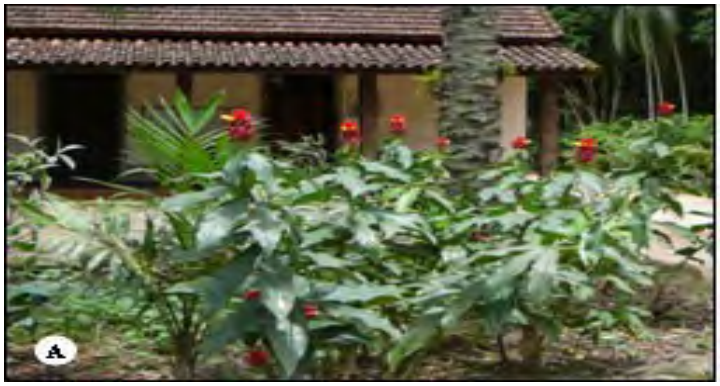
Costus arabicus variegata A. inflorescence B. general aspect of plant

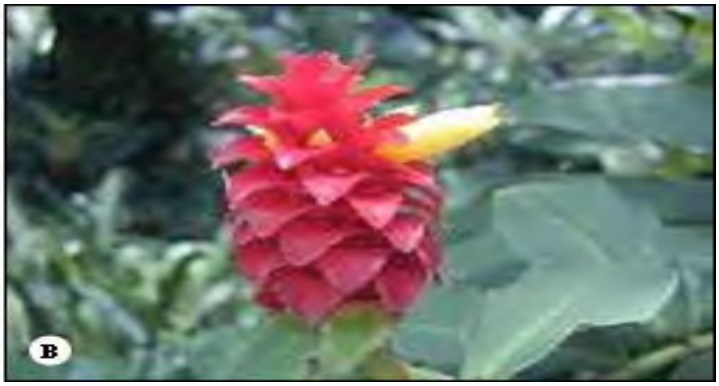
Costus stenophyllus A. general aspect of plant B. inflorescence



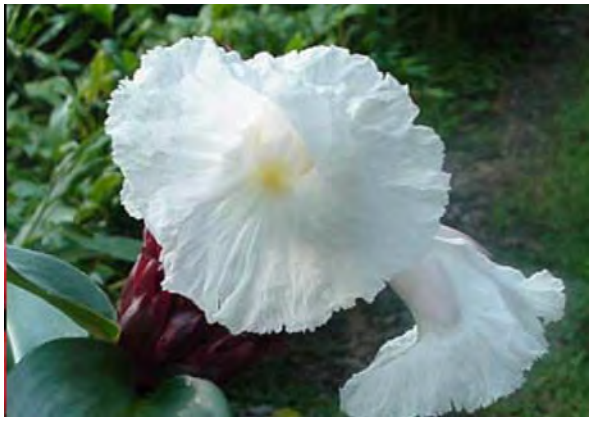
Costus pulverulentus, inflorescence

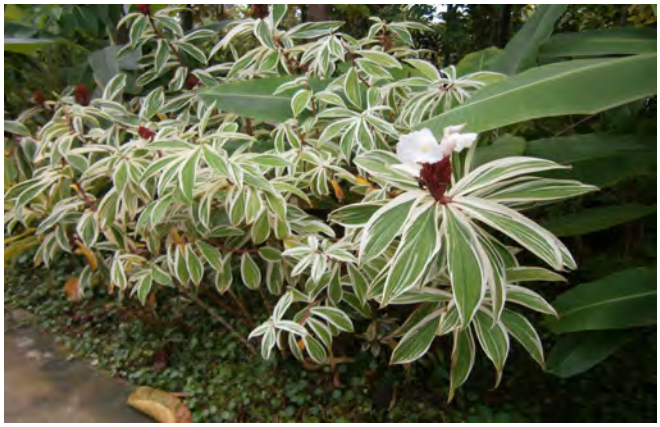
We are grateful to UH graduate student Alberto Ricordi for providing the translations for the tables.





