

行政院農業委員會所屬各機關因公出國人員出國報告書

(出國類別：國際農業科技合作)

夏威夷地區熱帶、亞熱帶花卉及藥用作物種原交流

服務機關：行政院農業委員會農業試驗所

作物種原組	研究員兼組長	范明仁
花卉中心	研究員兼主任	侯鳳舞
作物種原組	助理研究員	王昭月
農藝組	助理研究員	賴瑞聲

國立屏東科技大學		
農園生產系	教授	陳福旗

出國地區：夏威夷

出國期間：92年09月03日至09月12日

報告日期：92年 12月30日

F0/c09300186

系統識別號:C09300186

公務出國報告提要

頁數: 25 含附件: 否

報告名稱:

夏威夷地區熱帶、亞熱帶花卉及藥用作物種原交流

主辦機關:

行政院農業委員會農業試驗所

聯絡人/電話:

林美伸/04-23302301轉202

出國人員:

侯鳳舞	行政院農業委員會農業試驗所	花卉中心	主任
范明仁	行政院農業委員會農業試驗所	種原組	組長
王昭月	行政院農業委員會農業試驗所	種原組	助研員
賴瑞聲	行政院農業委員會農業試驗所	農藝組	助研員
陳福旗	國立屏東科技大學	農園生產系	教授

出國類別: 其他

出國地區: 美國

出國期間: 民國 92 年 09 月 03 日 - 民國 92 年 09 月 12 日

報告日期: 民國 93 年 01 月 12 日

分類號/目: F0/綜合(農業類) F0/綜合(農業類)

關鍵詞: 熱帶花卉、藥用作物、民俗植物

內容摘要: 透過本計畫赴夏威夷地區進行熱帶花卉、藥用作物、民俗植物等種原與資料之收集；並進行雙邊相關種原與資訊之交流。本年度計收集引進33品系之火鶴花種原，其中包含26個野生種。此外由屏東科技大學（農園生產系）相對提供夏威夷農業大學（University of Hawaii at Manoa）火鶴花（Anthurium sp.）品種“Tropical” 3瓶苗；以及農業試驗所提供夏威夷州農部白肉火龍果（Hylocerus undatus）種子（10公克）。藉由此行實際考察並與夏威夷州農業人員進行有關熱帶花卉以及藥用植物育種與研究經驗之交流。後續夏威夷州農業代表與研究人員，亦於本年度（2003年）十月赴臺灣參訪，行程中拜會農委會國際合作處以及農業試驗所，執行雙邊農業研究之交流；另針對茶葉生產、採收與加工技術，參訪茶葉改良場。以上與夏威夷州農業經驗與資訊的互惠交流，將助益於未來雙邊之發展。

本文電子檔已上傳至出國報告資訊網

## 「夏威夷地區熱帶、亞熱帶花卉及藥用作物種原交流」報告書

### 摘要：

透過本計畫赴夏威夷地區進行熱帶花卉、藥用作物、民俗植物等種原與資料之收集；並進行雙邊相關種原與資訊之交流。本年度計收集引進33品系之火鶴花種原，其中包含26個野生種。此外由屏東科技大學（農園生產系）相對提供夏威夷農業大學（University of Hawaii at Manoa）火鶴花（*Anthurium* sp.）品種“Tropical” 3瓶苗；以及農業試驗所提供夏威夷州農部白肉火龍果（*Hylocerus undatus*）種子（10公克）。藉由此行實際考察並與夏威夷州農業人員進行有關熱帶花卉以及藥用植物育種與研究經驗之交流。後續夏威夷州農業代表與研究人員，亦於本年度（2003年）十月赴臺灣參訪，行程中拜會農委會國際合作處以及農業試驗所，執行雙邊農業研究之交流；另針對茶葉生產、採收與加工技術，參訪茶葉改良場。以上與夏威夷州農業經驗與資訊的互惠交流，將助益於未來雙邊之發展。

**COA/USDA Project Final Report (Fiscal Year 2003)**

**Project Title: The Cooperation of Exchange of Ornamental and Medicinal  
Crops Genetic Resources with Hawaii State, USA**

**Code Number: 92-1.4-ID-01**

**Duration: Jan. 1, 2003 ~ Dec. 31, 2003**

**Principle Leader: Jau-Yueh, Wang**

**Cooperation Scientists and Institutions:**

**Prof. Fure-Chyi, Chen**

**Department of Plant Industry**

**National Pingtung University of Science and Technology (NPUST)**

**Investigators:**

**Ming Jen Fan (Taiwan Agricultural Research Institute, TARI)**

**Fong Wu How (Taiwan Agricultural Research Institute, TARI)**

**Fure Chyi Chen (NPUST)**

**Jau Yueh Wang (Taiwan Agricultural Research Institute, TARI)**

**Keng Chang Chuang (Taiwan Agricultural Research Institute, TARI)**

**Ruey Sheng Lai (Taiwan Agricultural Research Institute, TARI)**

**Executing Agency: Taiwan Agricultural Research Institute (TARI)**

## Abstract

Through this project we had exchanged the information of floral crops, medicinal and ethno botanical plants etc., and collected 33 accessions of *Anthurium* which included 26 wild species. Moreover, NPUST provided *Anthurium* cv. Tropical 3 plants *in vitro* to University of Hawaii, and TARI also provided *Hylocerus undatus* seeds (with white flesh) to the Department of Agriculture in Hawaii State. Besides exchanging the breeding information, and research experience of tropical ornamental and medicinal plants, the official agriculture delegations from Hawaii had visited Taiwan on October to courtesy visit the Director of the International Cooperation Department of COA, and to see tea production which include a visit to the Taiwan Tea Research and Extension Station for the information of manufacture equipment for the harvesting and processing of tea. Since these agricultural experiences exchanging will be benefit for both sides in the future.

