BULLETIN
HELICONIA SOCIETY INTERNATIONAL

A Journal of the Heliconiaceae and the related Cannaceae, Costaceae, Lowiaceae, Marantaceae, Musaceae, Strelitziaceae, and Zingiberaceae

AUGUST, 1995 VOL.7 NO. 4

HSI Headquarters
c/o Fairchild Tropical Gardens
10901 Old Cutler Road
Miami, FL 331556-4296 USA

HSI Editors:
Gilbert S. Daniels
700 West 56th Street
Indianapolis, IN 46208

Rudolf M. Sterkel
1444 Larson Street
Sycamore, IL 60178

Costus Flowers- a New Delicacy?

Alan Carle, The Botanical Ark, Mossman, Australia

Unbeknownst to many and seemingly just about everyone, Costus flowers may now find a place upon the tables of the humblest homes and fanciest restaurants. Until recently little was known about the edibility of Costus day flowers.

Over the past several years HSI members Alan Carle, from Australia and Mark Collins, of Hawaii, working independently, discovered that many of the individual day flowers of Costus were indeed edible and in fact some tasted quite lovely. Perhaps it was the hunter-gatherer in these men that made them search for food, or maybe it was an insatiable appetite for new things. Whatever it was the discovery has led to an increasing number of cooks, chefs and connoisseurs livening up their days and salads with an almost endless array of colour.

Above: Various Costus flowers preserved in alcohol.
Below: Costus salad

After the initial discovery that the flowers were edible and palatable, Alan did some research to ascertain if there was any literature on the subject. It was acknowledged that some Costus have been used medicinally (especially *C. speciosus*), and that the roots and new growth tips are occasionally eaten, even juice made from the stems (*C. guanaiensis*) but no mention was made of the day flowers being eaten.

Uncertain of how far or how fast to proceed the intrepid duo slowly began sampling different species. Having commenced with 'French Kiss', *Costus woodsoniana*, they sampled *C. pulverulentus, C. scaber, C. curvibracteatus, C. spiralis, C. dubius, C. varzearum* and so on. No one got sick or died - a first stage indicator, and they all tasted nice. Some were sweeter than others - in fact some of the same species tasted different at different times of the day, most likely due to freshness (time of emergence) and nectar content.

Time to try it on friends and neighbors. Everything went really well until someone ended up with a mouthful of ants - something we have to watch out for occasionally.

Costus woodsoniana is almost constantly in flower throughout the year and is generally a safe bet when initiating new recruits. Certain varieties of *C. guyanense* have very large flowers (to 80mm or 3.25" long) and are exquisite to look at, being a nature based painting of reds, yellows, whites and purples or maroons. Consume one of these flowers and you've already had an entree.

Costus occurs naturally in Africa, India and Sri Lanka, China, throughout South East Asia, Australia and Papua New Guinea, and across the Pacific into South and Central America and the Caribbean. A herbaceous plant with spirally arranged leaves its habit varies from a species in Africa that has its leaves flat on the ground to a South American species 5 metres (16 feet) or more tall. It is generally a plant of the understory, but often as an invading pioneer in cleared and disturbed lands. It flowers terminally on its vegetative stems or on separate stems. Occasionally some species flower both ways. The flowers are contained within a cone-like inflorescence and emerge in a sequential fashion, usually each day - hence the term day flowers. On some species there are very small inflorescences, thus not many day flowers, but on other species the inflorescences can be quite large and flower for many months.

So far more than 40 species have been sampled and most are quite palatable. On their recent expedition to tropical Africa, Alan and Mark were able to taste a number of species not yet in cultivation. Again tentative thumbs up!

Its not difficult to switch your easel for a plate, your canvas for a lettuce leaf and begin painting. There are probably more than 80 different species of *Costus* and they grow in most moist tropical and warm subtropical areas of the world. French Kiss is a small red and yellow flower- dab on liberally. For a fine and delicate texture add a few *Costus speciosus* or *C. villosissimus* flowers (white or yellow). If they are not in flower you can substitute a *Dimerocostus* - yes they are edible too! (and come in yellow or white). For bold outlines use *C. guanaiensis* - reds, greens. Try violet colours, pure yellows, even porcelain whites. Such a wide variety of colours and shapes and sizes to choose from. Your creation is only limited by your gardening skills. No wonder most people stare at our salads before consuming.

For those of you in need of a recipe for salads, try this:

4 large lettuce leaves, 24-32 mixed Costus flowers (yellow, red, purple, white, large, small, firm, fluffy) and 1 cup Nick Hannaford's Costus salad dressing. Pour on!

Nick is a neighbor to Alan and Susan Carle at The Botanical Ark and cooperates by dreaming up new and exciting recipes.

Nick's Costus dressing: mix together 1 clove of crushed garlic, 1/2 cup olive oil. 1/2 cup apple cider vinegar, 1 teaspoon sugar, pinch of salt and pepper, 1/2 teaspoon of hot English mustard and a squeeze of lemon juice, Shake thoroughly.

Editors note: It should be noted that these are preliminary findings and that some people might like to do some chemical analysis or clinical trials. While encouraging people like Alan and Mark to continue with their trials, HSI does not and can not endorse the edibility of Costus flowers.

Mark your 1996 calendar now!

Set aside July 12 to July 31, 1996 to come to Miami for the 9th International Conference of the Heliconia Society International.

Special features of this meeting in Florida include a pre-conference tour to Puerto Rico, a newly developing collection of Heliconias and Gingers at Fairchild Tropical Gardens, our new headquarters, and an educational post conference tour to Ecuador.

Puerto Rico is a tropical island which has its own Heliconia species and its own tropical forest and natural beauty. It also has growers who have collected from far and wide. This will be a special opportunity to see a large number of Heliconias with very little effort. Puerto Rico has a lot to offer for your enjoyment. It will be a great way to get you into the mood to enjoy the HSI conference in Miami, Florida from July 17 to July 20.

Fairchild Tropical Gardens is one of the world's important tropical botanical gardens. Heliconias and gingers have recently been given a home in the very special collections. Our meetings will be centered at Fairchild Tropical Gardens.

On July 21, we will depart for our post conference study tour to Ecuador. Ecuador is among the most botanically diverse countries in the world, extremely rich in plant species. You will have a wonderful opportunity to experience it first hand.

The cost will be very reasonable but the space is limited. Be prepared to act immediately when the detailed information is sent to you.

The Purpose of HSI

The purpose of HSI is to increase the enjoyment and understanding of Heliconia (Heliconiaceae) and related plants (members of the Musaceae, Strelitziaceae, Lowiaceae, Zingiberaceae, Costaceae, Cannaceae, and Marantaceae) 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 exotic 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: Individual, $35.00; Family, $40.00; Student, $10.00; Contributing, $50; Corporate (Company or Institution) $100.00; Sustaining, $500.00; Libraries, $25.00. Membership fees constitute annual dues from 1 July through 30 June. All members receive the *BULLETIN* (usually published quarterly), the Membership Directory, and special announcements. Please send all inquiries regarding membership or Bulletin purchases to: David Bar-Zvi, HSI Vice President For Membership, Fairchild Tropical Gardens, 10901 Old Cutler Road, Miami, FL 33156-4296, Phone (305) 667-1651, Fax (305) 661-8953. Back issues of the Bulletin are $25.00 per volume.

HSI Officers for 1994-1995

President, Alan W. Carle; Vice-president for Executive Affairs, Mark Collins; Vice-president for Membership, David Bar-Zvi; Secretary, Bruce Dunston; Treasurer, Gilbert S. Daniels; Editors, Gilbert S. Daniels and Rudolf M. Sterkel; Corresponding Secretary, Agneta Becker; Board of Directors: Jose Abalo, Raymond F. Baker, Sandra Barnes, Richard A. Criley, John V. Duey, Joseph Fondeur, Halijah Ibrahim, W. John Kress, Victor Lee, Roger Peckenpaugh, Boyo Ramsaroop, and Daniel G. Wood.

The HSI *BULLETIN* is the quarterly publication of the HELICONIA SOCIETY INTERNATIONAL. Editors: Gilbert S. Daniels, 700 W. 56th Street, Indianapolis, IN 46208 U.S A., 317-251-7343, 317-251-9071 (FAX) and Rudolf M. Sterkel, 1444 Larson Street, Sycamore, IL 60178 U.S A., 815-895-6705, 815-895-6809 (FAX).

Some Notes on *Heliconia* Nomenclature

Dan H. Nicolson, Department of Botany, Smithsonian Institution, Washington, DC 20560

Who first wrote about heliconias?

In validating the name *Musa bihai*, Linnaeus (*Species Plantarum* p. 1043. 1763) cited 3 synonyms published by Plumier in his *Nova plantarum americanarum genera* (p. 60. 1703) and one of Oviedo in his *Primera parte de la historia natural y general de las Indias, yslas y tierra firme del mar oceano*. 1636. The second citation is in error and (according to Heller, top p. 41 in Appendix to Linnaeus, *Species Plantarum* facs. ed. 1969) was probably miscopied from Plumier who had it right as "Gonz. Oviedo Lib. 7. cap. 9" in any edition but most particularly in the 1556 edition where the name Bihai appeared (Bihaos, Bihao in other editions). I have not looked up these works but I suspect they qualify as the first writings about finding heliconias: the first by Gonzalo Fernandez de Oviedo y Valdes (1478-1657) and the second by Charles Plumier (1646-1704).

Who named them for this mountain of the mythological Muses, Mt. Helicon?

Linnaeus (*Mantissa Plantarum* p. 147, p. 211 (later citing his earlier *Musa bihai* basionym of *H. bihai* (L.) L.). 1771) was the author of the generic name. To my astonishment, he said nothing about the provenance of his generic name, although he commented on the difference from *Musa* (Genus separated from *Musa* by the tricoccous capsule). The first reference (so far found) giving an etymology is G. C. Wittstein (*Etymologisch-botanisches Handworterbuch* 1862) who said "Vom Berge Helicon, dem Sitze der Musen; in Bezug auf die Aehnlichkeit dieser Gattung mit *Musa*". Subsequent etymological works repeat this, sometimes attributing it to Wittstein (done by Genaust), sometimes not. Stearn (*Stearn's Dict. Pl. Names for Gardeners* 1992) said, After Mount Helicon in Greece where it was supposed that Muses lived, so named from its relationship to *Musa*.

To understand this as a possibility you must understand that the Latin word for a Muse was *Musa*, plural *Musae*, (Greek *Mousa*, plural *Mousai*). It helps to understand that *mouz*, plural *mouza*, was the Arabic/Persian word for banana and Linnaeus could not condone using a vernacular word for a generic name without a classical allusion. So, when Linnaeus named *Musa* he was using a vernacular name twisted into a classical allusion (a Muse) and *Heliconia*, being the home of the Muses, would appear to be another classical allusion growing out of the first strained allusion.

Important Notice

HSI Headquarters has moved

New Address:

Heliconia Society International
c/o Fairchild Tropical Gardens
10901 Old Cutler Road
Miami, FL 33156-4296 USA

It's Not Too Early To Plan
For 1998
In Singapore
Watch for Details Soon

Natural Hybrids of Heliconias - Some Recent Discoveries

Fred Berry, *Berry's Tropicals Inc. Miami and UNESCO, IOCARIBE, Cartagena*

Hypothesis:

1) Hybridization in *Heliconia* species has not been studied enough to allow objective understanding and use.

2) In some natural *Heliconia* hybrids, hybrid vigor occurs.

The purposes of this note are:

1) to relate a little of the little that is known and

2) to encourage needed research for scientific and commercial purposes.

I believe undoubtedly that more natural hybrids of *Heliconia* exist out there in the bush than we have discovered. And we presume to have discovered more than 50, most of which are not yet documented.

Heliconia hybrids intrigue and fascinate me. What can really excite is to sense how many undecifered hybrids exist out there in the rapidly diminishing habitats - and those that do not allow for obvious morphological interpretation.