Costus comosus bakeri A. general aspect of plant B. inflorescence





Cheilocostus speciosus, flower , Ray Baker photo General aspect of plant , Rich Criley photo

Dimerocostus strobilaceus

Flower at left, plant at right

Images from Lyon Arboretum web site

Cut stems of 4 *Costus* species; A. *Costus pictus*, B. *Costus stenophyllus*, C. *Cheilocostus speciosus* var. *variegatus*, and D. *Dimerocostus strobilaceus*

An original heliconia society initiative in 1983, not '85! Plus, some early field-collecting thoughts

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Members of our HSI might be interested to know of a prior effort in 1983 announcing a heliconia society and a small conference. It came about while I was living on Maui. My friend, the legendary late Tim Plowman, was sending me seeds and live propagules of many things from his various South American botanical expeditions. He asked me what I'd like for my Maui nursery and a local plant enthusiast suggested that a rare new *Heliconia* would be ideal. The first one Tim sent was *H. zebrina.*

Tim put me in touch with John Kress (his former housemate during their Harvard years), and the prominent *Heliconia* specialist soon visited me on Maui. We got together with two local heliconia enthusiasts, Howard Cooper and Alii Chang. Late one balmy evening around a picnic table, the topic of forming a heliconia society arose. Howard subsequently wrote a draft invitation and statement, which I then prepared into an announcement in the spring of 1983. None of us were aware of any commercial growers outside of Hawaii, and so Howard Cooper's invitational draft was Hawaii-oriented. Howard and Alii's enthusiasm seemed to focus mainly on a forum and body for organizing commercial stakeholders in fostering this incipient trade and new branch of a growing tropical cutflower industry. I know that John foresaw, as did I, a broader context for botanical science, publication and conservation similar to other existing botanical societies devoted to orchids, ferns or palms.

We ended up having John return for that initial conference but the society never took off. Neither John nor I cared for Cooper's "Heliconia Society of America" versus the more inclusive title "Heliconia Society International," the name - and concept - that was later chosen by others for the current HSI.

The lure of field collecting became all-consuming and I lost track of other events for some time. In fact I sold off and donated most of my rare, unreleased *Heliconia* nursery stock to leave for a quick 30-day collecting trip to Costa Rica and Panama. As it turned out, I was gone for years collecting quantities of rhizomes and seeds... you never know what might happen when you leave home!

Encountering earthquakes, war zones and a stint in prison, my path led throughout remote natural forests of incomparable beauty in nearly every country in South and Central America, encompassing many incredible experiences, near-deaths, exhaustive ordeals and a great deal of very hard work. Fellow "heliconiaphiles" of that time understand what is involved to successfully ship tens of thousands of wild-collected rhizomes and countless quantities of seed: finding, documenting, digging and hauling, cleaning and crating, obtaining permits and meeting air cargo schedules only to repeat this in the next location. Among these accessions were new varieties, undiscovered natural hybrids and new color forms, many of which now bear names in global trade far distinct from their proper botanical identities. (I confess to having distaste for horticultural names.) I feel especially fortunate to have had a wide-open agenda, compared to the two-week research trips many botanists have to deal with. My intuition while in the field has lamentably turned out to be true, that one day these plants would no longer be there, as wild habitat vanishes so relentlessly. On the front lines of rainforest devastation decisions are made about how many specimens to collect: a difficult and controversial situation. In many cases this becomes a matter of rescue work, knowing that the future was near, clear and severe, witnessed by all fellow fieldworkers everywhere. Satellite images reveal that many of these then-remote locations have since had their unique ecologies disrupted forever, some endemic *Heliconia* species and forms are certainly now extinct. *Ex situ* conservation and propagation remain second best to preserving intact wild habitat. Eventually my own drop-in-a-bucket efforts were such cause for despair that I left to contemplate the results and reminisce on decades-past field collecting work.

You all must congratulate yourselves on being part of such an essential and valued effort as the Heliconia Society International (conceived of twice and born in 1985!) celebrating the diversity of these beautiful species and fostering scientific study of these complex 'life-form symptoms' while raising awareness of their unique and important place in wild Nature, in gardens and in homes and on public display.

Original documents provided by Rob Montgomery can be viewed at the HSI web site **www.heliconia.org**

Dr. W. John Kress "knocked over" by a giant roadside *Heliconia bihai* 'Balisier'. March 1986. Trinidad and Tobago.

