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Rear—First Journal photo of *Vriesea fribergensis* var. *fribergensis* from Brazil. Photograph by Vern Sawyer.

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Editorial

In This Issue

This month sees a break from the discussion of our member suvey to summarise the Annual meetings held just prior to the World Conference last year. I have tried to give you a reasonable summary of what was discussed and decided, without including too much detail of who had motions etc. Members are entitled to a full account of the meeting, and if you want them you have only to ask me and I will email or post you a copy of the official minutes.

Scientific

We have another paper based on the Tillandsia symposium at the World Conference last June, this time Carolina Granados gives an overview of tillandsia in Sierra de Juárez, Mexico (p.6) Simon Pierce found some amazing werauhia species growing on huge stems in Panama (p.12) and Jason Grant introduces two new pitcairnea species from the Venezuelan Andes (p.16).

Cultivation

Original articles for the cultivation section have been hard to come by, and this issue the Editor had to make a hurried contribution about his trials feeding nitrogen to tillandsia seedlings. You know how to avoid having future contributions from his desk!

Regular contributor Derek Butcher backgrounds a new neoregelia hybridised by Allan Freeman in Australia, and named 'Madam President' for Madam President. Tom and Carole Wolfe show us the culmination of 20 years growth by their V*riesea gigantea* var *gigantea* that certainly was a giant.

General Interest

Oscar Ribeiro sent us some photos from Brazil of ants eating his alcantarea, and from this we learned of work being done by Howard Frank and his students on leaf-cutting ants in Venezuela - his report is on page 34. Art is a wonderful way to display bromeliads, particularly to a wider audience. On page 38 we have a picture of a "Pineapple applique" made by Calandra Thurrott and exhibited at the World Conference in San Diego. Ken Marks has been enthralling us with his adventures seeking out Florida's native bromeliads, and he finishes off with a "nutans nocturn" beginning on page 39. I owe Ken an apology for not crediting him with the fine photos he used to illustrate his first 3 papers. This time, he has graced his article with photos from photographer Rick Cruz.

Carolyn Schoenau reports on another affiliate show, this time the Southwest Bromeliad Guild Show held last September. We have the upcomming events on page 46, then on the back cover Harry Luther introduces *Vriesea fribergensis*, with a photo first submitted to the Journal in 1997!

Francisco Oliva-Esteve advises that he has changed his email address since his advert. in our last issue. francisco_oliva32@hotmail.com

Annual Meetings 2006

The meetings of the members, and of the directors of the BSI, were held on June 6, 2006, prior to the World Conference. Joyce Brehm presided. Three members, from the UK, USA and New Zealand, who attended the member's annual meeting stayed on to observe the Director's meeting.

The BSI Survey was discussed at length. Initial focus was on the need to increase membership. The idea of an on-line, web-based, society was discussed at great length including how various societies are dealing with this shift in membership demands and expectations. Three vital issues were identified: first was the tardiness of the Journal, (which we have now fixed); the second is main taining membership numbers; and the third is what the BSI can do attract and keep new members through the affiliate societies. Another set of objectives to focus on are plants, information (programs, presenters), and sources to purchase plants. It was suggested that a commercial growers list be put together for the Journal and to be included in the new member packets. Another suggestion was to put together a list of programs and speakers/presenters available to affiliates and making these programs available on DVD/CD and the website that, for a small fee, can be downloaded. On-line plant auctions were then discussed. Many ideas were offered but it was decided that member-only plant auction/sales had the most interest.

All the information needed to put on a World Conference has been put onto a CD.. This is a compendium of all the experience from the last four World Conferences. It is 244 pages in length printed, on disc it can be copied and distributed as needed.

The Judges Handbook is in its final stages of revision, and should be ready for discussion at the next Board meeting. The Bromeliad Society of New Zealand wants to set up a judging school.

New member packets were including the cultural brochure, a copy of the latest Journal and 6 back-issues. It was decided to include also a copy of a bromeliad vendors list. The free back-issue promotion will end on 31 March, 2007.

BSI archives are held at the Marie Selby Botanic Gardens in Sarasota, Florida. Purchase of a new fire-proof cabinet for these was agreed.

The Conservation Chair was granted $1000 to hire a part-time graduate botany student to help with setting up a Conservation Corner web page and a conservation strategy document to be published in the Journal. The Board expressed a desire that this should be something that separates the BSI from all the other conservation websites and publications, i.e. more than just a plea to save the rainforests.

The Cultivar and Media Chairs wanted to know how to get people to pass on their old slides of plants. There are several individuals who have slide collections that need to be digitized and discussion ensued on how to get them to part with them for that purpose. Time is working against the project of digitizing these slide collections. It was decided to put out pleas in the Journal (forthcoming!) and on the website for submission of these historically important images.

In response to requests from members for a hard copy of the cultivar register, which is currently only available on the website, it was agreed to produce a CD version with periodic updates. Printing hard copy would be formidable as there are now over 7800 plants registered.

Harry Luther is to be provided with a part-time assistant to help in his clerical duties. He stated that the assistant would be required for approximately 10 hours per week. Harry also mentioned that more and more specimens for identification are coming in over the internet thus circumventing the fee requirement for identification. He stated that the fees weren't all that much in the first place and he asked for direction from the Board as to whether he should continue with this method of submission and identification. Harry pointed out that true specimens are worth something to his institution. The Board decided that the $5 fee charged per submission would be continued for this very worthwhile service.

The BSI library has traditionally been held by the Editor. The incoming Editor did not think it would be wise to ship it to New Zealand, and it will remain at the Marie Selby Gardens. $1000 for 2006 was voted to purchase new books for the library, with the inventory to be reviewed at the 2007 Board meeting.