The hybrids listed below have grown vigorously in my small, exotic nursery in Miami, Florida. This is a subjective comparison to the other 150 plus Heliconia forms that have been grown there. Here, these vigorous hybrids, grow faster, grow taller, produce more shoots, and produce more inflorescences that other similar or parent species or forms. This vigorous growth applies to both plants grown in the ground and in containers. Of course, the ground-grown Heliconia are relatively larger (in size of clump and inflorescence).

Figure 1 shows a hybrid of *H. bihai* and *H. psittacorum* or of *H. spathocircinata* and *H. psittacorum* with putative cultivar names of 'Tropics', 'Hawaiian Tropics', and 'Tropic Fleur'. 'Tropics' is a vibrant grower filling a ten-gallon pot with shoots and rhizomes within 6 to 12 months; only about 4 to 8 feet tall; one of several similar hybrids with green-tipped sepals; probably from French Guiana through Guadeloupe and Martinique.

The hybrid complex of *H. caribaea* and *H. bihai* may contain more than 25 putative cultivars. Cultivar Crisiwick (pronounced Kris-ik) has about the grandest of all erect *Heliconia* inflorescences (Figure 2). It grows rapidly and blooms very well in south Florida -- to more than 20 feet tall.

Cultivar Green Thumb is especially vibrant. Its rhizomes shoot new shoots out of a sprouting container and rapidly make a sizable clump in a ground planting. Its infloresence is more attractive in its younger stages -- as shown in the photo on page 73 of the reprinted edition of the *Heliconia Guide*. [My slides

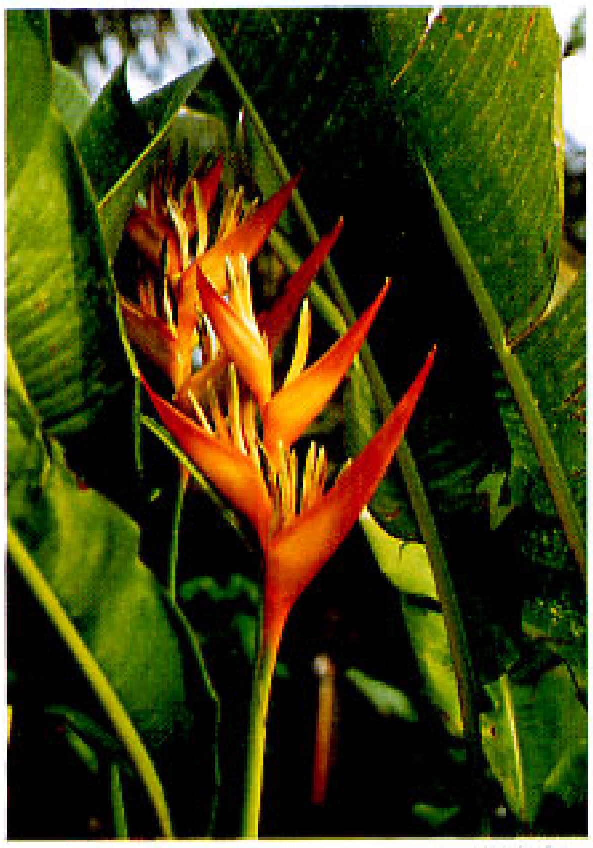


Figure 1. H. 'Tropics'

Figure 2. H. 'Crisiwick'

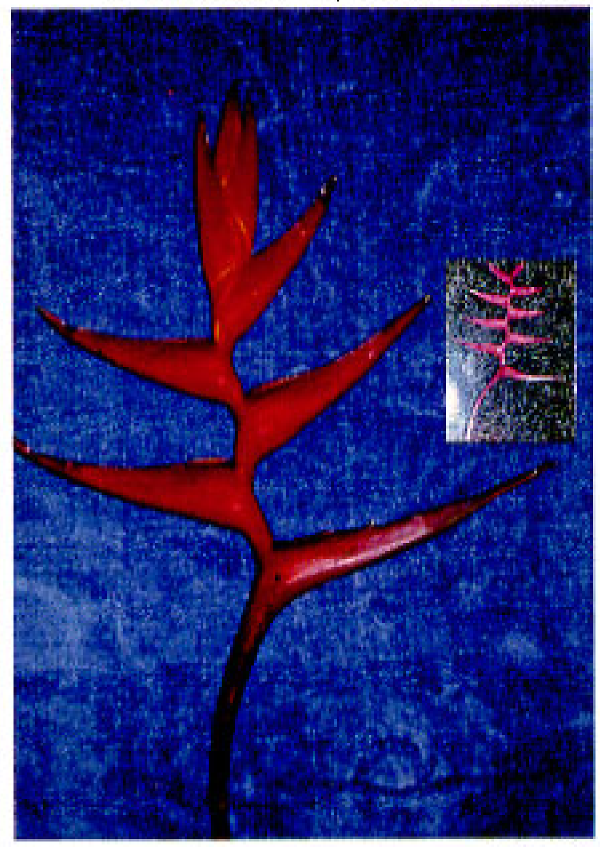


Figure 3. H. 'Hot Rio Nites'

of 'Green Thumb' are in Miami, while this is being written in Cartagena.]

From Venezuela and Brazil comes a hybrid that is interpreted to be a cross between *H. bihai* and *H. caribaea* or between *H. pendula* and *H. bihai* (Figure 3) Its proposed cultivar names are 'Dimitri Sucre', 'Brazilian Bomber', and 'Hot Rio Nites', with the upper eschelon of HSI preferring the latter. This is another vigorous grower and bloomer - an exciting part of a landscape.

From *H. marginata* and *H. bihai* came the hybrid *H.* x *rauliniana* (Figure 4) In South Florida (and of course many other areas) this is possessed of mighty vigor. It rapidly produces new shoots and blooms plentifully and continuously. The inflorescences go up and down and horizontally as they develop. They have a twisted and contorted structure; in my anthropomorphisms I vacillate between calling it crazy or excited. *H.* x *rauliniana* was the only clump of more than 1,000 Heliconia plants that was standing in my nursery after Hurricane Andrew blasted us on August 24, 1992. And it still stands - most vigorously.

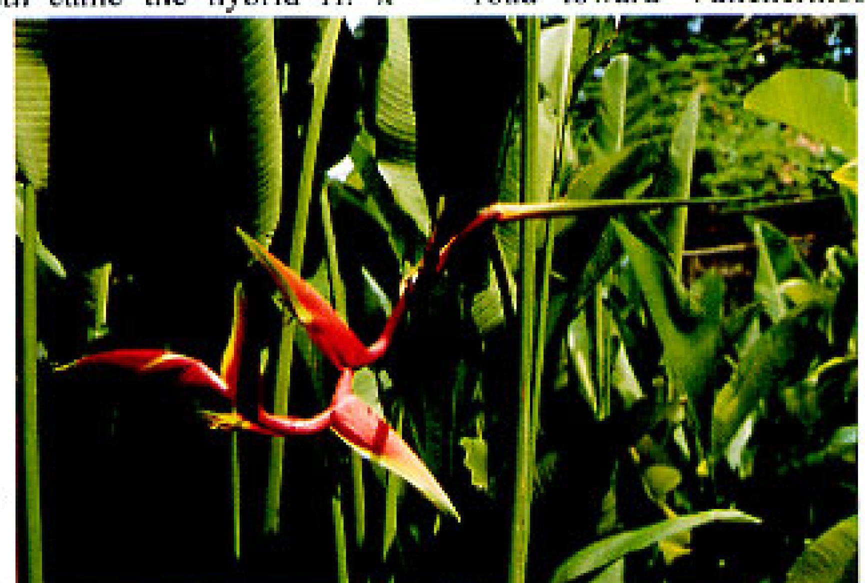


Figure 4.(above) *H.* × *rauliniana*
Figure 5.(below) *H.* 'Pedro Orrtiz'

We have driven through Yucatan, Mexico, dozens of times in our quest for the world's greatest tree, *Ceiba pentandra*, and our thirst for Mayan archeology. Not for *Heliconia*. Not native there. Bill Ballantyne has some at his nursery in Chulula. The Hacienda Chichen Itza has a large clump of *Heliconia latispatha* and *H. latispatha* plantings are slowly increasing around Merida. On December 12, 1991, we started to drive through Uman on the road from Merida to Uxmal. The Volkswagon Bug slammed to a stop opposite Restaurante Marina, because there was a 12-foot-tall clump of Heliconia BLOOMING. It was not there in all our prior drive-throughs. It had maroon stripes on the lower side of younger leaves and bright yellow flowers and absolutely beautiful flaming red bracts. What remarkable torsions the inflorescences took in growing up (Figure 5). The restaurant owner is Pedro Ortiz. He had bought a clump for sale on the road toward Vallehermosa, and planted it in front of his restaurant, because it seemed like the thing to do. We gave Pedro Ortiz the book, and he gave us two rhizomes. Suspecting this to be a hybrid of *H. bourgaeana* and *H. collinsiana*, we wrote the putative cultivar name as cv. Pedro Ortiz. We stopped there a year and a half later and the clump of 'Pedro Ortiz' was not doing so well. But the Yucatan is harsh for many herbaceous plants. But by June 1992, Pedro Ortiz was growing vigorously and blooming magnificently in Miami. It has since been distributed over South Florida, and to Hawaii, Puerto Rico, Venezuela, Costa Rica, and at Cholula, Yucatan. And we found it cultivated at Fortin de las Flores. But so far we don't know its native range.

We heliconiacs can't wait for research facilities to give us the work and results we need. We need an angel or so with interest and farsightedness -- to start the unlocking of the X's.

The Effects of Four Levels of Nitrogen on the Growth, Yield, and Shelf Life of Red Ginger *Alpinia purpurata* (Vieill.) Schum.

***Edwin F. Mersino**, Cooperative Extension Service, University of Hawaii at Manoa, 910 California Ave., Wahiawa, HI 96786, USA*

Abstract

Four levels of nitrogen were applied to plots of red ginger - *Alpinia purpurata* (Vieill.) Schum. Nitrogen in the form of Ammonium Nitrate was applied at 0, 168.1, 336.3, and 672.5 kg. of N/ha. (0, 150, 300, and 600 lbs. of N/Ac.) Applications of 1/6 of each amount were made every other month.

Plots consist of eight plants planted in a row 2m apart. Rows in the field were also spaced 2m apart. Treatments had four replicates. Plots were irrigated twice weekly via furrows. Fields are located 213m (700 ft.) above sea level and receive an average of 100cm (40 in.) of rainfall a year. The soil is a low humic latosol in the Wahiawa Family. It is approximately 25cm (10 in.) deep and is a dark red, silty clay with a pH of 5.5 - 6.5.

Preliminary results show that increasing levels of nitrogen resulted in faster growth. Also the 168kg of N/ha level gave the greatest number of Hawaii Standard flowers, whereas the 0 and 336kg of N/ha levels produced the largest number of total flowers. Shelf life showed no significant differences.

Introduction

There are approximately 70 hectares planted with gingers in Hawaii. On Oahu there are 65 commercial ginger growers, that primarily supply the local flower market. Among these growers there is a wide range of production efficiencies due to differences in cultural practices and environmental conditions. The growers' fertilizer practices fall into an enormous range from little or no fertilizer to massive amounts. Current adjustment in cultural practices is based on casual observations. Under-fertilization leads to poor growth and yield, and over-fertilization is a waste of resources and can result in contamination of the underlying aquifer with nitrates.

There is a large potential for exporting ginger, but one of the major limiting factors for expansion on Oahu is the high cost of land. This is changing. About 4000 hectares of agricultural acreage is becoming available in central Oahu due to the closing of one of the sugar plantations. Additional acreage may become available if the remaining sugar and pineapple plantations close or reduce their production. Poamoho Experiment Station is in the middle of the areas used for sugar cane and pineapple. Because of ginger's high requirement for water, the Schofield Plateau as the area is known, is not a customary ginger growing region. Because of the possibility of inexpensive land becoming available, the Poamoho Experiment Station was chosen as a site for the experiment.