Role of the Heliconia Society in Conservation

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For many years the Heliconia Society International has been active in promoting the conservation of plants in the order *Zingiberales* through its network of conservation centers. In 2014 the Board of Directors approved a plan to link our activities with an organization called the Botanic Gardens Conservation International (BGCI) and to become a member of that organization.

The BGCI has over 700 members, mostly botanical gardens, located in 118 countries. Their mission:

BGCI supports the conservation of endangered plant species around the world. We partner with botanic gardens and other conservation partners to secure plant diversity through research and practical action. We work to ensure that threatened plant species are secure in botanic garden collections as an insurance policy against loss in the wild. We also help to restore populations of endangered plants in their natural habitats. Our work encompasses supporting botanic garden development where this is needed and helping to develop the skills necessary to save plants from extinction.

Essentially, the HSI plan of action involves three main initiatives:

- Identify species of *Zingiberales* that may be threatened or endangered in the wild.
- Work towards the collection and *ex situ* conservation of these species.
- Determine whether or not they are being grown in botanical gardens anywhere in the BGCI network.

Identification of threatened species

The organization best known for its work in identifying threatened or endangered species is the International Union for the Conservation of Nature (IUCN) which publishes a list of threatened species. In 1998 they published *The 1997 Red List of Threatened Plants*, listing 33,798 species of vascular plants that were considered to be Rare, Vulnerable, Endangered or Extinct.

After this 1998 publication the IUCN has made important revisions to the assessment process and changed the categories as follows:
EX = Extinct, EW=Extinct in the wild, CR= Critically Endangered (the highest threatened category), EN=Endangered, VU=Vulnerable, NT=Near threatened, LC=Least concern, and DD=Data deficient.

A very complex and comprehensive process and scoring system has been adopted to ensure the assessments are as objective and comparable as possible. The assessments include the following sections:

TAXONOMY: The IUCN uses the International Plant Names Index (IPNI) as its authority for the list of species. Here you will find a discussion of any issues involving the taxonomy of the species, such as whether there are identification problems or disagreements among botanists.

GEOGRAPHIC RANGE: The distribution of the species is quantified in km^2 by two measures, the Extent of Occurrence (EOO) and the Area of Occupancy (AOO). They are part of the formula for determining the threatened status.

POPULATION: Population counts and estimates are very important in determining the status.

HABITAT AND ECOLOGY: Species with a very narrow habitat are more likely to be threatened.

USE AND TRADE: This section denotes the extent the species may be collected in the wild, imposing a threat of extinction.

THREATS: This section documents specific threats to local populations as well as general threats of habitat loss, etc.

CONSERVATION ACTIONS: Discusses whether there are programs in place for the species to be conserved *in situ* or *ex situ* or in seed banks.

All this is fully documented and available to the public on the IUCN website at www.iucnredlist.org. Searches may be made by family, genus or species.

Many of the species that were previously listed in threatened categories in the 1997 Red List have not yet been reassessed under the new process. For purposes of this project I merged the 1997 printed list with the current list for all species of *Zingiberales* and analyzed the data.

Determination of Ex Situ Conservation Status

The Botanic Gardens Conservation International (BGCI) maintains a searchable database of the species that have been reported as growing by participating botanical gardens. These include some private gardens as well as public botanical gardens, and there is no membership fee required for a garden to be listed with BGCI. Many of our Heliconia Society member gardens are already participating in the BGCI listings, including most of the gardens that have been in our HSI network of Conservation Centers.

The gardens are requested to submit to BGCI a list (at least annually) of the species they are growing, and this list is then compiled into the BGCI database and is searchable by genus and species to determine how many gardens are growing a given species. The garden location of the species is not publicly disclosed, but can be requested from BGCI and they will contact the garden(s) and pass along your inquiry.

The BGCI does not maintain a checklist of accepted names, and it includes accessions of cultivars and even unnamed

plants (ie: *Heliconia* sp.) in its database. There is an attempt to match the correct spelling of species names but I have found the data to be somewhat unreliable due to incorrect identifications,and of course it is incomplete if a participating garden fails to report the species they are growing.