## Introduction

Tropical and subtropical ornamentals have become more and more important in the world market. Taiwan is located in the subtropical areas with advanced cultivation technology. The market share of *phalaenopsis* and *paphiopedilum* in the world market is also becoming an important industry. Hawaii plays a key role in the collection and utilization of tropical and subtropical ornamentals. It is therefore urgent necessary to establish an exchange program between Hawaii and Taiwan for the mutual interest of providing the genetic resources such as domestic species, *Dendrobium* and other germplasms, which developed by our breeding programs. It will be beneficial to the agriculture development of both countries through cooperation exchange of germplasm material and researcher experience. The experience in biotechnological research of tropical ornamentals and fruits, such as orchids, *Anthurium*, *Cassia* spp., *Plumeria* spp., *Hibiscus* spp. and banana is well established in University of Hawaii. Plant protection study in Hawaii is also recognized worldwide. To improve our environment during agricultural cultivation, the experience developed in Hawaii should be very valuable

The reason for the increase in popularity in herbal medicine is due in part to the fact that many conventional chemical drugs are not only ineffective in treating chronic illness and have the possibility of side effects and resistance effects after long term use, but also to develop a new chemical drug requiring plenty of money and at least ten- year time. The herbal medicine consists mainly of two parts, one is traditional medicinal-plant system, and the other is aromatic-plant system. A total of 5,000

traditional medicinal plants and 1,500 aromatic plants have been evaluated in the past years. But there are still lots of opportunities that can be deserved to study on this field such as many important medicinal and aromatic plants of the Umbelliferae, Labiatae, and Compositae, etc.

## **Material and Methods**

1. Through this project we plan to exchange the germplasm resources of *Anthurium*, lily, and sweet yam etc., especially those have been preserved by National Plant Genetic Resources Center or collected by the Floriculture Research Center. Furthermore, exchanging production, breeding information, and researchers of tropical ornamental crops.
2. Exchanging germplasm of tropical ornamentals such as *Anthurium*, *Phalaenopsis*, *Oncidium* collected by the National Pingtung University of Science and Technology. Scientists from NPUST will be also assigned to assist conducting the cooperation program.
3. Exchange experience or research materials from the results of biotech study.
4. Invite the agricultural researcher from Hawaii to Taiwan for exchanging the experience of tropical and subtropical floricultural industry in both sides.
5. Collecting the information and varieties of medicinal and aromatic plants such as Umbelliferae, Labiatae, and Compositae etc. Moreover, in this year, we would be focus on the usages of ethno botanical plants.

## **Result**

### **Exchanged plant germplasm resources materials**

TARI provided *Anthurium* cv. Tropical 3 plants *in vitro* for University of Hawaii, and *Hylocerus undatus* (with white flesh) seeds 10 gram for the Department of Agriculture in Hawaii State. And through this program, we had collected 33 accessions of *Anthurium* which included 26 wild species from U.S. (Table 1).

Table1. *Anthurium* collections form U.S. in 2003

GENUS	SPECIES	REMARK
<i>Anthurium</i>	<i>sp. mirador</i>	
<i>Anthurium</i>	<i>sp. cristal # 1</i>	
<i>Anthurium</i>	<i>sp. cristal # 2</i>	
<i>Anthurium</i>	<i>sp. cristal # 3</i>	
<i>Anthurium</i>	<i>andreamum</i>	
<i>Anthurium</i>	<i>sp. danza # 1</i>	
<i>Anthurium</i>	<i>sp. danza # 2</i>	
<i>Anthurium</i>	<i>sp. guinda</i>	
<i>Anthurium</i>	<i>oxibellium</i>	
<i>Anthurium</i>	<i>reflexivervium</i>	
<i>Anthurium</i>	<i>sp. bosco</i>	
<i>Anthurium</i>	<i>trifilum</i>	
<i>Anthurium</i>	<i>arisaemoides</i>	
<i>Anthurium</i>	<i>var. carlos</i>	
<i>Anthurium</i>	<i>veitchii</i>	
<i>Anthurium</i>	<i>sp.</i>	Big black flower
<i>Anthurium</i>	<i>cutucuensis</i>	
<i>Anthurium</i>	<i>sp. maria</i>	
<i>Anthurium</i>	<i>palidiflorum</i>	
<i>Anthurium</i>	<i>calomystrinum</i>	
<i>Anthurium</i>	<i>corallium</i>	
<i>Anthurium</i>	<i>sp. mirador</i>	
<i>Anthurium</i>	<i>sp. plan1</i>	
<i>Anthurium</i>	<i>pennigtone</i>	
<i>Anthurium</i>	<i>grubbii</i>	
<i>Anthurium</i>	<i>lancea</i>	
<i>Anthurium</i>	<i>sp. recreo #5</i>	
<i>Anthurium</i>	<i>sp. recreo #6</i>	
<i>Anthurium</i>	<i>semaeophyllum</i> (section)	
<i>Anthurium</i>	<i>sp. soldados #1</i>	
<i>Anthurium</i>	<i>corrugatum</i>	
<i>Anthurium</i>	<i>arisaemoides #2</i>	
<i>Anthurium</i>	<i>warocqueamum</i>	

### Travel Report of Plant Germplasm Resources Collecting and Exchanging

Investigators from TARI and NPUST were assigned to conduct the cooperation program, the delegation members include Dr. Ming Jen Fan; Dr. Fong Wu How; Dr. Fure Chyi Chen (NPUST), Ms. Jau Yueh Wang and Mr. Ruey Sheng Lai. The activities have been executed during ten days of visiting period between Sep.3~12 of 2003, and the major subjects were about floral and medicinal plants' germplasm material and information collection. (Table2)