Materials and Methods

The experiment station is 200m above sea level, and has an average rainfall of approximately 100cm./yr. The soil is a low humic latosol in the Wahiawa series. It is a dark red, silty clay approximately 25cm. deep. The pH ranges from 5.5 to 6.5.

Soil tests indicated that the available field contained high levels of nutrients. To reduce these levels the field was planted with a crop of corn which was left unfertilized. Approximately 15,000 m^2 was planted in August of 1992 with red ginger rhizomes. The plants were planted in ten rows spaced 2 meters apart. Rows 1 and 10 were designated guard rows. In the rows the plants were spaced 2m. apart. Forty-five or more plants were planted per row. The field was furrow irrigated approximately every 5 days.

Plots were laid out and consisted of 8 plants in a row. Because the plants closest to the main irrigation line became established and grew faster than those further down the field, a block design was chosen. Four plots (a control and each of the 3 treatments) were assigned to each block. Generally plots in the blocks were in consecutive rows. Five blocks were set up in the field. Blocks were arranged in tiers based on distance from the main irrigation line.

By mid 1993 data on the plant growth and flower production was started. Plants' growth and size were rated on a monthly basis. In January 1994 three levels of nitrogen and a control were administered. The levels used were:

0kg N/ha./yr. - 0 lbs. N/ac./yr. Control
168kg N/ha./yr. - 150 lbs. N/ac./yr. Lowest N
336kg N/ha./yr. - 300 lbs. N/ac./yr. Middle N
672kg N/ha./yr. - 600 lbs. N/ac./yr. Highest N

These levels were selected, based on information from previous experiments (Criley, 1984) and recommendations from a U.H. soil scientist. Ammonium Nitrate was used as the source of nitrogen. It was side dressed in shallow furrows. Because of the high variability in the average plants' size and growth in the plots, the level of nitrogen administered was inversely related to its average. That means the plots with the largest plants were used as controls, and the plots with the smallest plants received the highest level of nitrogen. Since plants receiving nitrogen are expected to out perform the controls, any differences in yield can be ascribed to the treatment, not to random chance.

On odd numbered months, one sixth of the total nitrogen was applied to the plots. Guard rows received nitrogen at the 336kg N/ha/yr. rate. Soil tests indicated an adequate supply of other macronutrients, but a low supply of magnesium. Therefore 25kg $MgSO_4$ was applied on even months over the entire field.

The field was harvested weekly and monthly totals were compiled. The shelf life of the flowers from the various blocks were measured and compared on a monthly basis.

Results and Discusion

The plants were rated on a monthly basis beginning mid 1993. The system used is delineated in Table 1. The average plant ratings for the treatments are shown in Table 2 and plotted in Graph 1. In January when the treatments began, the plots with the largest plants and the best growth received the lowest rating, and these were designated the controls. As the average plant size dropped and the ratings increased, a higher level of nitrogen was applied. The plots with the smallest average plants received the highest rating, and consequently the highest level of nitrogen. The differences in plant sizes were significant at the .05 level from January until June. Since June the differences were no longer significant. The change in average ratings from January to August for the control, low, middle, and high levels of N are .62, 1.08, 1.32, and 1.54. This convergence of the graphs indicates that the higher the level of nitrogen applied, the greater the growth.

The plants in the lowest part of the field -- that area farthest from the main irrigation line -were not used in the experiment. Some plants in this area had died, and those remaining were generally smaller and weaker, than those in the experimental area. These plants were also rated, which resulted in an above average rating for the plants used in the plots.

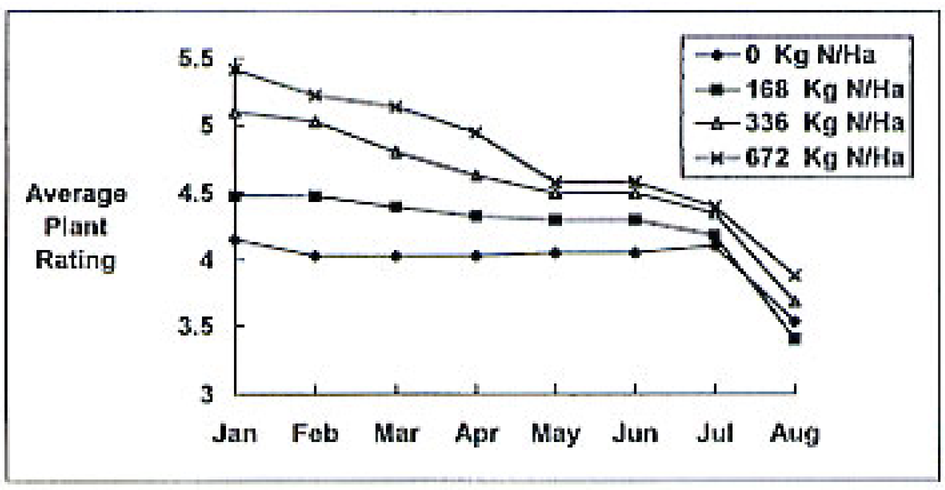
The total number of flowers harvested is shown in Table 3

Rating	Plant Description
1	Tallest & fullest plants with best growth
2	Very tall & full with very good growth
3	Tall and full plants with good growth
4	Above average height, size ant growth
5	Average in height, size and growth
6	Below average height, size and growth
7	Small, weak plants with poor growth
8	Very small, weak plants with very poor growth
9	Smallest & weakest - poorest growth
10	Dead plants

Table 1. Plant Rating System

Treatment	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
0kg N/Ha	4.15	4.03	4.03	4.03	4.05	4.05	4.1	3.53
168kg N/Ha	4.48	4.48	4.4	4.33	4.3	4.3	4.18	3.4
336kg N/Ha	5.1	5.03	4.81	4.63	4.5	4.5	4.35	3.68

Table 2. Average Plant Ratings



Graph 1. Changes in Average Plant Ratings

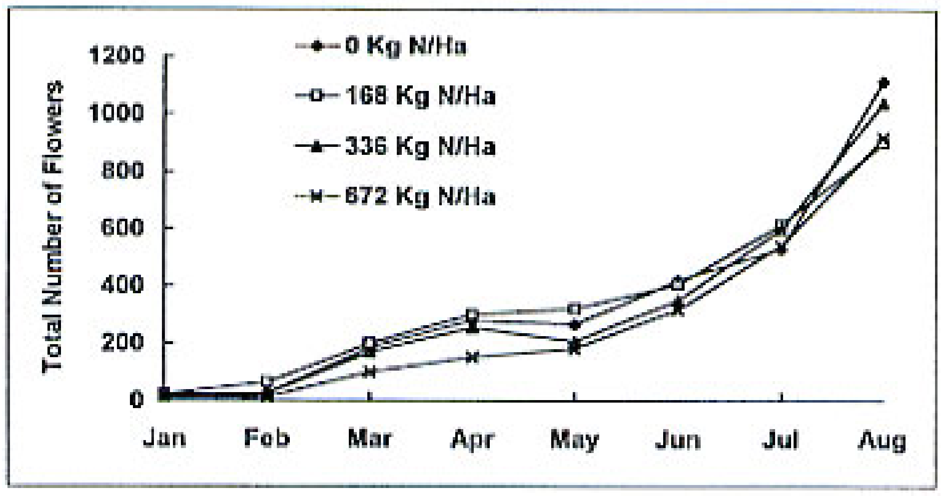
and plotted in Graph 2. This total includes all grades of flowers, including sub-standard grades. There were significant differences at the .05 level for the months of January through May, but none for June and July. The significant differences for the month of August were as follows:

0kg N/ha	1115	a
336kg N/ha	1041	ab
672kg N/ha	920	bc
168kg N/ha	901	c

Levels with the same letter are not significant at the 5% level.

Treatment	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
0kg N/Ha	23	28	186	278	266	421	530	1115
168kg N/Ha	23	64	199	298	322	407	614	901
336kg N/Ha	15	24	170	254	207	350	599	1041
672kg N/Ha	14	12	101	152	182	318	541	920

Table 3. Total Number of Flowers per Treatment



Graph 2. Total Number of Flowers per Treatment

These results indicate an interaction of several factors. The high variability, the fact that some blocks receive more water than others due to their location, and mode of selecting the control and treatment plots. A closer look at some of these factors is warranted.

The size standards for red ginger in Hawaii are listed in Table 4 (Hawaii Revised Statutes, Chapter 42). In addition, flowers must be of similar varietal characteristics, well-developed, clean, intact, fresh, firm, free of injury and well-colored. Although there were few Hawaii Fancy grade flowers harvested, there were a plentiful number of Hawaii Standard flowers. These numbers are shown in Table 5 and plotted in Graph 3. There were significant differences in the number of flowers in February through May at the .05 level. The 168kg of N/ha/yr. level of fertilization consistently produced more Hawaii Standard Grade flowers, than the control and the other levels of fertilization. What is perhaps even more striking is the large number of Standard Grade flowers produced during March and April. This may be due in part to the higher rainfall and the associated cloud cover experienced during those months (See Graph 4). On the other hand, the increased temperatures during the months of May, June and July may have depressed flower size. However, August, which also had high temperatures, showed a marked increase in the Standard Grade yield.

Table 6 and Graph 5 show the number of sub-standard

	Hawaii Standard	Hawaii Fancy
Flower Head Length	15.2cm (6 in.)	20.3cm (8 in.)
Stem Length	20.3cm (8 in.)	30.5cm (12 in.)

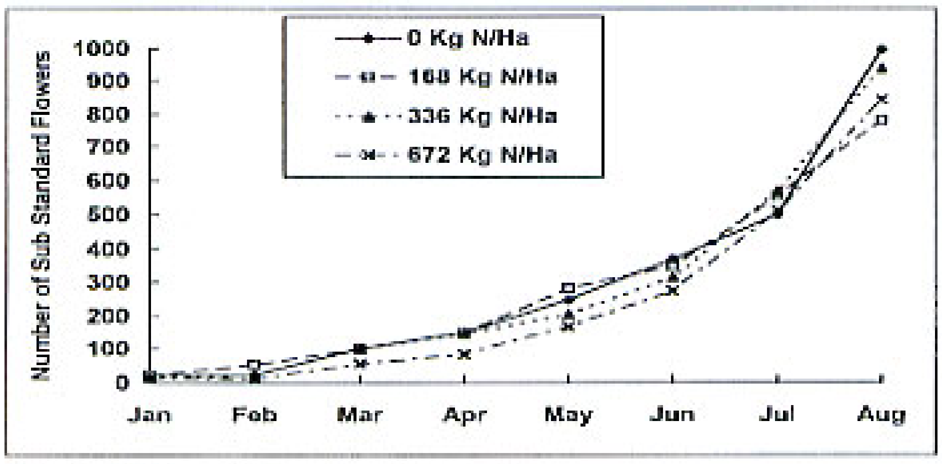
Table 4. Hawaii Red Ginger Standards

Treatment	Feb	Mar	Apr	May	Jun	Jul	Aug
0kg N/Ha	3	78	117	18	51	28	113
168kg N/Ha	11	93	139	40	60	57	117

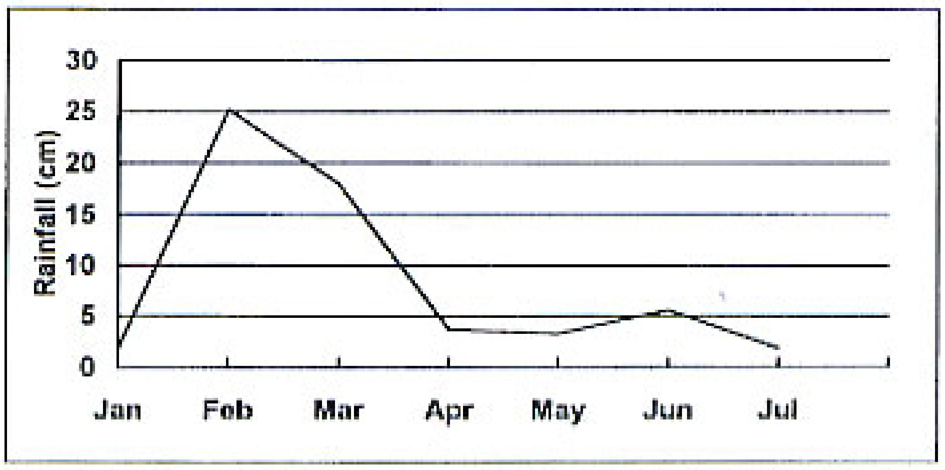
Table 5. Hawaii Standard Grade Flowers

Treatment	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
0kg N/Ha	23	24	100	150	248	370	502	997
168kg N/Ha	23	53	100	149	282	347	557	781
336kg N/Ha	15	22	98	146	205	314	569	939
672kg N/Ha	14	12	56	84	169	275	513	843