The Seed fund is still short of seeds for supply to members. The Board is working to set up a system to enable seed purchases over the internet as well as by mail.

The Media Chair talked of making the programs available on the web for downloading by affiliated societies. Discussion ensued about copyright issues, pirating, and keeping the library fresh with continuing expansion of the library. Shipping was also discussed. He suggests $10 for downloading the programs and $15 for shipping CD. He also puts out a plea for slides that concern genre, collecting trips, judging refreshers, classification, etc. These can be transferred to CD, Powerpoint, and DVD's with narration. The idea of publishing proceedings of the World Conferences was also discussed. The definition of abstracts versus full proceedings and what the expectations of the authors are regarding the publishing of their papers. It was decided that the BSI is very close to what is expected within the scientific community.

It was agreed to appoint Herb Plever of New York an Honorary Trustee, and to award the Wally Berg Award of Excellence to Harry Luther.

Future World Conferences were discussed. In the member survey one of the comments was that the WBC was only held within the US. There was discussion about the problems that need to be overcome in having a WBC outside the US. Planning logistics and costs were also discussed. It was agreed to hold the World Bromeliad Conference 2008 in Cairns Australia.

It was decided to print the Journal entirely in color. There was also discussion regarding the international shipping of the Journal, and this will be looked into.

The 2007 Budget was approved.

Taxonomic study of the genus *Tillandsia* L. (*Bromeliaceae*) in the Sierra de Juárez, Oaxaca, Mexico

Carolina Granados Mendoza[1]

Abstract

The species of the genus *Tillandsia* L. represents one of the most important seasonal earnings for the inhabitants of the *Sierra de Juárez*. The goal of the present work is a checklist of the species of this genus in the region. The *Sierra de Juárez* harbour 29 species of *Tillandsia* L. which represents 15% of the total species reported for Mexico. We also registered four taxa with a distribution restricted to the state of Oaxaca, and we found 2 new species.

Key words: *Tillandsia* L.**,** *Sierra de Juárez***,** Oaxaca, Mexico.

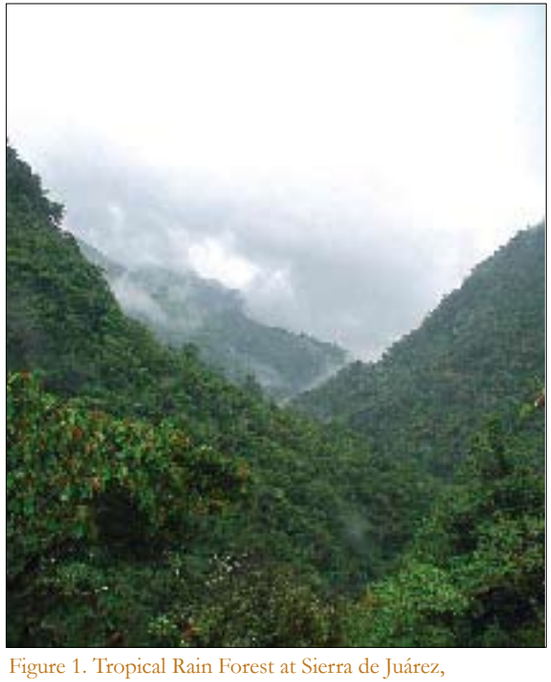

Figure 1. Tropical Rain Forest at Sierra de Juárez, Oaxaca. Photograph by Carolina Granados.

Introduction

The neotropical family *Bromeliaceae* Juss. (Espejo-Serna and López-Ferrari 1998, Barfuss, Samuel et al. 2005) has about 3000 species divided into 56 genera of which *Tillandsia* L. has the majority of species (Luther 2004.)

In Mexico the genus *Tillandsia* L. is represented by nearly 200 species (Espejo-Serna, López-Ferrari et al. 2004), Oaxaca is the state with highest species richness (ca. 90 spp.). This group is distributed in almost all the vegetation types found in the country, existing as a very conspicuous element of the epiphytic flora.

The tillandsias have a variety of uses, which includes food, forage, medicinal, and above all as ornamental (Flores 1998). At Christmas time it is common to find

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Figure 2. *Tillandsia carlos-bankii* Matuda individuals offered for sale at Calpulalpam de Méndez, Oaxaca. Photograph by Carolina Granados.

many species on sale in seasonal stalls at local markets (Figure 2) (Rees 1976).

These plants represent one of the main sources of seasonal earnings for many communities in the *Sierra de Juárez*. The correct use and conservation of this resource requires precise and reliable information, which is why we set out to do the taxonomic treatment of the genus *Tillandsia* L. in the zone with the purpose of giving an accurate checklist.

Study zone

The *Sierra de Juárez* is a group of mountains located in the North East of the State of Oaxaca (Figure 1). It covers an area of approximately 3,500 km^2 (WWF and IUCN). The *Sierra de Juárez* has an intricate topographic arrangement which results in a heterogeneous collection of climates and vegetation types. Rzedowski and Palacios (1977) described the vegetation types, mentioning the tropical rain forest, the cloud forest with relics of *Engelhardtia mexicana,* the oak and the pine forest.

Torres (*in prep.*), in his study about *Sierra de Juárez*, listed approximately 2000 species of vascular plants present in the area, of which nearly 130 have a restricted distribu-

Figure 3. *Tillandsia achyrostachys* E. Morren ex Baker from Guelatao de Juárez, Oaxaca. Photograph by Víctor Martínez.

Figure 4. *Tillandsia bourgaei* Baker from San Andrés Huayapan, Oaxaca. Photograph by Víctor Martínez.

tion. The *Sierra de Juárez* is one of the best conserved and rich areas; in fact, it has been considered one of the most important floristic diversity centers in the world by the WWF and IUCN (IUCN 1997).