**Table2. Major activities executed during the ten days of visiting period between Sep. 3 ~ 12 of 2003 when the Taiwanese investigators visited Hawaii , USA**

Date	Visiting Institute	Activities
Sep. 3	Departed for Hawaii	Dr. Ming-Jen Fan; Dr. Fong-Wu How; Dr. Fure-Chyi Chen; Ms. Jau-Yueh Wang and Mr. Lai Ruey-Sheng leaved Taiwan for Hawaii
Sep. 3	Arrived at (Big Island) Hilo	<p>1. Persons visited Mr. Leonard Gines (President of the Orchid growers Association of Hilo) Mr. Greg Braun (Owner of Asia Pacific Flowers)</p> <p>2. Activities executed Cross hybridization, selecting and cut flower producing of <i>Dendrobium</i> spp.</p>
Sep. 4	Hilo	<p>1. Persons visited Dr. Willian Sakai (UH) Dr. Francis Zee (USDA) Mr. James Fang (Orchid grower) Mr. Eric Tanoue (Anthurium grower)</p> <p>2. Activities executed (1) Visiting the University of Hawaii Hilo Horticulture Department and Experimental farm (2) Visiting the U.S. Pacific basin agricultural research Center, Pacific Basin tropical Plant Genetic Resources Management Unit (3) Visiting the Hilo Orchid Farm for Oncidiae pot flower producing. (4) Visiting the Green Point farm for Anthurium pot/cut flower producing.</p>



<b>Date</b>	<b>Visiting Institute</b>	<b>Activities</b>
Sep. 5	Hilo	1. Persons visited David R. Shiigi (Bromeliads' breeder)  2. Activities executed (1) Visiting the hybridizer of Bromeliads. (2) Visiting the producer for Oncidium young plant.
Sep. 6	Maui	1. Persons visited Ms. Jim Heid (Protea grower) Mr. David H. Brown (Heliconias' grower)  2. Activities executed (1) Visiting the Kula Vista Protea farm for Protea's cut flower producing (2) Visiting the Haleakala National Park (3) Visiting the Maui Tropicals & Foliage for cut flower producing of Ginger, Heliconias and Calatheas.
Sep. 7	Maui	Writing up report, survey produce and quality of local markets.
Sep. 8	(Oahu) Honolulu	1. Persons visited Dr. Lyle Wong Madam Sandra Lee Kunimoto (Chairperson, Department of Agriculture, State of Hawaii.)  2. Activities executed (1) Visiting the Ho'omaluhia Botanical Garden (2) Visiting the Department of Agriculture, State of Hawaii.
Sep. 9	Honolulu	1. Persons visited Dr. Rainer W. Bussmann Dr. Adelheid R. Kuehnie  2. Activities executed (1) Visiting the Lyon Arboretum (2) Visiting the University of Hawaii at Manoa (Department of Tropical Plant and Soil Sciences College of Tropical Agriculture and Human Resources)
Sep. 10	Honolulu	1. Persons visited Dr. Heidi A. Lennstrom  2. Activities executed Visiting the Bigshop Museum
Sep. 11	Departed for Taiwan	

**Detail Travel Report:**

**Sep.3, 2003**

**Asia Pacific Flowers visiting**

We arrived at Hilo Airport on Sep.3, the President of the Orchid Growers Association of Hilo, Leonard Gines, picked us and first to visit Asia Pacific Flowers located at Kapoho of Hilo. The owner is Greg Braun, who grows mainly Dendrobium cut flowers and potted plants, Oncidiae. A total of 5 acres for cut Dendrobiums and 2.5 acres for potted Dendrobiums. The oldest cultivar is Hian Beauty from Singapore somewhat 15 years ago. It turned out to be a good producer for flower spikes with pinky white florets. The spikes last long in vase but the plants were infected with cymbidium mosaic virus (CyMV). Professor Aldeheid R. Kuehnle used chemotherapy to get rid of the virus. The virus-free plants look vigorous and flower freely. The only drawback is some bud yellowing or floret drooping when in the spikes. Now, most cultivars were provided by University of Hawaii breeding program through certified propagators. Most cut flowers are from seed propagated varieties after amphidiploid's hybridization. About 60-70% of the cut flowers exported to mainland USA are whites. Some orchid growers even grow 100% white cultivars. Some potted hybrids were either from UH or from Thailand growers such as Burana Orchid. Cross hybridization from selected clones are being tested by the grower to select for elite cut flower and potted varieties. (Fig1)



Fig.1. Greenhouse of "Asia Pacific Flower" farm and excellently quality of Dendrobium.

**Sep. 4, 2003**

**Visiting the U.S. Pacific basin agricultural research Center, Pacific Basin tropical Plant Genetic Resources Management Unit**

We visited the University of Hawaii Hilo Horticulture Department and Experimental farm. Dr. William Sakai showed us around (Fig2). He also took us to visit Tropical Fruit Germplasm Repository led by Dr. Francis Zee (Fig3). Some collection of tea accretions derived from seedlings introduced from both Taiwan and China are being evaluated for their performances. Some lines showed promising for tea growing in Hilo area under the volcano environments. Dr. Zee also showed us about the preservation of tropical fruits and teas through tissue culture. We also visited Dr. Dennis Gonsalves's laboratory, who is the director of USDA Pacific Basin Agriculture Research Center. He is the first researcher developing transgenic papaya for virus disease resistance, in corporation with Dr. Richard Manshardt of University of Hawaii at Manoa. Most papaya field grows transgenic papaya (cultivar Rainbow) with success, especially in the region of Kapoho.