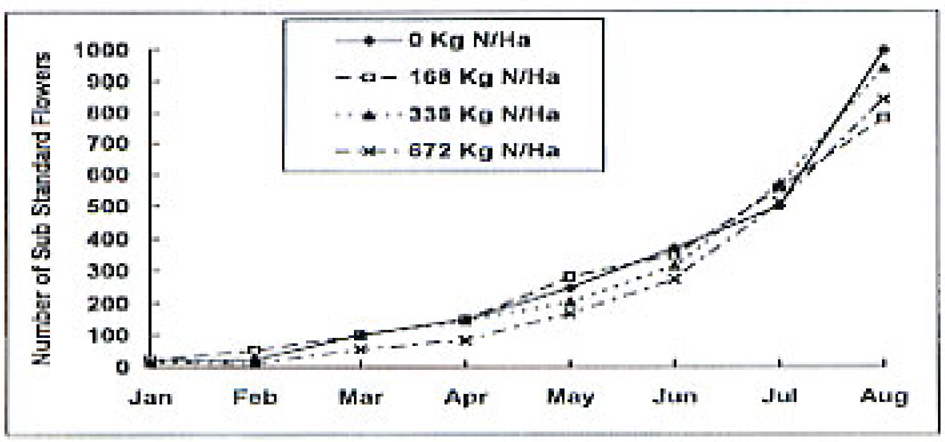
Table 6. Sub Standard Flowers



Graph 3. Hawaii Standard Grade Flowers



Graph 4. Rainfall Distribution at Poamoho Experiment Station



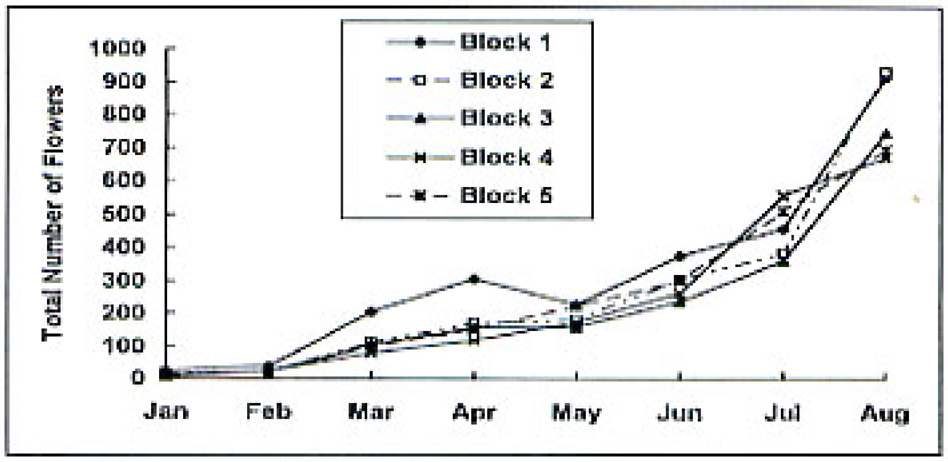
Graph 5. Sub Standard Flowers

flowers harvested. In comparing these with Table 3, and Graph 2, it can be seen that some of the differences found in the total number of flowers were caused by the high number of sub-standard flowers. Also the increased slope in Graph 2 during March and April was caused by the larger number of Standard Grade flowers.

The yield by blocks is shown in Table 7 and plotted in

Treatment	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Block 1	24	40	206	309	231	378	460	918
Block 2	16	21	115	172	183	307	386	936
Block 3	7	21	107	160	161	240	364	748
Block 4	12	24	82	122	176	267	560	676
Block 5	15	22	102	153	226	304	514	699

Table 7. Flower Yield by Blocks



Graph 6. Flower Yield by Blocks

Graph 6. Except for April and May the differences were significant at the .01 level. In addition, the differences in the average plant ratings for the blocks were highly significant. Those plants close to the main irrigation line received water for a longer duration and the ground around them became more thoroughly saturated than around plants further along the rows. The variation in irrigation rates did not produce consistent results in regards to the number of Hawaii Standard Grades. Some months the differences were significant and others they were not. There were a number of interactions between the blocks and the treatments. These need to be studied further.

When the Hawaii Standard Grade flowers were harvested, all but one fully expanded leaf was removed and the stems were cut to 64 cm. They were tagged with their plot number and immediately placed in a bucket with water. Every other day the flowers were individually evaluated using the rating system shown in Table 8. Every fourth day 2 cm. were cut from the stems and the water was replaced. Table 9 shows the average market life and average vase life of the flowers from the plots of the various treatments. Although there appear to be small differences among the averages, they proved not to be significant. Further trials will continue as more Standard Grade flowers become available.

References

1. Criley, R.A., 1984, Yield and Production of Red Ginger and Bird-

Rating	Description
1	Flowers showing no damage
2	Slight discoloration, but still marketable
3	More discoloration (10%) - no longer salable, but still suitable for vase
4	Discoloration expanding to approx. 10 -20%, vase life is questionable
5	Discoloration about 30%, no longer suitable for vase use.

Table 8. Flower Rating System

Treatment	Avg. Market Life (days)	Avg. Vase Life (days)
0kg N/Ha	10.14	16.29
168kg N/Ha	10.87	16.87
336kg N/Ha	9.86	15.36
672kg N/Ha	9.90	14.70

Table 9. Average Flower Shelf Life

of-Paradise at Waimanalo as Influenced by Fertilizer, Planting Density and Season, *Proceedings 2nd Fert. & Ornamentals Short Course*, Mar 1984, CES, CTAHR, Univ. of Hawaii at Manoa HITAHR 01.04.85.

2. *Hawaii Revised Statutes*, Title 4 Dept. of Agric., Subtitle 4 Division of Marketing and Consumer Services, Chapter 42, Standards for Hawaii-Grown Flowers and Foliage, Subchapter 2 Standards for Grades of Flowers and Foliage, sec. 4-42-15.

The Marketing of Tropical Flowers at the Flower Auctions in Holland.

M.L.T.de Kom (Paper presented at the VIIIth International Heliconia Conference)

Introduction

Since there is a lack of written information on the marketing of tropical flowers on the Dutch flower market (auctions), I thought that it is of significance to participate in this conference.

This paper will review our research done in the past years and add some valuable experience I have in the trade of tropical flowers as an importer of these products.

I hope that this information can encourage professional tropical flower production and marketing and eventually can result in a profitable tropical flower business in Holland.

History

Since 1900 Holland has been a major country for the trade in flowers which has resulted today in a flower market concentrated in 9 flower auctions. If we look at tropical flowers and especially *Heliconia* and *Alpinia purpurata*, they have been recorded in statistics of the flower auctions since 1980. Before that time only oral information tells us that there was no regular supply of *Heliconia* and *Alpinia purpurata* from tropical countries. The incidental shipments where done sometimes in wooden boxes and prices could go up to US $7 per stem for a *Heliconia psittacorum*. Before 1973 (the oil crisis) there was an increasing local Dutch production of especially *Heliconia psittacorum* which collapsed due to the high production costs after 1973. From 1980 until 1990 many attempts where made to create a regular supply on the market but all of them failed. Since 1991 there is a growing supply of Heliconia and Alpinia to the market caused by a change in marketing of the product and the increase of professional tropical flower producing companies.

The market

The Dutch flower market is concentrated in 9 flower auctions. The two major auctions for imported flowers are Aalsmeer and Naaldwijk which are responsible for 75% of the turnover of imported flowers. The buyers at the auctions can be classified as follows:

1 - exporters / wholesalers comprising approximately 1800 companies who buy their flowers on the major flower auctions, Aalsmeer and Naaldwijk.

2 - florists representing approximately 10,000 shops who buy their flowers partly through the wholesalers and partly at the other 7 auctions scattered throughout the country.

The following figures 1 and 2 show us the total turnover of flowers on all Dutch flower auctions.

	HFl	US$
1991	3,649,341	1,824,670
1992	3,559,830	1,779,670
1993	3,692,477	1,846,238

Figure 1. Total turnover of ALL flowers on all Dutch flower auctions.(x1000)

	HFl	US $
1991	475,203,000	237,601,500
1992	464,552,000	232,276,000
1993	480,021,984	240,010,992

Figure 2. Total turnover of IMPORTED flowers on all Dutch flower auctions.

The tropical flower market

It is useful to say that tropical flowers can be classified in the following statistical groups:

1 - *Alpinia purpurata*

2 - *Heliconia*
- a - large upright types (like *H. caribaea*)
- b - small flowered types (like *H. psittacorum*)
- c - pendant types (like *H. chartacea* 'Sexy Pink')
- d - others

3 - *Etlingera elatior* (Porcelain Rose)

Our experience has taught us that there was and still is an incorrect use of the statistical groups. This comes about by not using the correct groups as mentioned above and in sales made in statistical groups not mentioned here. We made an allowance for an extra 25 % for this wrong use of groups. This results in Figure 3 which shows us; the total turnover of imported tropical flowers at all flower auctions.

In Figure 4 we show the percentage of the total turnover of all flowers sold, of turnover from imported tropical flowers, at the flower auctions.

	Stems	HFl	US $
1991	278,387	682,049	341,025
1992	391,066	868,166	434,083
1993	763,858	1,642,294	821,147

Figure 3. The total turnover of IMPORTED TROPICAL flowers at all flower auctions

	1	2
1991	0.018	0.14
1992	0.024	0.19
1993	0.044	0.34

Figure 4. The percentage of tropical flowers in:
1 - total flower auction turnover
2 - total imported flower auction turnover

Figure 4 shows us a growth of more then 100% in the sales of tropical flowers at the auctions, but if we look at the total flower auction turnover it is still an insignificant number. But as we know, the tropical flowers are one of the favorites in the total flower sales mainly because of their rare and exclusive appearance.

This information does not mean that a tropical flower can not account for a large dollar volume in flower sales. As an example, the local Curcuma production in Holland in 1993 was responsible for a total turnover of US $ 1.1 million with approximately 880,000 stems. The lesson we can learn from our experience up to now is that small and medium sized tropical flowers can be sold in the flowermarket in large quantities for reasonable prices as long as the vase life tested under Dutch conditions is at least 7 days after arrival in Holland.

The marketing of tropical flowers

In past years we have seen tropical flowers sent to auction without any real knowledge of potential interest or expected selling price. Furthermore the market did not have any knowledge of the expected vase life of the flowers.

In 1993 we changed this way of selling to a policy of rapid sales which resulted sometimes in a lower price but gave us in the end a satisfied customer. This gave the tropical flower a better place in the market of today and traders are now interested in tropical flowers more then before. It is important to know that the low regard for tropical flowers was also caused by a lack of knowledge in the market as to how to correctly handle them, for example heliconias were sometimes put in cold storage at 2°C with the roses. Now the traders are starting to store them beside the anthuriums.

At this time sales of tropical flowers are increasingly handled on the clock auctions. The major reasons why this is happening are:

1 - the quicker handling of the product

2 - larger quantities of flowers can be handled by the auction

3 - modern transportation techniques.