Despite these drawbacks, I have run a match between the species of *Zingiberales* with an IUCN threatened status against the BGCI list of plants being grown in botanical gardens, and from that we can determine threatened species that still need to be conserved in botanical gardens. Based on this, the total number assessed as threatened that still need to be conserved in BGCI gardens is 108 species of *Zingiberales*.

If you believe you have some expertise in a group of plants and are willing to devote the time to do assessments, you can become a certified assessor for IUCN. This requires completion of an on-line training program and passing exams.

If you have seen a species growing in a botanical garden but it has not yet been reported to BGCI, please notify us and we will encourage that garden to report it to the BGCI system.

If you have a species growing in your own garden that is on this list as NOT being in conservation, you can donate a plant to a participating garden. This article will continue in the Bulletin 21(1).

Table 1. Taxa in the Zingiberales

Family	Total # of Taxa	IUCN Assessed	IUCN Threatened	Percent Threatened	Not in BGCI
Cannaceae	12	1	1	8.3%	1
Costaceae	138	32	20	14.5%	10
Heliconiaceae	205	61	47	22.9%	32
Lowiaceae	17	1	1	5.9%	0
Marantaceae	545	38	33	6.1%	22
Musaceae	91	4	2	2.2%	0
Strelitziaceae	8	2	1	12.5%	0
Zingiberaceae	1594	174	73	4.6%	43
Total Zingiberales	**2610**	**317**	**193**	**7.4%**	**108**

Collection and Conservation

The ultimate objective of this program is to ensure that any species that are threatened with extinction in the wild will be conserved *ex situ* in public botanical gardens where they are available for scientific study and for reintroduction into the wild should that become necessary. It is hoped that as lists of needed species are published here and on the Heliconia Society website, that some of our members will have plants growing in their gardens and/or will be able to assist in getting the threatened species into cultivation in public gardens.

What Can YOU Do?

We will be publishing in the Bulletin and on our website the lists of which species have been assessed as threatened, and whether or not they are listed as cultivated in the BGCI botanical garden network.

From the chart above you can see that only 317 species out of the total of 2,610 have even been assessed to determine whether or not they are threatened.

If you know of additional species that are rare and difficult to find in the wild, bring them to our attention and we will try to get a specialist in that genus to work on an assessment.

HSI Member Profile:

Richard Criley
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Dr. Richard A. Criley

When did you join HSI? At the beginning in 1985.

What is your professional position? Emeritus Professor of Horticulture (Retired from University of Hawaii in December 2010.)

What is your work with Zingiberales? I commenced research on *Alpinia purpurata* and *Strelitzia reginae* in the 1970s: nutrition and planting density studies. Later, I initiated a study on potassium requirements of *Heliconia stricta*, which demonstrated no response under our conditions, but which showed a seasonal flowering pattern. With my graduate students we also looked into seasonal flowering patterns of *Strelitzia* in Hawaii and cooperated with other researchers in Israel, California, (continued on page 15)

Chilling Injury Symptoms in Species of *Heliconia*

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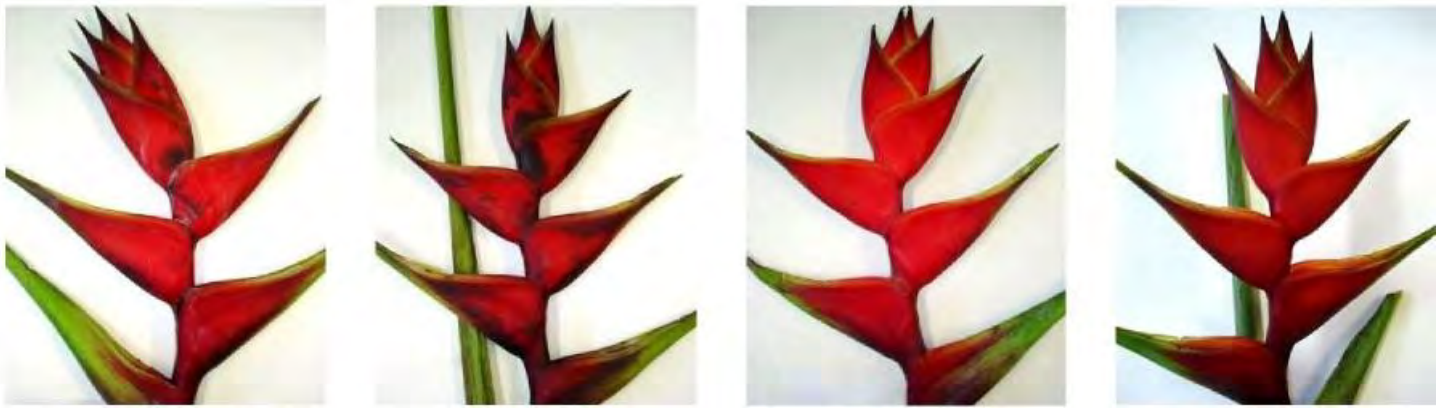
Keywords: refrigerated storage, postharvest, *Heliconia* spp, tropical flowers