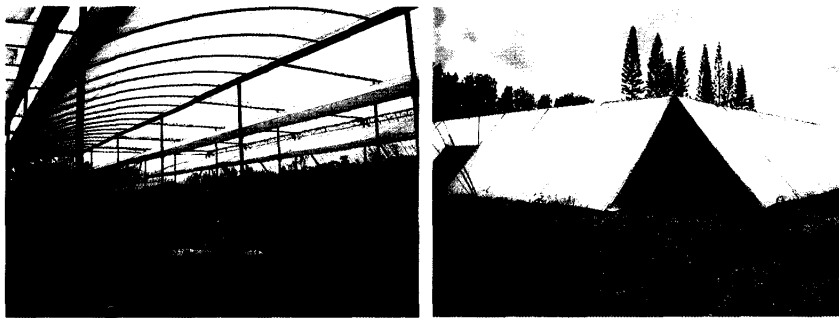


Fig2. Evaluating and testing new style greenhouse in the University of Hawaii Hilo Horticulture Department and Experimental farm.

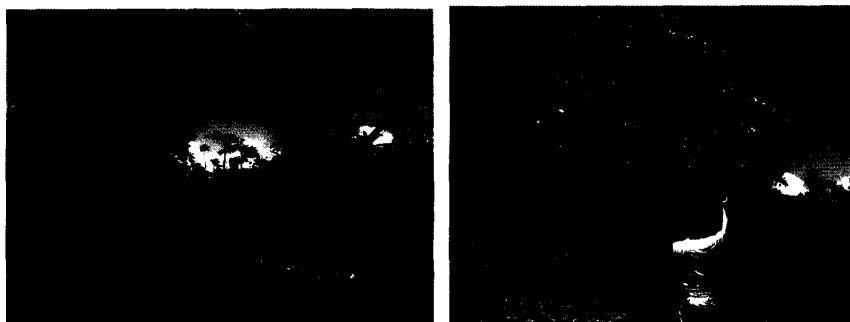


Fig3. Field conservation of the tropical fruit germplasm, such as Longan tree (right) and wild papaya (left) germplasm..

### Visiting the Hilo Orchid Farm & the Green Point Farm

We paid a visit to the orchid grower, Mr. James Fang, who came from Taiwan and grows lots of *Oncidiae* cultivars with very vigorous growth through his able management (Fig4). After that, we visited Green Points, headed by Harold Tanoue. His son, Eric, guided us about the grading and packing of *Anthurium* cut flowers. Many excellent *Anthurium* cultivars are produced, such as the UH cultivar Kalapana, one of the Obake (bicolor) varieties. Several green cultivars also looked very good quality, such as Midori and Jasmine. Some potted cultivars are also being used as cut flowers, such as Lady Jane, Arcs. Several new UH lines are also being evaluated for their performance as cut flowers. The main market is in the mainland US, with very small part going to Japan. The competition of Japan *Anthurium* auction markets comes from Taiwan and Mauritius. So with Taiwan's expertise on growing *Anthurium*, there is still some space for improvement of cut flower quality as well as new cultivar development. To diversify crop choice, some Florida and Netherlands potted *Anthurium* cultivars are also being evaluated for their flowering characteristics (Fig5).



Fig4. The “Hilo Orchid farm” produce very vigorous *Oncidiae* cultivar that running by Mr. James Fang.

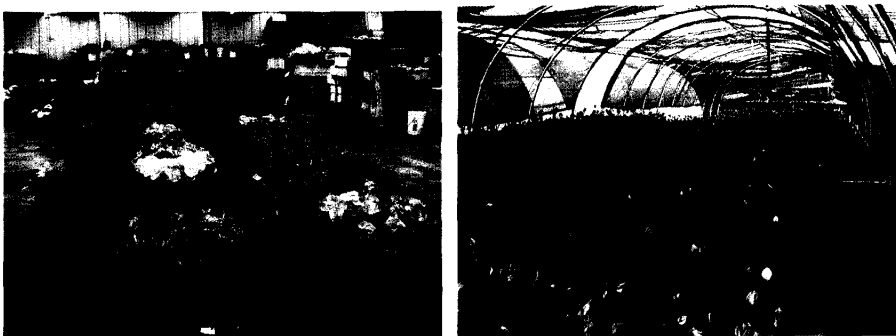


Fig5. *Anthurium* pot flowers (right) and cut flowers(left) are major product items for “Green Point” company.

Sep. 5, 2003

**Visiting the Bromeliad hybridizer: Mr. David R. Shiigi**

We had a wonderful visit to the Bromeliad hybridizer, David R. Shiigi, who lived in Hilo. He has a tremendous, amazing collection of Bromeliad species and hybrids, including the horticultural important genera, such as *Guzmania*, *Aechmea*, *Neoregelia*, *Vriesea*, etc. He is a careful hybridizer with detailed records of flowering habit of each species used in the hybridization. Each species or hybrid has its own time of pollen shed, which is the key to success of cross pollination. Some species shed pollens in the early morning, while some released pollens in the evening. During pollination period, he keeps the plant parts dry until fruit set. A hybridization record was attached in the floret using a small piece of plastic tag. Moreover, He has bred some commercial hybrids for either cut flower or potted plant use, such as *Guzmania* 'Puna Gold', a bright yellow inflorescence cultivar. Other hybrids include *G.* 'Super Alii', *G.* 'Alii' and *G.* 'Super Puna Gold'. He divides hybrids into two different uses: hobbyist use or commercial growing. We were all fascinated by his collected germplasms with either showy leaves or flowers or inflorescence (Fig6). His collection and hybrids have been written by Ronald W. Parkhurst, also a Bromeliad grower in Maui and published as 'The Book of Bromeliads and Hawaiian Tropical Flowers'. Several of his hybrids have been clonally propagated by tissue culture and grown in Hawaii and other countries as cut flower or potted plants. Since Taiwan is an important area producing high quality Bromeliad potted plants, the source of planting materials all are imported from the Netherlands, it is urgently necessary to development techniques of micro-propagation of Bromeliads to supply market demand of young plants. Breeding for cut Bromeliad and potted plant use is also important to help the flower industry more competitive in the international markets. It will be very helpful if mutual exchange of Bromeliad and other tropical flower species between Taiwan and Hawaii, and possibly Florida or California, although a lot of germplasms belong to private collections.