It is inhabited by Zapoteca and Chinanteca communities with a rich culture (García-Mendoza, Ordónez et al. 2004). Despite being one of the poorest regions in Mexico, its people have a special interest in education and also possess a wide knowledge of their natural resources, which is an important factor in their family economy.

Method

We checked the available taxonomic literature about the genus; in addition we examined the herbaria specimens deposited in MEXU, ENCB, FCME and OAX. The fieldwork consisted of collecting specimens at localities that were previously poorly explored.

The species identification was made by examining dry material, keys, comparison with original descriptions and type specimens, and field notes. Also, information about the phenology was collected.

Figure 5. *Tillandsia carlos-hankii* Matuda from Calpulalpam de Méndez, Oaxaca. Photograph by Carolina Granados.

Figure 6. *Tillandsia fasciculata* Sw. from Ixtlán de Juárez, Oaxaca. Photograph by Carmen Loyola.

Results and discussion

After the examination of herbaria specimens and our collections we concluded that 29 species of *Tillandsia* L. are distributed in the *Sierra de Juárez*. We assigned scientific names to 27 of the 29 species of *Tillandsia* L., while the remaining 2 were considered new species and are currently in the process of being described (Granados and Torres, *in prep*)

As we mentioned, one of the most important uses of these plants in the region is ornamental, especially in Christmas season. The species most used for this purpose are: *Tillandsia achyrostachys* E. Morren ex Baker (Figure 3), *T. bourgaei* Baker (Figure 4), *T. butzii* Mez, *T. calothyrsus* Mez, *T. carlos-hankii* Matuda (Figure 5), *T. fasciculata* Sw. (Figure 6), *T. gymnobotrya* Baker, *T. imperialis* E. Morren ex Roezl (Figure 7), *T. juncea* (Ruiz & Pav.) Poir., *T. macdougallii* L. B. Sm. (Figure 8), *T. multicaulis* Steud., *T. oaxacana* L. B. Sm., *T. punctulata* Schltdl. & Cham., *T. schiedeana* Steud., *T. sierrajuarezensis* Matuda, *T. usneoides* (L.) L. and *T. violacea* Baker.

Figure 7. *Tillandsia imperialis* E. Morren ex Roezl from San Pedro Yaneri, Oaxaca. Photograph by Víctor Martínez.

It was observed that most species of *Tillandsia* L. in the region bloom or fruit in April and December. The specific richness of *Tillandsia* L. in the Sierra de Juarez is - without any doubt - important, since it represents approximately 15 % of the *Tillandsia* L. species reported for Mexico by (Espejo-Serna, López-Ferrari et al. 2004). We registered 15 national endemics, of which 4 are restricted to the state of Oaxaca: *T. carlos-hankii* Matuda, *T. sierrajuarezensis* Matuda, and the 2 new species restricted to the *Sierra de Juárez*. The floristic studies by (Ortiz 1970), with zero species reported, and (Villa 1999), with seven species, did not mirror the specific richness of the genus in the *Sierra de Juárez*, although these studies did not concentrate on bromeliads. However, (Espejo-Serna, López-Ferrari et al. 2004), in their extensive work at national level, contributed considerably to the knowledge about *Tillandsia* L. in the region by mentioning 22 species.

It is our wish for this study to be not only of interest for taxonomists but also to become a useful tool for people not specialized in the subject, especially for the inhabitants of the *Sierra de Juárez*.

Figure 8. *Tillandsia macdougallii* L. B. Sm. from Ixtlán de Juárez, Oaxaca. Photograph by Gerardo Salazar. See front cover.

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Leviathans of the cloud forest: epiphytic bromeliads with woody stems

Simon Pierce[1]. Photographs by the author

Figure 1. *Werauhia capitata* at Cerro Jefe in central Panama, showing a woody pseudostem approximately 50 cm long attached to the trunk of the host tree.

Bromeliads are not famous for their stems, but a small number of species do actually have substantial woody stalks. Perhaps the best-known example is *Brocchinia micrantha*, which is the only arborescent bromeliad. According to Smith and Downs (1974) this species can reach 8 m in height, with a columnar, woody stem up to 15 cm in diameter). Epiphytic *Werauhia* species may have substantial stems at the center of a dense rosette, but these rarely extend beyond the rosette. However, *Werauhia capitata* may have woody stems reaching around 50 cm in length, which are attached to the trunk of a host tree by lateral roots, and covered in black, rotting leaf bases (Figure 1). Here I present photographs of two species that I believe are new to science and which have woody stems that can achieve a length of over two metres. Unfortunately, during my two years living and working in Panama (February 1999 to April 2001), I only ever found old infructescences and one half-eaten pale yellow flower, which is not enough to be certain of their identity. From the structure of the infructescences and the flower, and the fact that they grow in a similar fashion to *Werauhia capitata* and *W. jenii*, I firmly believe that they are both species of *Werauhia*, but I'm afraid I'll have to leave the job of formal description to someone with more time on their hands. However, seeing these beasts in nature was an amazing experience, and the fact that they are epiphytes with long woody stems is something rare enough that it is worth reporting.

Both species were photographed on or around the summit of Cerro Jefe, central

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Panama's highest peak (1007m) where they are relatively common, although younger plants without obvious stems are easily confused with *Werauhia lutheri* (Pierce and Aranda 2000) or, for the redder species shown in Figure 2, with *Vriesea monstrum*. In an earlier publication, dealing with the physiology of bromeliads at Cerro Jefe, I referred to these species as "*Werauhia* sp. nov. 1" and "*Werauhia* sp. nov. 2" (Pierce, Winter et al. 2002), but as it is not my intention to name these species I shall refer to them informally hereon as "Leviathan 1" and "Leviathan 2", to reflect the great size and age of mature plants. I cannot be certain of their age, but given that bromeliads are slow-growing plants with leaves that live for a number of years, and that the rosettes are dense and sit atop stems of considerable length, I would not be surprised if these plants have a lifespan in the order of 100 to 150 years. I invite anyone to test this, but before starting please ensure that your children are willing to carry on your observations.