Abstract

The severity of chilling injury in plants depends on temperature, length of exposure to low temperatures and the sensitivity of each species. Temperatures between 10 and 13 °C can cause damage in tropical and subtropical species. The aim of the present study was to induce, describe and compare the differences of chilling injury and senescence symptoms in eleven *Heliconia* genotypes. Flowering stems of each species were submitted to two conditions: a) refrigerated treatment (RT) at 6.5 °C and 81% relative humidity; b) control treatment (CT) with flowering stems kept at room temperature at 24.7 °C and 66% relative humidity. Flowering stems kept at RT were evaluated daily and removed when the inflorescences presented the first chilling injury symptoms. After being removed from the low temperature, the stems were kept in water at room temperature to evaluate the evolution on the chilling injury symptoms. The number of days it took for chilling injury symptoms to appear on stems after the low temperature treatment were: two days for *H. rostrata*; five days for *H. bihai* 'Peachy Pink', *H. caribeae* x *H. bihai* 'Jaquinii', *H. stricta* 'Iris' and *H. stricta* 'Tagami'; six days for *H. caribaea*, *H. foreroi*, *H. stricta* 'Dwarf Jamaican', *H. stricta* 'Bucky' and *H. wagneriana*; seven days for *H. orthotrica* 'Candy Cane'. The initially chilling injury symptoms appeared on the bracts as darkened spots near to the junction with the rachis. These spots evolved to darker tones and then to necrotic spots. In the control stems, the initial senescence symptoms, in the majority of species, appeared as wilted areas at the bracts apex. The withering advanced towards the bract base. The evaluation of the chilling injury and senescence symptoms are different and allow to make the comparative description of both kinds of symptoms. Senescence symptoms of cultivars *H. stricta* are different from the senescence symptoms of other species. The full text of this article, including illustrations, will appear in the Bulletin 21(1).

(a) (b) (c) (d)

Fig. 1. *H. bihai* 'Peachy Pink': chilling injury symptoms on the fifth (a), seventh (b) and on the fourteenth day (c); senescence symptoms on the fifth day (d).



(a) (b) (c) (d)

Fig. 2. *H. caribeae:* chilling injury symptoms on the sixth (a & c), and ninth days (b & d).