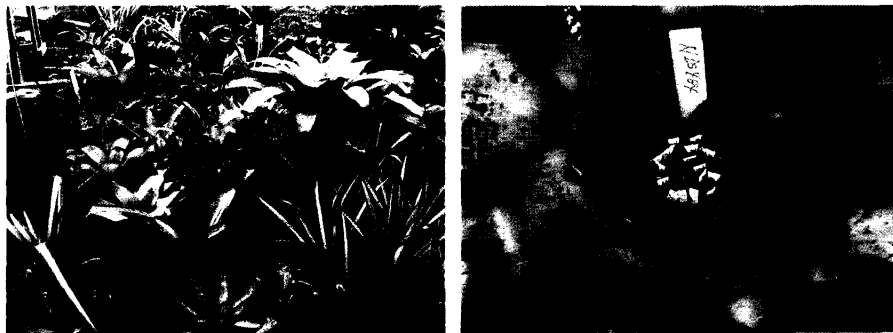


Fig6. The Collections of Bromeliad and hybridizations hold by Mr. David R. Shiigi.

In the afternoon, we planned a visit to the Oncidium young plant producer, The Orchid Works, which located in Hakalau of Big Island. The company has an area of about 5/8 acre. The manager told us they only grow tissue cultured plants, which were done by Thailand tissue culture labs, into plug plantlets. They sell young plants to retailer or growers. One neat method they grow young plant is the use of small foam blocks fitting into the small plug tray. A young Oncidium plant is inserted along the side of the plug hole by single foam, which is ventilated and can keep moisture. This culture feature makes most tissue plants survive and grew very vigorous (Fig7). One problem during acclimatization is the root rot caused by fungi, one of them is *Fusarium*. Another feature of the nursery is the clean ground, which reduced hazardous disease problems. The owner of the nursery also runs a hybridization nursery. It focused on the hybridization of *Oncidium* family, including *Miltonia* (cool species), *Odontoglossum*, and *Oncidium*, and other related genera. Once a good seedling is selected, they put it into tissue culture and look for its performance later for market potential.



Fig7. Two neat methods for growing vigorous Oncidium plantlet, one used small Oasis's blocks fill into a planting tray for younger plantlet (left), and the other used Oasis's cube, but a young Oncidium plantlet was inserted along the side of the plug hole.

**Sep. 6, 2003**

#### **Visiting the Kula Vista Protea and the Haleakala National Park**

An exotic view of Proteas growing in the hillsides of Kula, Maui, was revealed to us when we visited the Kula Vista Protea. We were amazed by the diverse category of cut flowers and cut greens of the Protea family, including four important genera, *Protea*, *Leucospermum*, *Leucadendron* and *Banksia* (Fig8). The Proteas are mainly originated in South Africa and some in Australia and New Zealand. Main growing

areas are in Hawaii. The exotic flower stems and cut greens are exported to many countries, such as US mainland, Taiwan. Year round price is quite stable in order to keep in touch with their customers. Peak season for export is the New Year, Christmas, Valentine, Mother's Day and Chinese New Year. Mostly, Proteas prefers acid soil with good soil porosity but dry soil. Kula areas meet such requirement, which make Maui the most important production and exporting regions in the world. The only pest probably is the dieback caused by *Phytophthora*. Less pesticide is used during year-round production.

After visiting the Kula Vista Protea, we headed on to the summit of Haleakala National Park, with an elevation of 10,023 ft. One of the native plant species is the Silversword (Fig9), a Compositae plant that evolved exclude in Maui islands



Fig8. The "Kula Vista Protea" runned by Mr. Jim Heid, and produced diversely of cut flowers and cut greens of the protea family.



Fig9. Haleakala National Park and the endemic plant of "Silversword" (left) which under the protection.

### Visiting the Maui Tropicals & Foliage Farm

In the afternoon, we visited Maui Tropicals & Foliage, owned by David H. Brown and his son. They grow numerous Gingers, Heliconias, Calatheas, Ti plant (*Cordyline* sp.), Curcumas, Musa. Several new species and hybrids of Gingers and Heliconias are being evaluated in the farm. No pesticide is used in the farm except pre-emergence herbicide to control weeds. This makes some plants with insect damage in the leaves. However, most of the Heliconias and Gingers produce flower spikes with good shape and without insect damage (Fig10). The Heliconias can grow to the height of 2 m or more. Some Ti plants grown in the acid soil with sunburn leaves that probably caused by potassium-deficient leaves, since we saw many tip-burns in the Ti plants. He made several crosses of the Ti from selected clones. The progenies segregated with different leaf shape and plant height. We were so please to see such tremendous categories of tropical and foliage in one farm.