Figure 2. "Leviathan 1" – an unknown species with a woody pseudostem, growing at the summit of Cerro Jefe.

These species do not have free-standing trunks like that of *Brocchinia micrantha* – a small number of apparently freestanding individuals were found, but these were actually anchored to the stump of a dead host tree and leaned on nearby plants for support (including the plant shown in Figure 2). Stems were typically attached to the trunk of a host tree along their entire length by adventitious roots, in the manner of *Werauhia capitata*. Leviathan 1 is characterized by down-turned leaf tips, and for plants growing in sunny positions these are marked with red pigment like splashes of blood (Figures. 2-4; plants growing in the shade may lack this pigmentation). The infructescence has the radial symmetry and large fruits typical of *Werauhia* species (Figure 4). The longest stem that I measured for this species was 94 cm (Figure 5), although the base had rotted away and it is impossible

Figure 3. A dense rosette of Leviathan 1 showing the down-turned leaf tips.

Figure 4. An old infructescence sticks out laterally from a plant of Leviathan 1

Figure 5. A plant of Leviathan 1 with a pseudostem 94 cm long.

Figure 6. A plant of "Leviathan 2" growing on the northern slopes of Cerro Jefe.

to be certain how much previous growth had been lost. Leviathan 2 is a more slender species with longer stems and pale green leaves forming a relatively erect rosette. I could not measure the tallest individuals, as I was not suitably equipped at the time, but I estimate that the stems were approximately 2.5 m in length (Figure 6). An old infructescence, grazed flower and possible seedlings are shown in Figure 7.

Bromeliads have "monocarpic" shoots, meaning that they die after flowering (the growth point that creates the shoot switches from producing leaves to producing flowers, and then dies), but growth can continue from lateral buds. This has profound implications for such potentially long-lived plants as the Leviathans shown here. Either the plant flowers just once at the end of a long life, after having produced a single long stem, or it can flower and then continue to grow from lateral buds, repeating this process a number of times throughout its life. Which situation applies here? Several clues point towards the latter. Firstly, a range of stem lengths is apparent for flowering individuals of *Werauhia capitata*, from almost non-existent to half a metre (Figure 1), suggesting that maturity is reached by relatively small plants that can continue flowering later in life. Also, inflorescences of large *Werauhia* species tend to stick out sideways from the plant, with the inflorescences inserted below the crown of the plant (e.g. Figure 4; also *Werauhia jenii*; Pierce 2001). This indicates that after the inflorescence has been formed by the main growth point a single lateral bud then takes over the role of vertical growth and forms a new crown. What we think of as a continuous stem is actually a sequence of shoots that emerge vertically from one another (generations of daughter shoots sitting on top of one another, and directly linked together by their stems). In botanical terms, the overall stem is not really a stem but a "pseudostem" formed by modules that grow sympodially from one another by intravaginal tillering (illustrated in Figure 8).

For the record, when I first saw these plants I was shocked by the ordinary-looking

Figure 7. Leviathan 2 with an old infructescence. Inset photos show (starting top right, moving clockwise): the only (and half-eaten) flower to be found in two years; a bromeliad seedling found amongst a colony of this species; the structure of an old infructescence.

rosettes seemingly glued to stems of a different plant – it was chimerical, like a lion's head on a goat's body, and I remember tracking the pseudostems almost down to the ground and thinking how bizarre and impossible they looked. I was also awed by the realization that these plants were probably several times older than me (I was 26), and that the forest I was standing in had been undisturbed for a very long time. The trees in this vegetation are short and slender, and it is easy to think of them as well-developed saplings, but in fact cloud forest trees are natural bonsais, because high rainfall leaches nutrients out of the soil and retards plant growth, and the forest is deceptively old. The fact that these large and distinctive bromeliads have remained undiscovered until now is particularly unexpected when you consider that central Panama, home to the Smithsonian Tropical Research Institute, is one of the most highly studied regions in the American tropics, and Cerro Jefe, where the bromeliads have been scrutinized by professional botanists since the mid twentieth century, is the most accessible and closest cloud forest to Panama City. This could indicate that there is a wealth of undiscovered biodiversity hiding in even relatively familiar places, although I suspect that these species have been seen before, but folding them onto herbarium sheets was too inconvenient.

Acknowledgements

I thank Dr. Aurelio Virgo for the photograph of the half-eaten flower.

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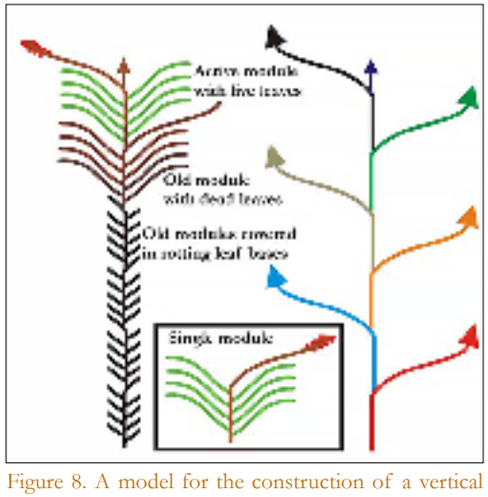

Figure 8. A model for the construction of a vertical bromeliad pseudostem from repeated modules via sympodial growth.

Pitcairnia albo-lutea and *P. oliva-estevae*: two new species from the Andes of Venezuela

Jason R. Grant[1]

Abstract. Fieldwork conducted in the Venezuelan Andes has revealed two new species here described as *Pitcairnia albo-lutea* J.R. Grant and *P. oliva-estevae* J.R. Grant.