Abstract

There is a lack of written information on the marketing of tropical flowers in Holland. Until 1980 there was no trade of any importance in tropical flowers in Holland, but from 1981 until today there had been initially an irregular growth which lately has been followed by a steady one. Dutch flower sales are concentrated at 9 flower auctions scattered throughout the country. The trade in tropical flowers is of no significance if looked at as a percentage of the total flower auction turnover, but in the past two years there has been a growth of more than 100% in sales of tropical flowers at the Dutch flower auctions. Experience tells us that small and medium sized tropical flowers can be sold in large quantities in this market, but this all depends on correct handling of the flowers and fast sales of the product. Modern transportation techniques will help in achieving this.

Postharvest Studies of *Heliconia* Sp.

T. Lösel and R. Röber, State Experimental Station for Horticulture, Department of Floriculture, Fachhochschule Weihenstephan, D-85350, Freising, Germany

Heliconias are increasingly welcomed by the german customer and are more and more available in our flower shops. To increase acceptance and strengthen the role of heliconias in the flower market, some problems in the postharvest life of these flowers must still be solved. A recent study at the Fachhochschule Weihenstephan has worked on potential post-harvest treatments to be used by wholesalers and florists after the receipt of the flowers. This paper presents the results of these experiments. As an introduction the major postharvest factors influencing keeping quality of heliconias are shown as follows.

Post Harvest Factors

1. The main problem: the lack of water uptake, hence floral preservatives have no or little effect on postharvest life of the cutflowers.

Broschat and Donselman (1983) as well as Tija and Sheehan (1984) showed that water uptake is minimal in heliconias and suggested that microbiological activity in vase water is not the major problem in prolonging vase life.

2. Application of antitranspirants to reduce water loss of bracts.

Ka-Ipo et al. (1989) showed significant improvement in vase life in a trial with *H. psittacorum* Parakeet flowers (23 days versus 17 days) when flowers were dipped in a wax dilution directly after harvest. Among all postharvest practices this seems to be the most promising.

Experiments in Weihenstephan

Our own studies initially tried to improve the water balance of the flowers after harvest. There were two main objectives to be examined in detail:

In the first experiment, we wanted to increase the water content of the stems by immersing them in water for 8, 16, and 24 hours in either tap or deionized water, having in mind the water loss after transport. This trial was carried out with *Heliconia psittacorum* 'St. Vincent Red' , and the hybrid *Heliconia psittacorum* × *H.spathocircinata* 'Golden Torch' (both from the Ivory Coast).

In a second experiment, we tried to improve postharvest life by using antitranspirants in combination with splitting of the stems for about 2 inches to force water uptake. In addition, we applied different water qualities with/ and without a floral preservative. In this case *Heliconia stricta* 'Las Cruces', from Ecuador, was used.

In both experiments the flowers were received after an approximate shipping delay of 5 days, counting from initial harvest. Stems were recut to remove one inch of the bottom. Flowers were arranged in a block design with 4 replications and 3 flower stems per replication. The criterion to determine flower life was the degree of necrosis of the bottom bract of the inflorescence. When it was more than 0.5 inch, it was noted. This was especially true when the colour of the inflorescence was yellow, like 'Golden Torch'. Laboratory conditions were 20° C and relative humidity of 70%. Statistical evaluation was made by using the Bonferroni Test. Treatments methods followed by different letters within columns are significantly different at the 5% level.

	pH	EC in micro-Siemens	mg CaO/l H_2O
Freising's tap water	7.2	690	270
Deionized water	3.5	440	60

Table 1:Water quality used in the trials

The trials showed that there is no general statement possible concerning the influence of water quality used with heliconias. 'St. Vincent Red' seems to have longer shelf life in tap water, while 'Golden Torch' and 'Las Cruces' showed no reaction. (See Table 2).

Vase water	'St. Vincent Red'	'Golden Torch'	'Las Cruces'
Tap water	15.3 a	9.3	7.7
Deionized water	13.9 b	9.1 n.s.	8.0 n.s.

Table 2: Influence of vase water quality on the shelf life (in days) of different heliconias.

The benefit of the immersing process in the first trial with 'St. Vincent Red' and 'Golden Torch' proved significant. Especially the 'Golden Torch' cultivar profited from this procedure. Immersing time (8, 16, and 24 hours) had no further effect on keeping qualities in both cultivars. Nevertheless it is doubtful, if an average of 1 1/2 days prolonged vase life is economically worthwhile. It can be concluded, that the influence of the water quality during the immersing process was negligible.

Treatment	'St. Vincent Red'	'Golden Torch'
Immersed	14.8 a	9.4 a
Not Immersed	13.9 b	7.9 b

Table 3: Shelf life in days of *Heliconia psittacorum* 'St. Vincent Red' and *Heliconia psittacorum* X *H. spathocircinata* 'Golden Torch' immersed in water.

In the second experiment a waxy spray (which is normally used as leafshine) was applied as an antitranspirant on the bracts. As an additional treatment some of the stems were split 2 inches to improve water uptake as it is already known to improve shelf life in Cyclamen cut flowers. There is undoubtably a positive response on the antitranspirant treatment, which seems to reduce desiccation and therefore improves postharvest life. The benefit of this treatment was the most noticeable obtained in the experiments. The shelf life of the antitranspirant coated flowers is about 9 days, nearly a 2 day improvement as compared to the uncoated control. Splitting of stems did not significantly affect vase life.

Treatment	Antitranspirant	Splitting stems
No	7.5 a	8.0
Yes	8.9 b	8.4 ns

Table 4. Shelf life of *Heliconia stricta* 'Las Cruces' after different treatments with antitranspirants and splitting of stalks

Heliconia stricta Las Cruces seems to respond to floral preservatives (Chrysal prof.). The best postharvest life could be obtained in combination with deionized water. However, the results are not very impressive, since increase of postharvest life in the various solutions hardly exceeds 1 day.

Water quality and additive	Shelf life in days
Tap water	7.7 a
Tap water with Chrysal	8.2 a
Deionized water	8.0 a
Deionized water with Chrysal	9.0 b

Table 5. Effects of different water qualities with and without a floral preservative on the shelf life of *Heliconia stricta* 'Las Cruces'

Extending vase life of heliconias is still an uncertain matter. The treatments applied in our institute did not show the expected effects. The antitranspirant treatment did have the most encouraging results. Having in mind that we applied this treatment after a 5 day period of desiccation, it is even more likely that the same treatment applied directly after harvest could have better results. According to the study of Ka-Ipo et al. (1989) and our own experience a treatment with antitranspirants before transport (when still turgid) should be the most promising. Since different practices are used by the producers to remove insects, which consist in immersing the stalks in various solutions, there should be no major problem in establishing an additional dipping process.

References

Broschat, T. K. and H. Donselman. 1983: Production and postharvest culture of *Heliconia psittacorum* flowers in south Florida. *Proc. Fla. State Hort. Soc.* 96:272-273.

Ka-Ipo, R. W. S. Sakai, S. C. Furutani, and M. Collins. 1989. Effect of postharvest antitranspirants on the shelf life of *Heliconia psittacorum* cv. Parakeet cut flowers. *Bul. Heliconia Soc. Intern.* 4(3):13-14.

Tija, B. and T. J. Sheehan. 1984. Preserving profits and beauty.

Seasonality of Flowering in *Heliconia chartacea* and the Potential for its Control

R. A. Criley and S. Lekawatana, Dept. of Horticulture, University of Hawaii, Honolulu, HI 96822

Abstract

Although year-round flowering of *H. chartacea* is potentially possible in Hawaii as new shoots develop regularly, flowering is low in the spring months. The shoots which should flower at this time are produced 40 to 48 weeks earlier in June-August. Since floral initiation occurs after shoot emergence when four leaves have unfurled with 2 to 3 still within the enclosing pseudostem, flower initiation occurs in October-December. In contrast, fall-winter shoots initiate flowers during January-March and average one leaf fewer than summer shoots. The greater leaf count and low flowering percentage of spring-emerged shoots suggest fall conditions are favorable for leaf initiation and unfavorable for floral initiation. An attempt to promote flower initiation during the fall with light break lighting was thwarted by disease.

Introduction

Orderly marketing of heliconia to US Mainland markets requires a stable supply of the principal species and cultivars on a year around basis. Selection of desirable cut flower types remains a problem as there is little published information about cultural requirements and keeping qualities excepting a recent review (Criley and Broschat, 1992). Although species such as *H. psittacorum* are capable of year-round bloom when not limited by cool temperatures (Broschat and Donselman, 1983), many of the popular cut flower types have a distinct seasonality for flowering (Criley, 1989; Hawaii Dept. of Agr., 1990). While substitution is possible for out-of-season types, some heliconias are requested by cultivar name or species for which suitable substitutes do not exist. Even heliconias which produce year-round have peaks and valleys in their supply. One such is *Heliconia chartacea* 'Sexy Pink' which has a period of low production in the spring with high production in summer and fall. This species is native to the upper Amazon drainage region below 500m on the east Andes slopes of Brazil and Peru.

Several factors that control flowering in heliconia have been identified: photoperiod (Criley and Kawabata, 1986; Criley and Lekawatana, 1990; Lekawatana, 1986; Sakai et al., 1990), leaf number (Criley and Kawabata, 1986; Kwon, 1992; Lekawatana, 1986), and failure of an inflorescence to develop (Criley, 1985; Lekawatana, 1986). Manipulation of the environment could enable commercial heliconia growers to meet the demands of their markets for consistent supplies.

The objective of this study was to determine how the growth and development cycle of *Heliconia chartacea* 'Sexy Pink' contributed to its seasonal yield pattern. A second objective was to demonstrate that the seasonal low could be overcome by prevention of inflorescence abortion through daylength manipulation.

Materials and Methods

Two experiments were conducted during 1988-1990 and 1991-1993 in a field at the University of Hawaii Waimanalo Experiment Station on Oahu. The soil is a mollisol, subgroup vertic haplustoll, Waialua series variant (Ikawa et al., 1985). The plants were irrigated by drip emitters mounted on polyethylene tubing. The min/max average temperatures during winter and summer ranged from 15/20 to 22/28°C, respectively.

In the first experiment, initiated April 1988, a minimum of 25 emerging shoots on 20 clumps of 9-month old plants were tagged with plastic tags every two months through November 1990. At two month intervals, the number of unfurled leaves was counted on each shoot, while at monthly intervals, the appearance and flowering of the inflorescence were recorded. Data consisted of leaf counts at two month intervals through the growth of the shoot to anthesis, yields, and development times. Growing shoots with 4-5 unfurled leaves were dissected to determine the condition of the growing point.

In the second experiment, 60 plants of a clone of *H. chartacea* Sexy Pink were established during the summer of 1990 with monthly tagging of a minimum of 100 emerging shoots (first year) and up to 250 shoots (second year) from January 1991 through December 1992. In the beginning, flowers were harvested monthly at the time of tagging, but by mid-1992, harvests were made twice a month. At harvest, the number of leaves subtending the inflorescence was counted. The data for this experiment consisted of yields, leaf counts, and development times.

Temperature and rainfall records were available continuously, but solar radiation data were not available during the first experiment. Data were analyzed using SAS and programs written to use SAS (SAS Institute, 1986).

Results

Results differed somewhat between the two experiments despite the nearly identical plant and soil conditions. While temperatures were similar over the different years, rainfall and irrigation differed, and the second experiment suffered major losses due to *Phytophthora nicotinae*.

Experiment 1.

Dissection of apices of pseudostems which began development during June-July showed reproductive development (3-6 cm) in January-February when 6 leaves had unfurled. Since the floral apex was only 30 - 40cm above the soil line, additional time was required to complete inflorescence development and to elongate the floral stalk to its 1.5 - 2m final length.

The rate of leaf appearance was fairly constant with approximately one new leaf every 5-6 weeks, averaged over 208 inflorescences (Fig. 1A). Rate of production was faster for spring/summer shoots than for those produced in fall/winter (Fig. 1B) while final leaf count decreased from spring/summer to winter (Fig. 2). Approximately 45 weeks were required from shoot emergence to flowering, but there was quite a bit of variation about these means as well (Fig. 1A).