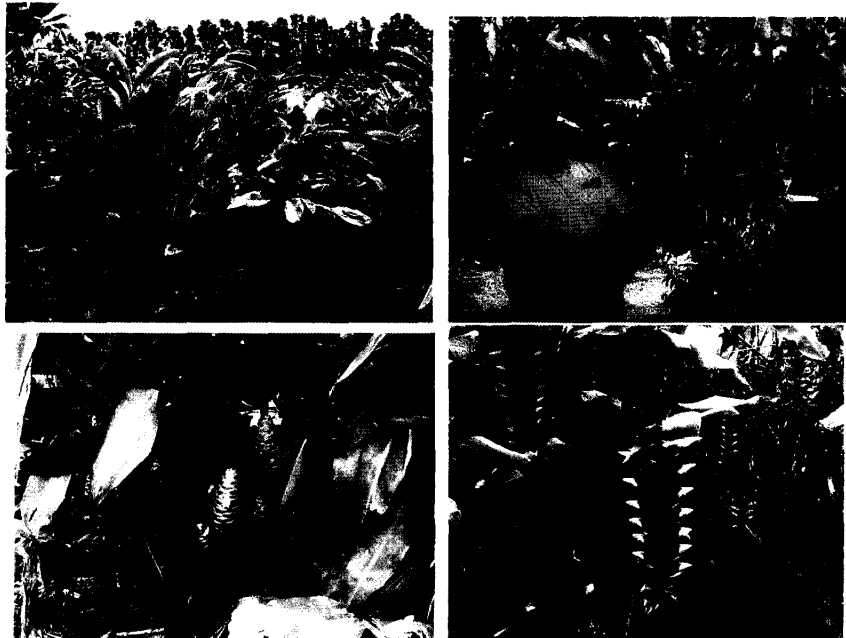


Fig10 “Maui Tropicals & Foliage Farm” owed by Mr. David H. Brown, growing numerous Ginger (left) and Heliconias (right) plants.

### Sep. 7, 2003

Doing paper work that included writing up the report of collections, surveying collection produce, and also to see the quality of agricultural product in local markets.

### Sep. 8, 2003



### Visiting the Ho’Omaluhia Botanical Garden and the Department of Agriculture, Hawaii State

We visited the Ho’Omaluhia Botanical Garden upon arrival in Honolulu International Airport. The Garden is located in Kaneohe site near the Likelike Highway. It is managed by Honolulu City Council with Foster Botanical Garden as the main gardens headquarter. It wide collection of rainforest trees and tropical plant species from the world was arranged in a 400-acre area (Fig11). The main purpose is to conserve plant species and educate public. Some studies have been done by New York Botanical Garden and pharmaceutical companies regarding to the chemical composition and potential health promoting function of the collected plant materials. The strategy in the management of the Garden is a good experience for Taiwan to learn. Another function of the Garden is to serve as a buffer of flood protection for the community.

Furthermore, informal meeting with Dr. Lyle Wong to discuss current progress of mutual agreements set during last year by previous Minister Mr. Fan, Chen-Chung, and delegates, including Director of International Cooperation, of COA, Mr. Ming Lai Wang. Moreover, we met with Chairperson of the Board of Agriculture, Hawaii, Madam Sandra Lee Kunimoto regarding further cooperation. Some understandings were achieved to strengthen bilateral agreement in exchange of plant germplasm resources and related information. The germplasm per se does not include commercial cultivars that may be covered by patents or intellectual property rights. Accessions of species or land races may be considered for future exchange after some communications. Hawaii Agriculture Department acknowledged receiving two packs of germplasm material from Taiwan include *Hylocerus* seeds (10 grams) and 3 plates of *in vitro* Anthurium hybrid for their experimental needs. They agreed to provide information of ethno botanic surveys and arranged a visit to the Bishop Museum, where most information of local ethno botanical uses is being established. In the other hand, Hawaii likes to obtain ethno botanic information from Taiwan.

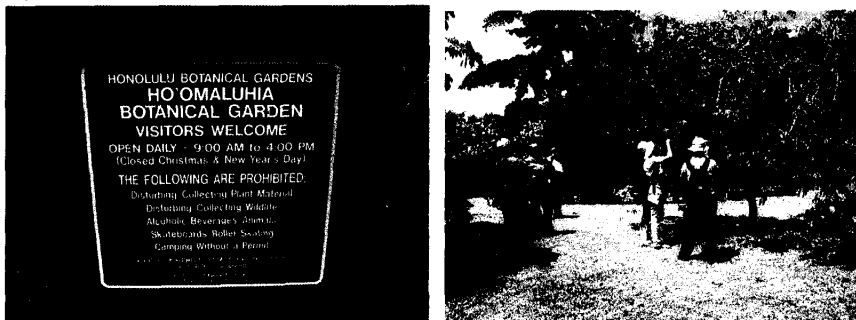


Fig11. Ho’Omaluhia Botanical Garden wide collected the rainforest trees and tropical plants species from the world.

**Sep. 9, 2003**

**Visiting the Lyon Arboretum**

A guided tour of the Lyon Arboretum was set for us in the morning. In the arboretum, wide collection of tropical plants, especially Palms, Aroids, Bromeliads are displayed (Fig12). Ethno botanic use of many collected plant species are being evaluated for their pharmaceutical potential and chemical components related to health function. An informal discussion about the future cooperation in duplication of rare or endangered plans from both Hawaii and Taiwan can be set up and conserved *ex situ*. The participating tissue culture laboratories include those from Lyon Arboretum, Taiwan Agricultural Research Institute (Genetic Resource Center, Agronomy Department), Floral Research Center, and National Pingtung University of Science and Technology (NPUST), Department of Plant Industry. Professor Will C. McClatchey of the UH Botany, an expert in the field of ethno-botany, expressed his interest for further cooperation. An alternative exchange program for tropical plant species between NPUST and Lyon Arboretum was also mentioned, as NPUST and UH are the sister universities. Graduate exchange program between UH and NPUST can also be strengthen so that graduate students can apply for a short or long term visit study in either sides.