During fieldwork conducted in the Venezuelan Andes with Francisco Oliva-Esteva, numerous collections of Bromeliaceae were made. Among these were two species of *Pitcairnia* identified in the field as potentially new. Subsequent herbarium studies at the U.S. National Herbarium of the Smithsonian Institution (US) revealed additional material and verified that these were indeed two new species. The descriptions and measurements of the flower parts below are largely based on alcohol-preserved material. If measurements from herbarium specimens differ from the alcohol-preserved material, those measurements are indicated in brackets.

Pitcairnia albo-lutea J.R. Grant, sp. nov. **Type**: Venezuela. MERIDA: San Isidro between Barrinitas and Santo Domingo, 8° 52' 362" N, 70° 40' 390" W, 16 April 1999, *J.R. Grant* & *F. Oliva-Esteva 99-03409* (holotype US [2 sheets]; isotype SEL). Photos 1-3.

A *Pitcairnia maidifolia* (C. Morren) Decne. ex Planch. cui affinis, inflorescentia semper polysticha, rhachidi lutea, bracteis florigeris luteis angustioribus et sepalis luteis bracteis florigeris brevioribus differt.

Plant terrestrial, to 0.85-1.00 m tall in flower (according to label on *Steyermark et al. 107703*). ***Leaves*** dark green, persistent, entire, long-pseudopetiolate, 66-136 cm long in herbarium material (1.0-2.5 m long according to labels on *Bunting 2287*; *Dorr et al. 5684*); ***sheaths*** castaneous, rather inconspicuous, clasping the stem, ovate, 3-4 x 2.50-3.0 cm, entire; ***petioles*** 21-31 cm long, entire, narrow (to 4 mm wide); ***blades*** lanceolate, acuminate, entire, 42-105 x 2.5-6.0 cm in herbarium material (to 10 cm wide according to labels on *Bunting 2287*). ***Scape*** erect, thinly white flocculose; ***scape bracts*** lanceolate to triangular, 8-10 mm wide just below the inflorescence, lepidote. ***Inflorescence*** a spike, flowers erect to spreading horizontally. ***Flowers*** short-pedicellate, trigonal, 70-75 mm long (pedicels to exserted anthers); ***floral bracts*** citron-yellow with some hues of light green at base and apex, broadly ovate, acuminate, glabrous, 30-37 mm long, 15-17 mm wide [20-32 x 9-15 mm], longer than the pedicels, and equaling to exceeding the calyx; ***pedicels*** stout, 1-5 mm long, 2-3 mm wide; ***sepals*** citron-yellow, ovate-oblong, apex rounded to cuspidate, firm, glabrous, 22-25 mm long, 10-12 mm

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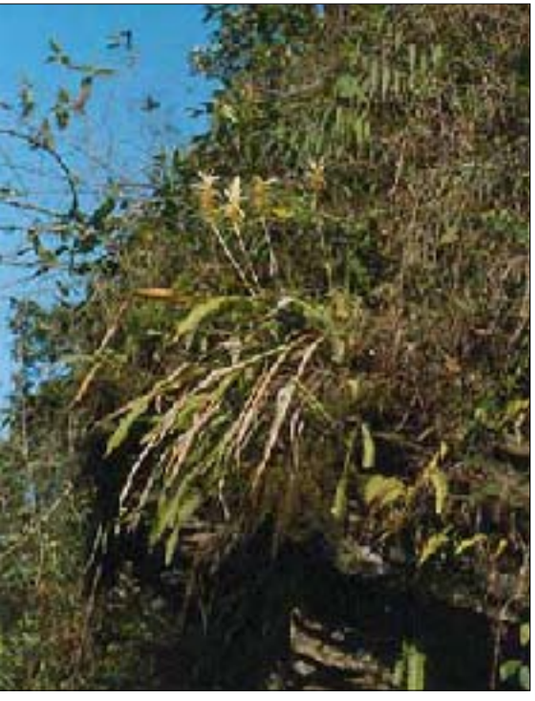
Figure 1. Young inflorescence of *Pitcairnia albo-lutea*

wide at base, 7-10 mm wide towards the apex, thickened but not exactly carinate, the apex unequilateral (i.e. one side is distinctly shorter than the other), the cuspid bent



to the side; ***petals*** white, obovate, apically obtuse to acute, glabrous, unappendaged, 56-64 mm long, 5-7 mm wide at base, 12-16 mm wide at the middle, and 13-18 mm wide at its broadest towards the apex, shorter than the stamens and pistil but exceeding the calyx; ***stamens*** included, 65-68 mm long; ***filaments*** slender, 56-59 mm long, 1 mm wide; ***anthers*** linear, 9-10 mm long, 1 mm wide, basifixed; ***pistil*** exserted, 66-70 mm long; ***ovary*** ovate, ½ inferior (i.e. half its length beneath the level of the base of the petals and stamens), 8-9 mm long, 4-5 mm wide at anthesis; ***style*** 56-60 mm long, 1.5 mm wide; ***stigma*** 3-5 mm long, 2.0 mm wide, with the conduplicate-spiral type morphology (e.g. the three lobes twist spirally. ***Capsules*** and seeds unknown.