The percentages of flowering were not very high, 66% for the best tagging date (Table 1), but some flowers were lost to unknown heliconia harvesters. When a stalk had not flowered and most of the other stalks of the same tag date had been harvested, we examined the growing point and usually found that it had aborted. It is not clear whether the seasonal trends for flowering reflect marked losses of pseudostems which should have flowered or if the weather lengthened development time.

When the time spent in development was examined by tag date, it appeared that there was a seasonal difference in

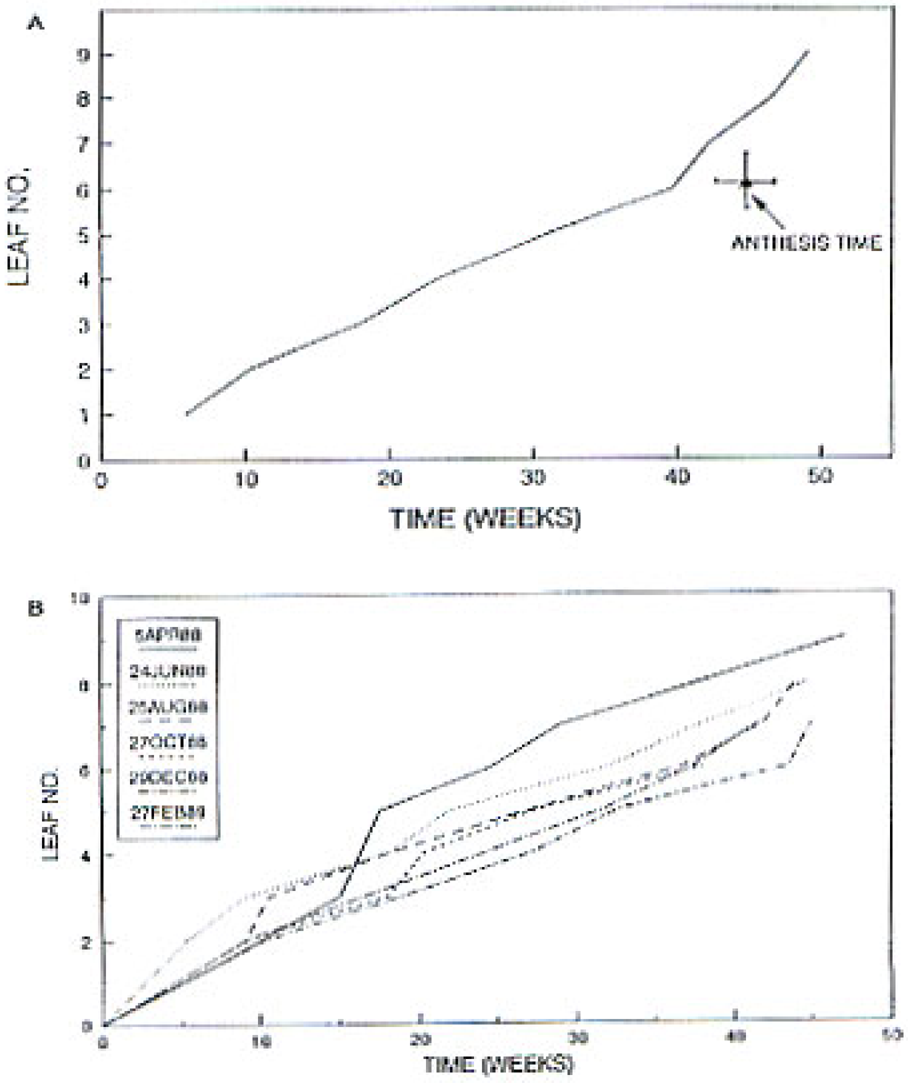


Figure 1. A. Representative plots of leaf production during the first year of study for *H. chartacea* shoots tagged and observed at two month intervals. B. Mean rate of leaf production for 208 *H. chartacea* shoots. Solid triangle represents mean leaf count and anthesis time + 1 STD.

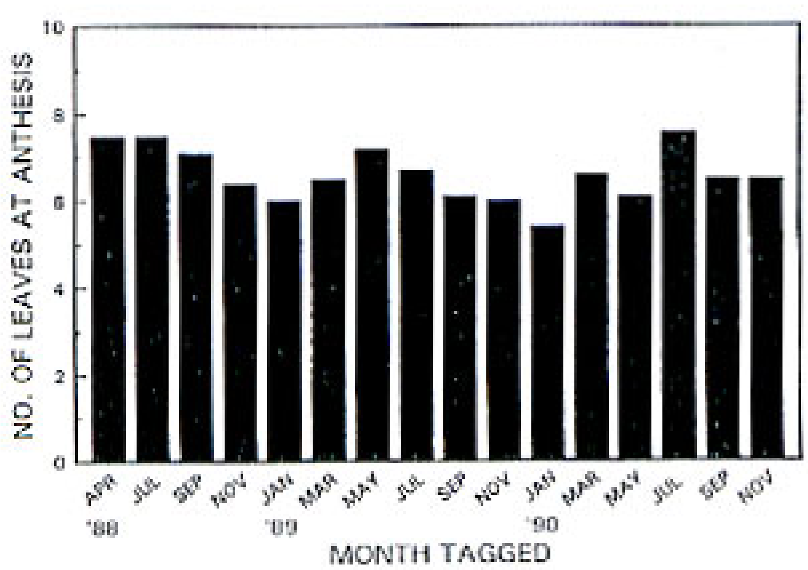


Figure 2. Leaf count subtending the inflorescence for shoots emerging April, 1988 through May, 1990.

time-to-flower. Pseudostems which emerged in summer required a year or more to come into bloom while those which emerged in late fall-winter and early spring required less time (Table 1). The difference in development time was also reflected in the number of leaves subtending the inflorescence (Fig. 2). Leaf number ranged from five per pseudostem up to nine, but averaged 6.2. The trend to a longer development period correlated well with leaf number (R = 0.91, Table 2).

As the inflorescence is probably initiated by the time four leaves have unfurled, with two leaves yet to elongate and unfurl, we looked at development time before and after the four leaf stage for 159 shoots for which the 4-leaf stage could be identified in our records (Fig. 3). This actually turned out to be

Tag Date	No. Tagged	No. of Flowers	Percent Harvested	Weeks to Harvest
APR 88	20	6	30.0	38.2
JUL 88	16	4	25.0	43.5
SEP 88	12	8	66.7	48.1
NOV 88	72	26	36.1	43.9
JAN 89	70	34	48.6	48.4
MAR 89	72	31	43.1	47.6
MAY 89	58	5	8.6	51.8
JUL 89	29	3	10.3	55.7
SEP 89	25	8	32.0	50.0
NOV 89	33	17	51.5	43.4
JAN 90	32	19	59.4	36.7
MAR 90	33	14	23.3	41.9
MAY 90	30	8	26.7	36.8
JUL 90	32	3	9.4	52.0
SEP 90	54	10	18.5	44.8
NOV 90	42	12	28.6	45.4

Table 1. Yields of *H. chartacea* by tag date, flower production expressed as a percentage of the pseudostems tagged at each date, and weeks from tagging to harvest.

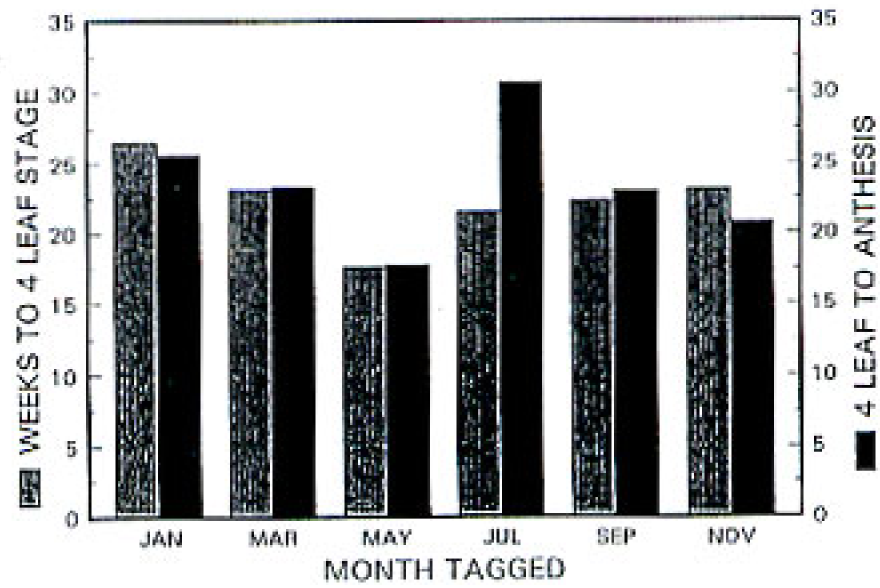


Figure 3. Weeks from shoot emergence to 4 leaf stage and from 4 leaf stage to anthesis pooled across two monthly tagging dates during 1988-1990.

about halfway through the emergence to flower cycle, averaging 24 weeks to the 4th leaf stage and another 21.4 weeks to flowering. Presumably, development of the inflorescence and elongation of its stalk accounted for the longer duration of the second time period as appearance of two more leaves should have taken only 10-12 weeks. It seemed logical that environmental influences during this period would have an important effect on development.

In Table 2 development times are compared for shoots grouped by time to flower. The time to the 4-leaf stage varied by eight weeks while the 4-leaf to anthesis time varied by more than 12 weeks and contributed more to the longer development

Time to flower (weeks)	No.	To 4-leaf stage (weeks)	4-leaf to anthesis (weeks)	Total Time emergence to anthesis	No. leaves at anthesis
30 - 40	39	20.9	14.3	35.2	5.8
40 - 50	107	22.9	21.9	44.8	6.4
50 - 60	42	25.4	26.9	52.3	6.6
> 60	4	28.0	35.0	63.9	7.0

Table 2. Time to flower and leaf number at anthesis for *H. chartacea* at Waimanalo Farm, 1988-1991, grouped by time to flower.

times.

The role of temperature on development was examined. For each day with an average daily temperature (ADT) above 6°C, the difference was accumulated as a degree-day (DD) sum. The DD accumulations were summed and used to determine the total degree-days for the development period of each heliconia shoot which produced a flower. The number of DD units was about 2900 through the production of 4 unfurled leaves, and 2700 during subsequent development (Fig. 4). Some variation would be expected if more than two additional leaves developed before the inflorescence was initiated, as happened in this study.