**Visiting the University of Hawaii at Monoa**

We met Professors Adelheid R. Kuehnle (Heidi) and Richard M. Manshardt in the Department of Tropical Plant and Soil Sciences. Heidi explained her current research on biotechnology approaches of flower color modification of Dendrobium orchid, which is the most important orchid in Hawaii. Several color genes of anthocyanin biosynthetic pathway have been cloned and transferred into the orchid genome (Fig. 13). The purpose is to create novel flower colors such as purple, orange, or pure white. She showed us briefly about Anthurium research and conservation of germplasm (species, cultivars). Professor Fure-Chyi Chen, a member of the visiting group, is a formal PhD graduate student under the guidance of Heidi. Exchange of floral germplasm was achieved this and last year, including 4 species (current one being *A. formosum* seedlings from sibling and germinated *in vitro*) to NPUST and two (*Oncidium* Gower Ramsey and *Anthurium* hybrid, both tissue culture materials) to UH. NPUST will duplicate Anthurium species and transfer to the /flower Research Center located in Ku-Keng.

**Sep. 10, 2003**

**Visiting the Bishop Museum**

Bishop Museum of Honolulu has been known worldwide for its collection and study of Hawaiian and Pacific Islanders' plants, cultures. We were accompanied by Dr. Lyle Wong to visit Dr. Heidi A. Lennstrom, a paleo-ethno botanist, and Dr. Christopher F. Puttock, a collection manager of the Herbarium. Useful information related to the most used plants in Hawaii, education on identification of plant species for kids, literatures on ethno botanical studies have been posted on a website for public accession. A scientific garden was designed with a small creek and grown with many native plant species (Fig14), such as taro (Karo) cultivation and usage, native cotton species, to educate children and publics. Dr. Puttock also explained how plant species were collected, including those native species, introduced or established species. Some 600,000 accessions of plant specimen were annotated and put into database. The Herbarium was helped by many volunteers for preparing and processing of collected plant materials. Molecular fingerprinting using RAPD has been used for identification of plant species of Myrtaceae regarding to their genetic diversity in Hawaii islands. A study was also conducted to identify an eel introduced as pet and reproduced in some lakes.

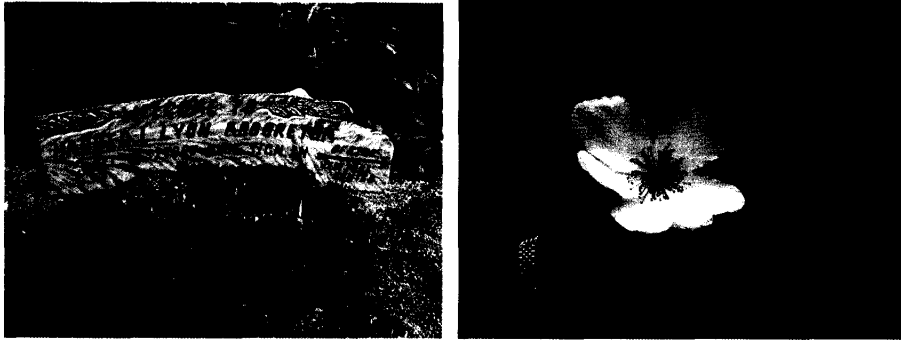


Fig12 “Lyon Arboretum” widely collect the tropical plants, especially palm, Aroids, Bromeliads etc., and the right one is *Hibiscus arnottianus* which is endemic at O’AHU.



Fig13. Dr. Adelheid R. Kuehnle and her laboratory for flower color modification of *Dendrobium* by transgenic technique at the University of Hawaii.

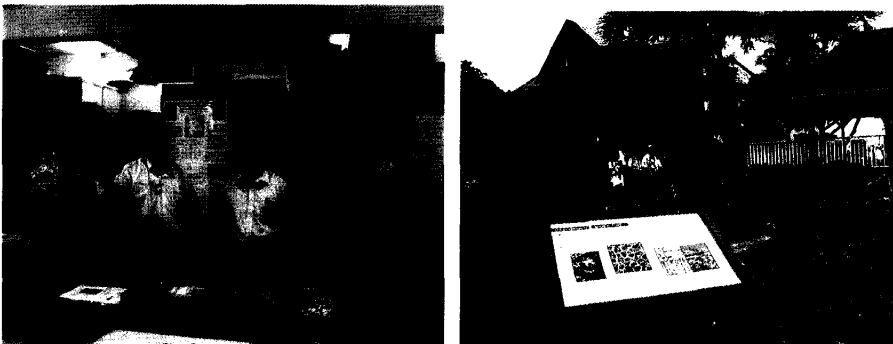


Fig14. “Bigshop Museum” has 600, 000 accessions of plant specimen, and a small creek which grow with many native plant species.

**Scientific Cooperation activities with the US (Hawaii State)  
counterpart in 2003**

The official agriculture delegations from Hawaii, include Dr. Andrew Hashimoto (Dean of College of Tropical Agriculture and Human Resources, University of Hawaii), Mr. Russel Kokubum (Senate of Hawaii State), Mr. Milton Yamasaki ( Farm manager of University of Hawaii ) , and Mr. Dwight Sato ( County agent of University of Hawaii ). Delegations visited Taiwan on October 28 to courtesy visit the Director of the International Cooperation Department of COA, and to see tea production that include a visit to the Taiwan Tea Research and Extension Station for the information of manufacture equipment for the harvesting and processing of tea (Table3 & Fig15). Since these agricultural experiences exchanging will be benefit for both sides in the future