Figure 2. Habit of *Pitcairnea albo-lutea.*

Paratypes: Venezuela. BARINAS: Distrito Pedraza, east of Carrizal (La Escaza on maps), along the south bank of the Rio Canagua on the trail to Santa Gertrudis, P.N. Sierra Nevada, 8 39' N, 70 46' W, saxicolous, leaves to 2 m long, pendant, tepals translucent, whitish yellow, inflorescence and infrutescence erect, *Dorr et al. 5684* (US). LARA: Distrito Jiminez, Parque Nacional Yacambú, between El Blanquito and Paso de Angostura dam site, 800-1000 m, terrestrial on moist forested banks, stem with gray scurfiness, peduncle and inflorescence 1 m tall, petals creamy white, bracts green, calyx pale green and yellow, anthers pale yellow, filaments creamy, cloud forested slopes, 31 July 1973, *Steyermark et al 107703* (US 2 sheets). PORTUGUESA: límite con Edo. Trujillo, Río Saguas, El Amparo, 10 km arriba de Biscucuy, carretera Biscucuy-Boconó, en selva de montaña, 800-950 m, large herb on ground forming colonies in partial shade, leaves to 2.5 m long x 10 cm wide, matte and rich green adaxially, glossy medium green abaxially, peduncle erect, corolla white with tip of pistil greenish, pollen golden yellow, filaments white, developing ovaries creamy-yellow, common, 22 August 1967, *Bunting 2287* (US 2 sheets); Disto. Sucre, approx location 9 20' N, 70 00'W, 850 m, plants very abundant along the low rainforest, transitional forest and plantation areas, along slopes, flowering to 85 cm, scape green, bracts pale turning brown, sepals yellowish green, petals white to yellow, *Varadarajan & Ortega 1154* (US). TRUJILLO: cut-over area on banks below El Batatal and Campo Elias (El Morro), 1300 m, terrestrial, corolla white, calyx pale green, floral bracts pale green, anthers yellow, leaves deep green above, pale green below, coriaceous, 3-5 September 1966, *Steyermark & Rabe 97415* (US); Campo Elias, town on the road between Guanare and Bocono, 17 April 1999, *J.R. Grant & F. Oliva-Esteva 99-03419* (US).

Figure 3. Habit of *Pitcairnea oliva-estevae.*

Pitcairnia albo-lutea approaches *P. maidifolia* (E. Morren) Decne. ex Planch. & Linden with which it is sympatric. However, *P. albo-lutea* always maintains a completely polystichous inflorescence (where in *P. maidifolia*, the flowers are polystichous in bud and anthesis, then become strongly secund post-anthesis). Additionally, *P. albo-lutea* has a yellow rachis (vs. red), solid yellow floral bracts (vs. red to bicolor red/yellow), and solid yellow sepals (vs. tricolor red, yellow and green) that are shorter than to equaling the subtending floral bracts (vs. sepals that are always longer and slightly displaced). Three published photos of *P. albo-lutea* occur in Oliva-Esteva (2000: 19) (Oliva-Esteve 2000) as *Pitcairnia maidifolia* forma "lutea", a name never validated.

The only other white-petaled, yellowish-green-bracted species of *Pitcairnia* in the Venezuelan Andes with which this species might be confused is *P. brevicalycina* Mez. From *P. brevicalycina*, *P. albo-lutea* differs notably in its sessile to short-pedicellate flowers (vs. long pedicellate) and floral bracts that are slightly shorter than to equaling the length of the sepals (vs. floral bracts that are so short as to barely reach beyond the length of the subtended pedicel).

Pitcairnia oliva-estevae J.R. Grant, sp. nov. **Type**: Venezuela. TRUJILLO: On road from Guanare to Bocono, 2 km past Batatal, 9° 19' 730" N, 70° 08' 850" W, 1586 m, 17 April 1999, *J.R. Grant* & *F. Oliva-Esteva 99-03415* (holotype US [2 sheets]; isotype SEL). Photos 4-5.

A *Pitcairnia altensteinii* (Link, Klotzsch, & Otto) Lem. cui affinis, inflorescentia erecta, floribus remotis et sepalis bracteis florigeris longioribus differt.

Plant terrestrial, 1 m tall in flower. ***Leaves*** dark green, polystichous, persistent, entire, long-pseudopetiolate, 98-151 cm long; ***sheaths*** castaneous, rather inconspicuous, clasping the stem, ovate, 3-5 x 3-4 cm, entire. ***Petioles*** 36-47 cm long, entire, narrow (to 4 mm wide); ***blades*** lanceolate, acuminate, entire, 99-110 x 5-8 cm; ***scapes*** erect, glabrous; scape bracts linear-triangular. ***Inflorescence*** a spike. ***Flowers*** short-pedicellate, trigonal, 49-51 mm long (pedicels to exserted anthers); ***floral bracts*** red, ovate, acute to acuminate, sparsely lepidote on the outside, 24-29 mm long, 11-14 mm wide at the broadest, much longer than the pedicels, but shorter than the calyx; ***pedicels***

Figure 4. Inflorescence of *Pitcairnea oliva-estevae.*

stout, 2-4 mm long, 2-4 mm wide; ***sepals*** red, ovate-oblong in outline, navicular, apex cuspidate, firm, lepidote, fleshy, thickened but not exactly carinate, 20-23 mm long, 8-10 mm wide at base and 6-8 mm wide towards the apex, longer than the floral bracts, the apex unequilateral (i.e. one side is distinctly shorter than the other), the cuspid bent to

the side; ***petals*** white, linear-obovate, apically obtuse to acute, glabrous, unappendaged, 37-44 mm long, 5-7 mm wide at base, 8-10 mm wide at the middle, and 10-13 mm wide at its broadest towards the apex, longer than the sepals, and equaling to slightly shorter than the stamens and pistil; ***stamens*** 38-43 mm long, equalling to slightly exceeding pistil; filaments slender, 29-32 mm long, 0.5 mm wide; ***anthers*** linear, 8-9 mm long, 1.0-1.5 mm wide, basifixed; ***pistil*** included, 38-43 mm long; ***ovary*** ovate, ½ inferior (i.e. half its length beneath the level of the base of the petals and stamens), 8-9 mm long, 4 mm wide at anthesis; ***style*** 27-31 mm long, 1 mm wide; ***stigma*** 2.5-4.0 mm long, 1.0-1.5 mm wide, with the conduplicate-spiral type morphology (e.g. the three lobes twist spirally. ***Capsules*** and seeds unknown.