The time required to develop and unfurl a leaf and the number of DD units/leaf both increased with the number of

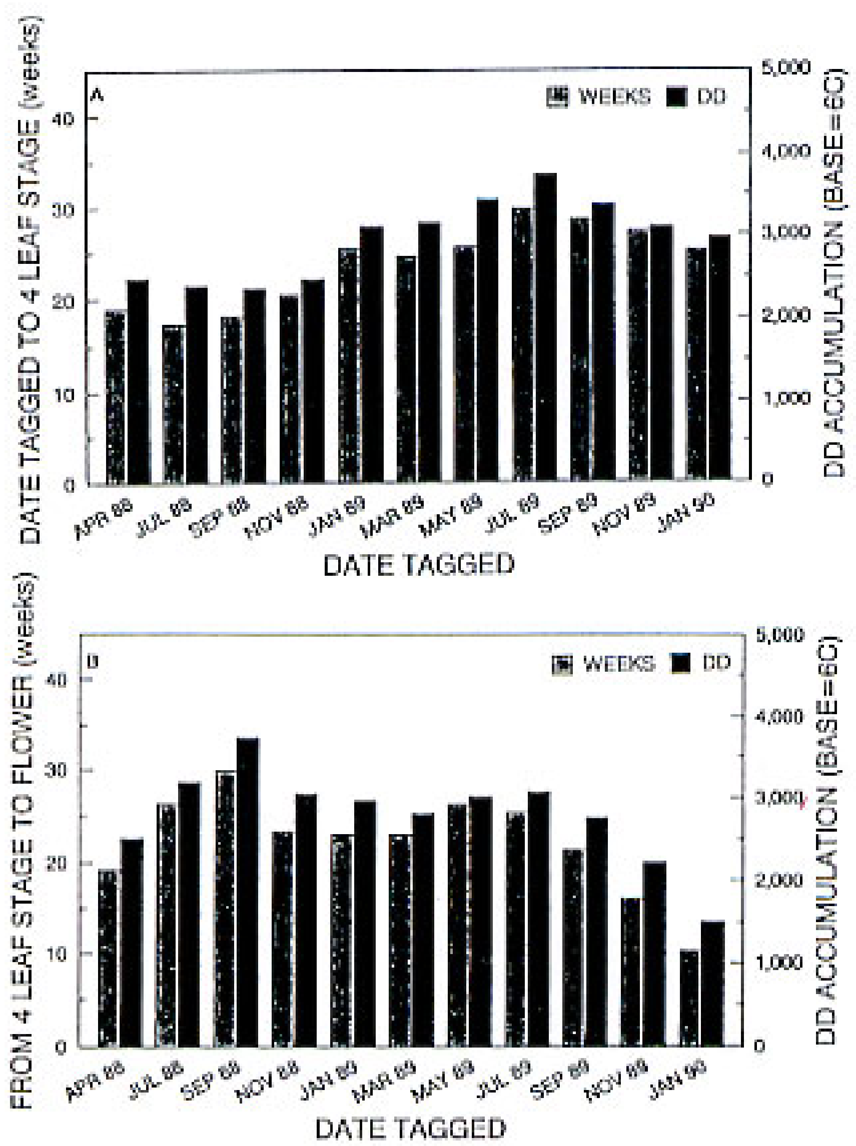


Figure 4. A. Weeks from shoot emergence to 4 leaf stage and degree day accumulations for this period by month of shoot emergence. B. Weeks from 4 leaf stage to anthesis and degree day accumulations for this period by month of shoot emergence.

leaves, at least through 5 leaves (data not shown). The correlations between development time, numbers of leaves, and degree day units were good (Table 3).

We had hypothesized that temperature would affect development time and explain some of the seasonal variation we encountered in flowering of *Heliconia chartacea*. Given the long development times involved and the four week intervals between data collections, we believe that our results supported the hypothesis. Still, given the large proportion of non-flowering pseudostems, factors which may lead to flower bud abortion require examination.

Independent Variable	Dependent Variable	Correlation Coefficient (R)
Development time (weeks) from emergence to flower	Total degree day units	0.995
Number of leaves per pseudostem	Time spent in development (weeks)	0.91
Number of leaves	Total degree day units	0.88
Weeks of development for each leaf that leaf	Degree day units for	0.79
Cumulative time (weeks) at each leaf position	Total degree day units	0.997

Table 3. Correlation coefficients (R) for the relationships among development time, leaf number, and degree day sums for *H. chartacea* during 1988-1990 at Waimanalo Farm.

Experiment 2

There were 944 inflorescences harvested from tagged shoots between the first harvest in October 1991 and the last harvest in December 1993. With a conservative estimate of 3500 shoots tagged, this represents only a 27% return. Some losses were due to disease and drought. In fall 1992, a number of plants were decimated by *Phytophthora nicotianae*, and these were removed from the study. A drought in 1993 stressed the plants in spite of irrigation as they had grown beyond the soil moistened by the emitters. The remaining losses were due to inflorescence abortion.

Fig. 5 shows the yield pattern by month of shoot emergence while Fig. 6 shows the yield pattern by month of inflorescence appearance and harvest. In general, shoots emerging in April-June of any year yielded fewer inflorescences than did shoots emerging in October-January (Fig. 5), and this was similar to Experiment 1 (Table 1). The harvest pattern showed low yields in late winter-spring with high yields in summer-fall (Fig. 6).

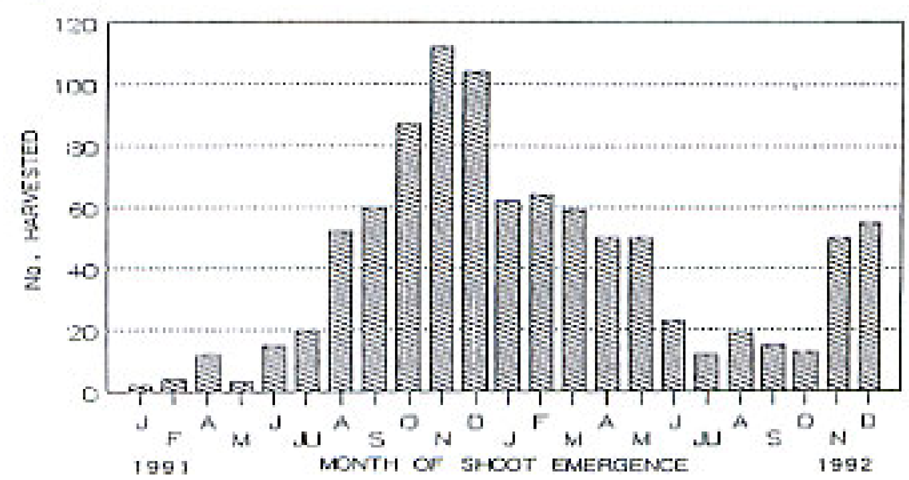
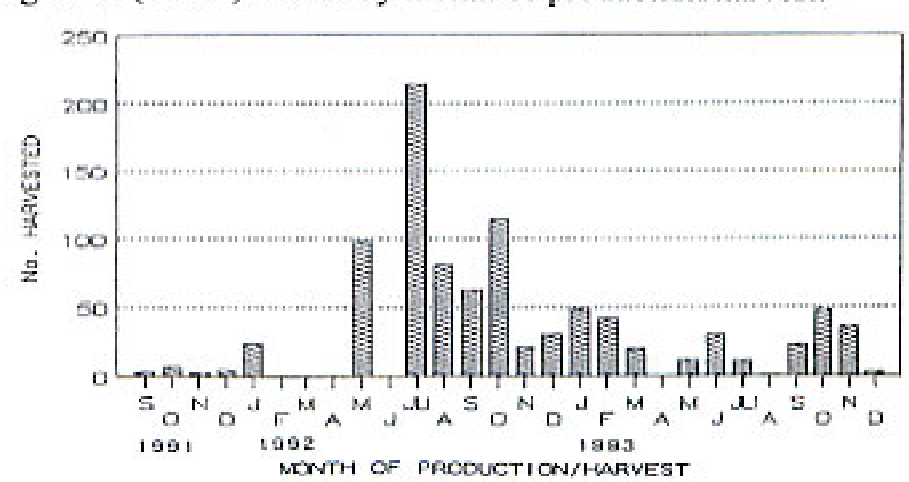


Figure 5. (above) Yields by date of shoot emergence.
Figure 6. (below) Yields by month of production/harvest.



Yields in 1991 were low (Total = 12) because few shoots tagged in early 1991 produced flowers maturing in the same year (x = 30 weeks). Yields in 1992 were high (Total = 652). Yields in 1993 (Total = 280) were diminished because of disease and drought. The high yield months in 1992 were July-October (473 = 72.5%), and few flowers were harvested in February-April or in June. In 1993, the low yield period again included March and April, but May yields were down and summer yields accounted for only 15 % of the annual total. The September-November 1993 yields were 38% of the annual total.

Since 1992 more closely resembled the previous experiment and yields recorded by commercial growers, the remaining focus is on 1992 data.

Table 4 shows the range and modal class for tagging dates of shoots which flowered during 1992. For the zero-harvest months of February, March and June 1992, the month of the modal class for shoot emergence is estimated by interpolation. In general, shoots appeared about 40 weeks before their inflorescences were ready to harvest. This was about 5 - 6 weeks earlier than in the previous experiment.

Harvest in 1992	(N)	Month of Tag Date: Earliest	(N)	Latest	(N)	Modal class	(N)	Main month(s) of shoot origin
January	24	Feb	2	Mar	3	Jun	8	June
February	0							June-July*
March	0							July-August*
April	1					Aug	1	August
May	98	Jun	3	Nov	3	Aug	40	August-Sept.
June	0							Sept.-October*
July	214	Jul	2	Jan	3	Nov	89	Oct.-Nov.
August	81	Sep	2	Jan	11	Dec	41	Nov.-Dec.
Sept.	63	Sep	1	Mar	2	Dec	27	Dec-Jan.
October	115	Dec	13	May	2	Jan	32	Jan.-Feb.
November	21	Jan	1	Apr	4	Mar	8	Feb.-March
December	30	Jan	1	May	1	Mar	21	March

*Estimated

Table 4. Range and modal class for tagging dates, yields per month (N), and month(s) of origin for 1992 harvested shoots. .

Leaf number subtending the inflorescence tended to decrease from the first half of the year to the end of the year (Fig. 7). This would suggest earlier initiation for winter-emerging shoots, but the shoot emergence-to-harvest time showed little change, averaging about 40 weeks (Fig. 8). On the other hand, for shoots which emerged in 1992 and mostly flowered out in 1993, development time increased from 40 to 50 weeks (Fig. 9), probably reflecting slowed growth due to the drought.

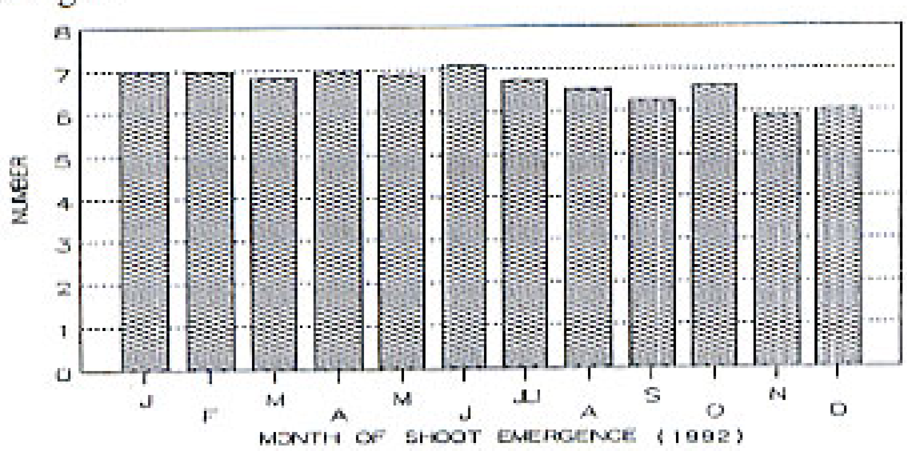


Figure 7. Number of leaves subtending the inflorescence for shoots which emerged in 1992 and were harvested in 1992-93.