**Table 3.Itinerary for visitors from State of Hawaii in 2003**

<b>Date</b>	<b>Visiting Institute</b>	<b>Activities</b>
Oct.28	Arrived at CKS International Airport	Visit National Palace Museum
Oct.29	1. Council of Agriculture, Executive Yuan 2. College of Bioresources and Agriculture, National Taiwan University	1. Visit Ping Lin Tea Museum 2. Courtesy visit the Director (Ming Lai Wang) of the International Cooperation Department of COA, and the College of Bioresources and Agriculture of Taiwan University
Oct.30	Tea Research and Extension Station(TRES), COA	Visit the facilities and research specially in tea, at the Tea Research and Extension Station
Oct.31	1. Taiwan Agriculture Research Institute, COA 2. Yu-chi Tea Branch Station, TRES, COA 3. Yu-chi Farmer's Association 4. Formosa Aboriginal cultural Village	1. Briefing about the overall agricultural research at TARI 2. Visit the Plant Germplasm Resources Center, and the Agricultural Engineering Department of TARI 3. Visit the facilities and research specially in black tea.
Nov.1 (Saturday)	Departure for Hawaii	

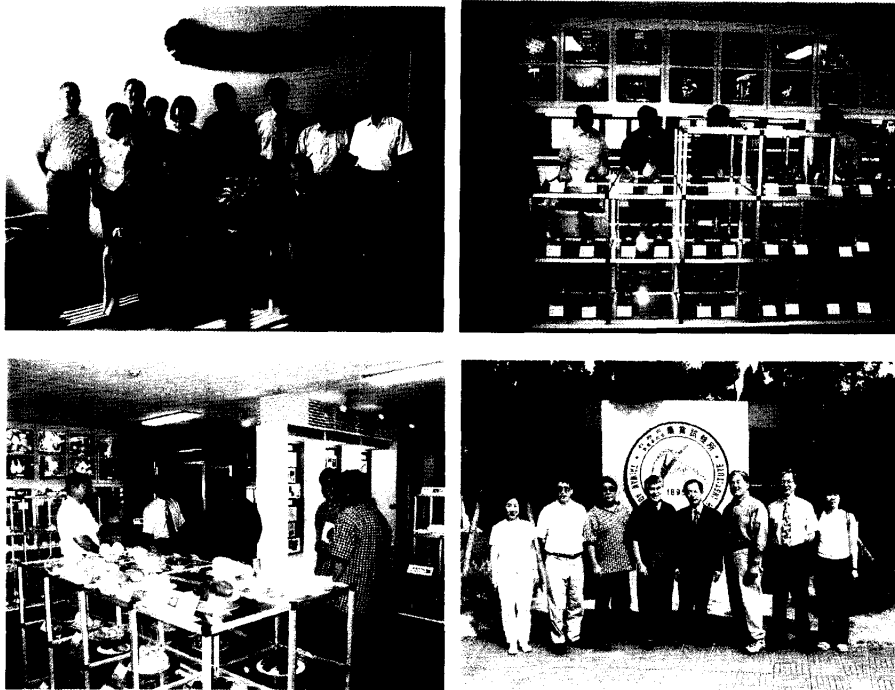


Fig15. The official agriculture delegations from Hawaii visited Taiwan Agricultural Research Institute on Oct.31 of 2003.

### **Conclusion and Recommendations**

1. From the current experience during this trip, we strongly suggest to maintain and strengthen the bilateral relationship between Taiwan and USA.
2. Representatives from both countries are urged to discuss the operation of germplasm exchange as described in the project. Recommended party of USA may include the chairperson of Board of Agriculture, Hawaii, or other suitable representatives. An equivalent representative from Taiwan is recommended to lead a group of researchers from institutions, such as National Plant Genetic Resources Center of Agricultural Research Institute.
3. Research on medicinal herbs is emphasized as current and future strategies to cope with modern crop industry in Taiwan. It is suggested that exchange of research information as well as plant materials should be strengthened in the future.
4. A visit of scientists, official employers, professors from Hawaii is invited to Taiwan to see its ornamental industry and medicinal crop industry and research, so that mutual interest in the exchange of germplasm can be strengthened from both countries.

5. Visiting study or research to agricultural institutions and universities in Taiwan is encouraged to work together common interest topics.

### **Acknowledgements**

This trip of visiting ornamental nurseries, botanical gardens, and University of Hawaii, Hilo and Manoa campus, has been very successful with thoughtful discussions and exchange of ideas. We are very grateful to those who helped arranging our visiting schedules, including Sandra Lee Kunimoto, chairperson of the Board of Agriculture, Dr. Lyle Wong, Larry M. Nakahara of the Department of Agriculture, Hawaii, Leonard Gines, the President of Hawaii Orchid Society, Kelvin Sewake, Dr. Tessie Amore. We also like to express our sincere thanks to the growers, curators, students, volunteers, who were so kind to share their experience. Without their assistance, this trip will not be so fruitful. Thanks were due to the USDA-Sino bilateral germplasm exchange project sponsored by Research and Scientific Exchanges Division, International Cooperation and Development, USDA, where the funds came from. The financial and executive support from Council of Agriculture, Taiwan to all visiting members was appreciated.

## References

- Gutmanis, J. 2002. Hawaii Herbal medicine. Island Heritage. Hong Kong.
- Kepler A. K. 1997. Hawaii Floral Splendor. Mutual Publishing. Taiwan.
- Kepler A. K. 1997. Maui's Floral Splendor. Mutual Publishing. Chain.
- Pratt H. D. 1998. A Pocket Guide to Hawaii Trees and Shrubs. Mutual Publishing. Thailand.
- Sohmer, S. and R. Gustafson. 2000. Plant and Flowers of Hawaii. University of Hawaii Press. Singapore.
- Stevens R. 1981. Tropical organic Gardening Hawaiian Style. Petrogyph Press. Hilo.