Paratypes: Venezuela. PORTUGUESA: At the foot of the Andes, near Biscucuy, October 1995, *F. Oliva-Esteva s.n.* (US); 10 km from Campo Elias, 46 km from Bocono, on road from Guanare, 9° 23' 488" N, 70° 01' 654" W, 429 m, 17 April 1999, *J.R. Grant* & *F. Oliva-Esteva 99-03411* (US).

Key to differentiate *Pitcairnia oliva-estevae* and *P. altensteinii*

1a. Inflorescence strictly erect; floral bracts spreading, becoming lax flowers remote, laxly positioned on the rachis; sepals longer than the floral bracts; plants of Portuguesa and Trujillo; published photos in Oliva-Esteva (2000: 18)… *P. oliva-estevae*

1b. Inflorescence always slightly crooked; floral bracts densely imbricate and remaining so, flowers compact and densely overlapping; sepals shorter than the floral bracts; plants of Aragua and Distrito Federal; published photos in (Oliva-Esteve and Steyermark 1987) Oliva-Esteva & Steyermark (1987: 360-361), Oliva-Esteva (2000: 372)… *P. altensteinii*

Pitcairnia oliva-estevae is closely related to *P. altensteinii* but is geographically isolated.

Eponymy.

This species is dedicated to co-collector of the type, Francisco Oliva-Esteve of Caracas, Venezuela. Francisco has discovered numerous new species of plants, and has written three important books on the bromeliads of Venezuela as indicated below.

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Neoregelia 'Madam President'

Derek Butcher, Cultivar Registrar

Neoregelia 'Madam President.' Photo by Keith Golinski.

Keith Golinski at Palmwoods, Queensland has been marketing Bromeliads for many years under the name of 'Bromagic'. In the 1990's he purchased a large collection of Allan Freeman's hybrids. Allan was a conscientious hybridist who kept records and was always culling for better cultivars. However, his failing health meant his bookkeeping had become a burden so Keith inherited problems. First we saw hybrids from this source, where yellow was a predominant colour in the leaves - just think of 'Ipswich Gold'. Recently there have been some plants with white being dominant with some clones being better than others. Where this trait came from is guesswork but Keith does ask the question where did the white centred *Neoregelia chlorosticta* called 'Marble Throat' come from? We know that *Neoregelia chlorosticta* was used in the Freeman program.

So here we had a really outstanding hybrid that Keith had made. What should Keith call it? He remembered a certain Joyce Brehm, who had travelled to Australian shores in 2003 and thence to attend the New Zealand Conference as a great BSI ambassador.

"Joyce's Joy' was in our minds but as first female President of the Bromeliad Society International, Joyce preferred 'Madam President.'

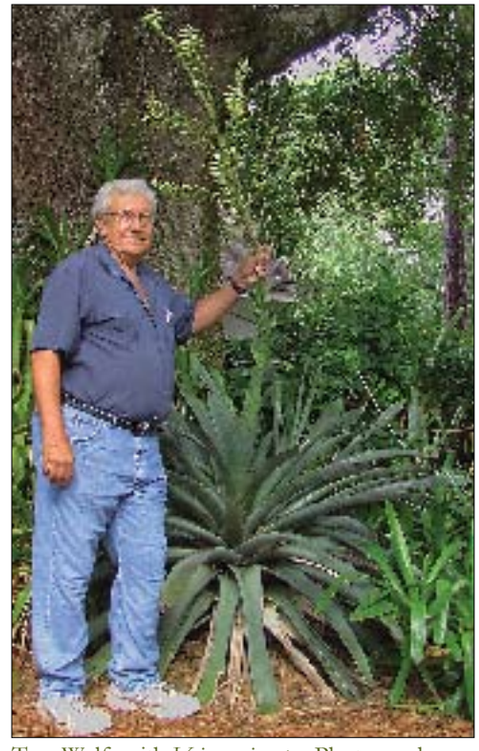
Vriesea gigantea

Tom Wolfe

Vriesea gigantea is one of the old majestic species from southern Brazil. *Vr. gigantia* 'nova' which is a synonym for *Vr. gigantea* var. *seideliana*, has a much different foliage pattern than *Vr. gigantea*.

My plant took approximately 20 years to mature at which time the tank rosette measured 5 ½ feet across. From the ground to the top of the inflorescence it measured 8 feet at full maturity. The inflorescence grew daily for several months, majestically rising above the plant foliage. I knew the night blooming flowers were not going to be very showy but every few days we checked for blooms. After a late afternoon Florida thunderstorm and a darkened sky, we noticed some of the tightly bound flower buds beginning to swell open. Several hours after dark, we checked again and found very pale yellow flowers. About midnight they were fully opened and a much darker yellow in color. By sunrise the flowers were closing and by mid-morning they were spent.

The flowers are 2 inches long and ¾ inches wide and are pale yellow to deep yellow at the petal tips. The stamens and pistils are exserted and each evening we found them loaded with pollen. The branches were about 15 inches. Since the flowers only open at night they are obviously pollinated by nocturnal pollinators. I checked several nights but never observed anything on them so I tried a small brush and my finger in an attempt to set seed.



Tom Wolfe with *Vriesea gigantea*. Photograph by Carol Wolfe.

Foliage pattern on *Vriesea gigantea* var. *seideliana* seedling. Grown and photographed by Andrew Flower.

With my wife Carol as the photographer, we attempted to take pictures of the night blooming flowers. She adjusted the flash to several different settings to no avail.