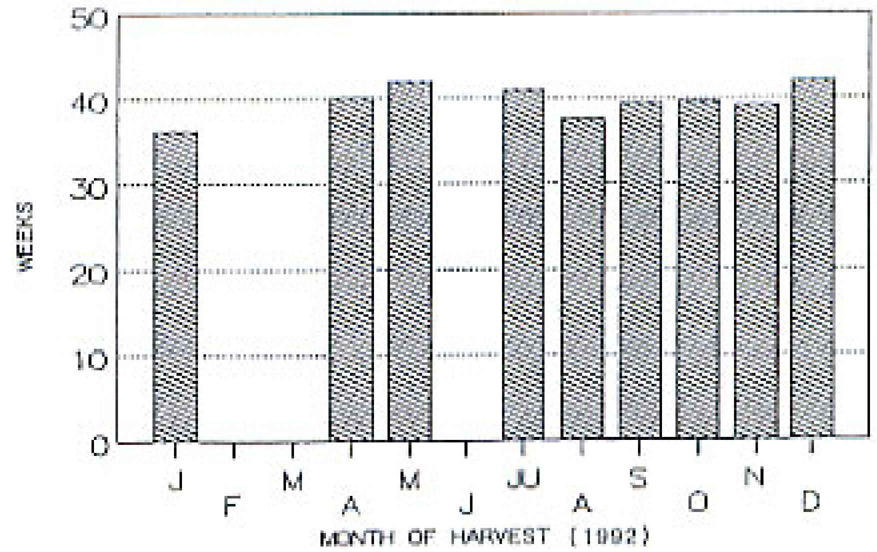
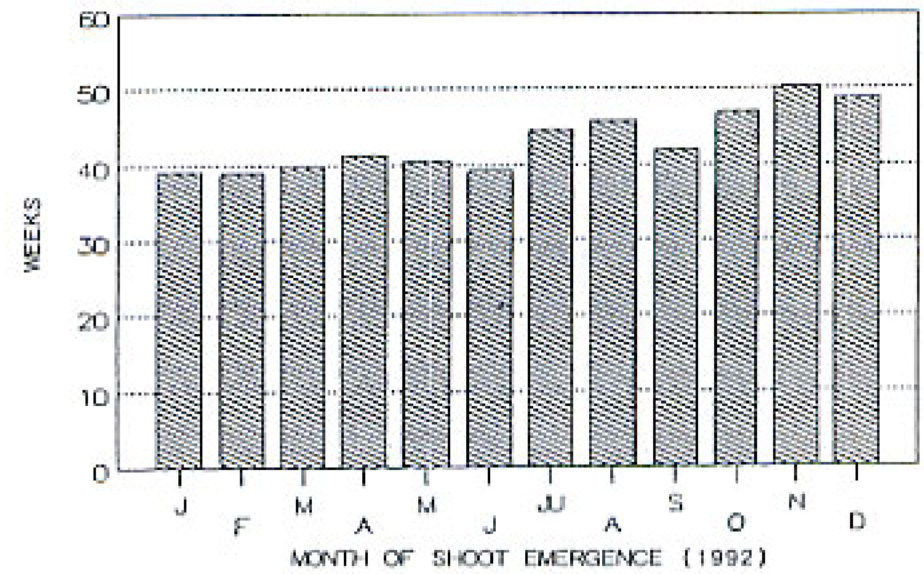


Figure 8. (above) Weeks from shoot emergence to harvest for shoots harvested in 1992.

Figure 9. (below) Weeks from shoot emergence to harvest for shoots emerging in 1992 and harvested in 1992-93.



Discussion

Since inflorescence production was low in spring months for the years 1990 and 1991 (previous experiment, Criley and Lekawatana, 1991) as well as for 1992 and 1993, flower initiation and development were examined to consider what environmental effects might be common to the preceding development periods.

Criley and Lekawatana (1991) reported that a reproductive shoot apex was not apparent until at least 4 leaves were unfurled on the pseudostem. In this respect, *H. chartacea* parallels *H. stricta* (Lekawatana, 1986) and *H. angusta* (Kwon, 1992) Slightly more than one-half of the 45 week development period of the first experiment was spent to arrive at the 4-leaf stage. Subsequently, 2-3 leaves unfurled and the inflorescence emerged. When no inflorescence developed, dissection revealed an aborted apex with poorly developed bracts. Thus, about 6 months after shoot emergence the developing inflorescence is susceptible to some influence which can cause it to abort.

It is evident that the shoots which should flower in the spring months emerge in June-July of the preceding year (Figure 5, Table 4). The sensitive stage for floral abortion is reached in November-December. Apices of shoots from April-June 1992 taggings were uniformly aborted when dissected in April and May 1993 although some flowered earlier in the year and a few flowered later.

Among the flower bud abortion factors may be water stress and warm temperatures. High field temperatures might limit growth or cause flower bud abortion. Hawaii winter temperatures are not limiting to growth (minimum average daily temperatures of 16-19° C), and winter rains are usually sufficient to support plant growth as well. Our field did not receive as reliable irrigation as we would have liked during 1993 due to water rationing at the experimental farm. Rainfall was concentrated in winter-spring during the 1988-1990 experiment. Other environmental conditions which could influence development include daylength and light intensity. The total daily net radiation for November 1992 - February 1993 averaged 7 MJ m-2 for daylengths of 11.6 to 11.9 hours (including civil twilight).

We hypothesized that daylength may have been limiting for development of initiated inflorescences. One hundred emerging shoots were tagged in June-July 1993. Most of these had achieved 4 or 5 unfurled leaves by November 1993. A solar panel and storage battery array provided light breaks from 25 W incandescent lamps to six plants to interrupt the night (15 minutes on, 45 minutes off from 10 PM to 2 AM). Procurement problems prevented the start of this treatment until 18 December. Inflorescences which matured during March-June 1994 were harvested. It was expected that tagged shoots from lighted plants would develop flowers while tagged shoots from natural day controls would fail to develop. However, of 22 inflorescences harvested in April and 6 harvested in May, only one in each harvest carried a tag, hardly sufficient data from which to draw conclusions. With two more tagged shoots harvested in June, a total of four inflorescences from the 100 shoots flowered, while the majority of the shoots succumbed to the phytophthora rot noted earlier. The cause of inflorescence abortion remains unexplained at this time.

References

Broschat, T. K. and H. M. Donselman. 1983. Production and post-harvest culture of *Heliconia psittacorum* flowers in south Florida. *Proc. Fla. State Hort. Soc.* 96:272-273.

Criley, R. A. 1985. Heliconias. pp 125-129. IN: A. H. Halevy (Ed.) *Handbook of Flowering II.* CRC Press, Inc. Boca Raton, FL.

Criley, R. A. 1989. Development of Heliconia and Alpinia in Hawaii: Cultivar selection and culture. *Acta Hortic.* 246:247-258.

Criley, R. A. and T. K. Broschat. 1992. Heliconia: Botany and horticulture of a new floral crop. *Hort. Rev.* 14:1-55.

Criley, R. A. and O. Kawabata. 1986. Evidence for a short-day flowering response in *Heliconia stricta* Dwarf Jamaican . *HortScience* 21: 506-507.

Criley, R. A. and Lekawatana. 1990. Environment influences seasonality in flowering of Heliconia. XXIIIth Int. Hort. Congr. Abstr. 1:376 (Abstr. 1824).

Criley, R. A. arid S. Lekawatana. 1991. Managing seasonality in Heliconia. *Proc. 1990 Hawaii Cut Tropical Flower Conf. Univ. Hawaii.* HITAHR Res.-Ext. Ser. 124: 167-172.

Hawaii Department of Agriculture. 1990. *Hawaii's floral industry and nursery products 1990 export directory.* State of Hawaii Dept. Agr., Honolulu, Hawaii. pp. 50.

Ikawa, H. et al. 1985. *Soils of the Hawaii Agricultural Experiment Station, University of Hawaii Soil survey, Laboratory Data and Soil Descriptions.* Univ. Hawaii, HITAHR Res. Ext. Ser. 002.

Kwon, E. 1992. Flowering of *Heliconia angusta*. Ph.D. dissertation. The University of Hawaii, Honolulu, HI.

Lekawatana, S. 1986. Growth and flowering of *Heliconia stricta* Huber. and *H. angusta* Vell. MS thesis, The University of Hawaii, Honolulu, HI.

Sakai, W. S., A. Manarangi, R. Short, G. Nielson, and M. D. Crowell. 1990. Evidence for long-day flower initiation in *Heliconia angusta* cv. Holiday -- Relationship between time of shoot emergence and flowering. *Bul. Heliconia Soc. Int.* 4(4): 1-3.

SAS Institute. 1987. SAS/STAT Guide for personal computers. Version 6. SAS Institute, Cary, NC

Notices

The University of Hawaii Library has been attempting to obtain back issues of the Bulletin of the Heliconia Society International, so far without success. We need vols. 1-4 (1985-1989), vol. 6 no. 3/4 (1993), and vol. 7 no. 1/2 (1994). If you are willing to donate any of these issues, please contact:

Eileen Herring
Science & Technology Reference Department
University of Hawaii Library
2550 The Mall, Honolulu, Hi 96822, USA
Tel: (808) 956-2543 or 956-8263, Fax: (808) 956-2547

We have two botanists here in Europe that, each year, go on an expedition to China to look for rare palm seeds. We would love to "rescue" *Musa wilsonii*, the "snow banana" to exploit its horticultural and scientific potential but we lack precise locality data.

I would be very grateful if anyone having information about *Musa wilsonii* could write me and send me the available information. Thank you.

Carlo Morici, Via N.Fabrizi,3 98123 Messina, Sicily, Italy.

The Botanical Ark
PO Box 354
Mossman Q4873
Australia

G'day colleagues and friends,

I am happy to report that HSI is still alive and functioning well. Activity has abounded since our last meeting in Frankfurt, and I appreciate having the opportunity to tell you what is happening.

In May a number of Board and ordinary members attended the 2nd UNESCO sponsored Botany 2000 Conference on South Asian Zingiberaceae in Guangzhou, China. Numerous papers were delivered on many aspects of the Ginger family, including systematics, local flora, morphology and cytology, enzymology and phytochemistry, pharmacology and ethnobotany, and conservation and cultivation. The Conference was held at the South China Botanical Gardens and was organized by the South China Institute of Botany and the Guangdong Provincial Association for Science and Technology. Our hosts made it a wonderful experience for all, and cooperation agreements have been initiated to see that Heliconias and other Zingiberales will indeed be growing in China for millions to see.

In July the HSI Board met at the National Tropical Botanic Garden on Kauai, Hawaii, USA. Board members from as far away as Guyana, Washington DC, Singapore, Chicago, Miami, Hilo, Hawaii and even the big island Australia attended.

The 1996 Conference to be held in Miami in July is progressing well and we expect another international class performance of speakers to enlighten us. A few surprises will be in store for delegates as well as a planned post-conference tour to Ecuador. We need to ensure a good attendance, so please feel free to contact the Conference Chairman, David Bar-Zvi (or any Board member) with suggestions on how we can advertise more widely.

At this stage it appears likely that Singapore will host the 1998 Conference, as they submitted the most detailed and spirited bid at the Kauai meeting. Watch the Bulletin for further news in this direction.

I think we all agree that the Bulletin is indeed an essential vehicle for members of the Society. As President, I am happy to say that I am Pleased with the current trend in editorial content and performance. We occasionally receive comments that it could have more scientific content or more commercial content, but in reality the editors have to work with what is available. It is up to members to contribute, or if you are not a writer, to locate contributors to the Bulletin. We cannot rely on the same team of authors to keep coming up with new and exciting articles for us. If you are an artist, provide us with some artwork; if you are a travel person, how about a travelogue; if you are a historian, how about some history; but if you are a sculptor, I'm not sure what to say. How about bringing your work to the meeting in Miami? The Bulletin can only be what the members make it.

Its time again to call for nominations for a new executive and the board members who are up for renewal. Should you have any nominations to make (please be sure that they are current members in good standing), contact the Chairman of the Nomination Committee, Ray Baker at the Lyon Arboretum, Honolulu, Hawaii. We are also in need of a new Treasurer as our beloved and tireless current Treasurer and Co-Editor Gil Daniels wants to concentrate his efforts on editing the Bulletin.

And finally, and possibly the most exciting and controversial item to come before the Board concerns a name change for our organization. Since its inception, the Heliconia Society International has had the aim of representing the whole of the order Zingiberales, which includes the families Zingiberaceae, Costaceae, Marantaceae, Strelitziaceae, Lowiaceae, Cannaceae, Musaceae, as well as the Heliconiaceae. It has been suggested to the Board that the name of our Society should more accurately represent the group as a whole. What do you, as members think? We would like to get your suggestions if we should change the name, and if so to what? And should we change the logo? If so, do you have any artistic suggestions?

If we are going to make a change, it must be a step forward and we must do it to create a more diverse and dynamic Society. It will be up to the members to assist in this important decision. We hope that we can either accept or reject a change at the Miami Conference. Please give it your careful consideration.

Kindest Regards,

Alan Carle,
President HSI

HELICONIA SOCIETY INTERNATIONAL

HSI Headquarters
c/o Fairchild Tropical Gardens
10901 Old Cutler Road
Miami, FL 33156-4296 USA