Advertisement

Peruvian Members of International Heliconia Society:
I would like you to look for fresh seeds of *Heliconia subulata* 'Cock of the Rock' from September to December, to send to me, please. The seeds of *Heliconia subulata* 'Cock of the Rock' are ripe in September, October, November, and December, in Cusco, Peru. This cultivar had never been in cultivation before and needs new overseas homes as insurance against extinction. Please contact me before sending me the seeds at:
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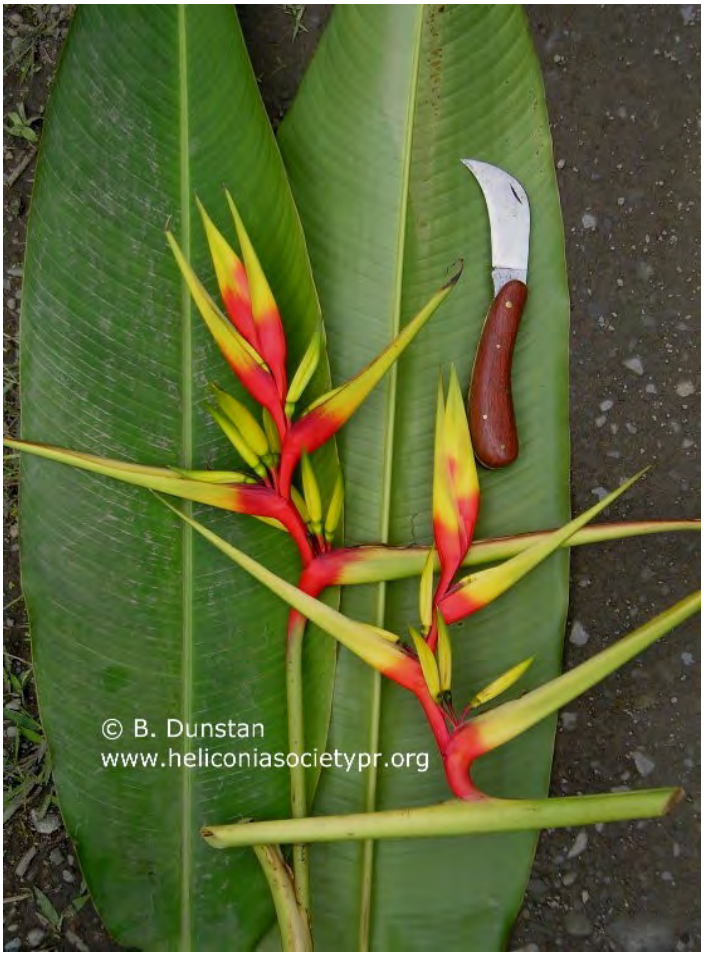

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(HSI Member Profile, Dr. Criley, continued) Australia, and South Africa to determine seasonal flowering in other settings. Eventually, we were drawn back to *Heliconia* as local growers were interested in their production for export. The interest in the flowering behaviors of gingers, heliconias, and other bold tropical cut flowers allowed us to review the production/sale records of a couple of Hawaii cut tropical growers which revealed seasonal flowering patterns ripe for investigation. My graduate students and I investigated seasonal flowering in *H. stricta* 'Dwarf Jamaican,' *H. angusta*, *H. rostrata*, and *H. wagneriana.* Later I set up a study on 20 different heliconia used as cut flowers in Hawaii to follow their productivity. I published these studies in Acta Horticulturae and the Bulletin of HSI. I also mentored a graduate student who carried out an irrigation study on *Alpinia purpurata*. Together with Dr. Jeff Kuehny, a professor at Louisiana State University, we received two grants from the American Floral Endowment to conduct research on some tropical gingers. His students did work on responses to growth retardants, storage durations and temperatures, and carbohydrate status, I extended the studies in Hawaii to production of *Curcuma alismatifolia* potted plants year around and am presently completing a similar study with *Globba.* Along the way, one of my students elucidated the long day response of *Hedychium coronarium* and I showed the possibility to produce it as a potted plant using growth retardants.

What was your initial attraction to Zingiberales?
When I started my career as a researcher at the University of Hawaii in 1968, I knew I did not want to follow my mainland colleagues in the study of roses, carnations, and chrysanthemums. I was in the tropics and wanted to study tropical flowers. Since others in my department were already conducting research on orchids and anthuriums, I was told to find my own niche. Simultaneously another new researcher introduced me to proteas, so I began cooperative research with him and I have been involved with working group on protea research ever since. My interest in *Alpinia* and *Strelitzia* was initiated during my graduate student days at UCLA, so I've been on a dual track of tropicals and proteas and a few other species ever since. There was little known in those days about the culture of these exotics and that was my challenge.

What is your favorite in the order? *Strelitzia*

What do you hope to accomplish? What do you see in the future of your field?
In nearly 45 years of research I have accomplished a number of things, including publishing the discoveries of photoperiod responsiveness in heliconias, and year around production protocols for *Curcuma*, plus having guided 4 PhD students in their studies in *Strelitzia* and *Heliconia*. I hope that my work will have provided an incentive to others to take up studies of the many unknown Zingiberales to provide the information needed to make them commercially successful cut flower and potted plants.

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HELICONIA SOCIETY INTERNATIONAL

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