The photos were over exposed from too much light. We could not seem to capture the beauty and true color of the flowers. One evening, we tried turning the flashes off and using flashlights as the source of light. It worked. I held the flashlights, strategically placed, on the open flowers while she shot the pictures. The end results were satisfying and captured the real colors of the flowers.

Vriesea gigantea flower. Photograph by Carol Wolfe

Late one night while making pictures, we saw an unusual small lizard about 7 inches long with light beige skin setting on the leaves. This was our first time to see this particular lizard on any of our plants. It sat contently while we made our nightly quota of photographs. Hopefully he did his share of pollinating the flowers after we left.

Vr. gigantea adapts well to central and south Florida gardens where the humidity is very high most of the time and the temperatures are usually warm to hot. However, under the canopy of a very large oak tree it has withstood winter temperatures as low as 20˚F many times and sustained below freezing temperatures for as long as 72 hours.

As you can see from the plant description, it isn't your typical window sill plant or even greenhouse plant. During blooming as the inflorescence became heavier and heavier, we had to add some ties to the oak tree to support it. *Vriesea gigantea* is a great foliage plant and with the inflorescence lasting several months, it is a very worthwhile plant to enhance your landscape.

We are now into August and the last flowers are opening, the spent blooms are drying up, but it has brought us many hours of enjoyment watching it grow, making our nightly vigils to see the flowers, and learning to photograph at midnight with flashlights in hand.

Sources and Strengths of Nitrogen in Tillandsia Propagation

Andrew Flower, BSI Editor

Introduction

At my nursery, Anwyl Bromeliads, we ran an observational trial to check the effects on epiphytically-grown tillandsia seedling growth rates of increasing nitrogen supply and also differing sources of nitrogen. We delivered nitrogen sourced from nitrate, ammonium and urea in three different combinations supplied in five different strengths between 2 and 4 millimols nitrogen per litre.

Figure 1. Group of tillandsia seedlings at the conclusion of the trial.

Plants need access to various elements in addition to their primary requirement for the energy in sunlight. In order to carry out the processes by which they manufacture energy-containing substances for future use by themselves (or their consumers). Carbon [C], hydrogen [H], and oxygen [O], are obtained from carbon dioxide [CO_2] or water [H_2O]. A number of other elements are needed to facilitate the various chemical reactions going on in plants, and these are obtained from mineral salts dissolved in water absorbed through the plant's roots or leaves. Of these nitrogen [N], is the element required in the largest amount, and it can be taken from three different sources in water: ammonium [NH_4], nitrate [NO_3] and urea [$CO(NH_2)_2$]. Ammonium and nitrate molecules are available in dissolved salts such as ammonium nitrate and calcium nitrate respectively. Urea is dissolved in water as an intact molecule that is rapidly decomposed by bacteria in soil, but taken up intact in solution by plants, such as tillandsia, that absorb water through their leaves.

We have these three different sources of nitrogen available for our cultivated plants. Why do we need to test which ones are the best? Commercial research over the years has shown that there are plusses and minusses to each of them.

Energy efficiency is important. Plants convert the energy in sunlight into short-term internally stored forms of energy to fuel the chemical reactions that are going on inside their cells, and in turn some of these reactions convert carbon, hydrogen and oxygen into longer-term forms of energy storage in the form of sugars and starches. So plants have to expend energy in the processes of manufacturing their food. It follows that the less energy needed to manufacture stored energy, the more effective the plant is. Nitrates and urea have to be converted into ammonium nitrogen by the plant before it can use the nitrogen, which apparently means that absorbing ammonium nitrate in the first instance will be more efficient.

Toxicity matters! High ammonium to nitrate-nitrogen ratios are toxic in most plants, and so we need to be cautious in the use of ammonium nitrate. Urea has had a lot of bad press. I asked a group of tillandsia growers at an Australian conference in 2006 how many of them would use urea on their tillandsias: no hands were raised. Leaf-burn is commonly attributed to urea, but this burning is actually caused by an impurity called "biuret" in the urea most commonly supplied for agricultural use. In our trials we used a detoxified product sold as "low biuret urea."

Side effects are a minefield. Nitrate nitrogen may increase the plant's uptake of calcium and boron, whilst ammonium nitrate reduces uptake of calcium and magnesium. Urea is thought to increase the penetration of other nutrients absorbed through the leaves, which could be very useful for tillandsia nutrition.

Materials and methods.

We started with single batches of tillandsia seedlings of five different species, and selected 25 plants of roughly the same size from each of them. One plant from each species was glued to a strip of plastic (figure 1) and these 25 strips were then dipped 95 times over the 120 days of the trial. A dipping consisted of submerging the batches for 5 seconds to approximate the amount of water being supplied by hand watering to the other occupants of the growing-on house they were living in. The dippings co-incided with the times we watered the normal stock of seedlings in the growing-on house, with the trial strips being left outside while the watering was in progress.

Each seedling was weighed individually at the start and finish of the trial, and then the 25 groups of 5 seedlings were sent to a commercial laboratory to be analysed for their mineral content. Due to the high cost of analysis, seedlings were analysed in their groups of 5, not individually.

All water used in the trials was demineralised by our reverse-osmosis system. Concentrated "stock" nutrient solutions were made up in groups of two 5 litre batches, labelled "A" and "B". This was necessary because the calcium nitrate has to be kept

in a different solution to the sulphates and phosphates to avoid having the calcium precipitate out. We then added 30 mls of each "A" and "B" stock solution to 3 litres of demineralised water to make the dipping solutions. Fresh dipping solutions were made up each month. The concentrated stock nutrient solutions were made up in three series:

"nitrate" with all solutions nitrate-nitrogen only (table 1);
"+NH_4" with increasing concentrations of ammonium-nitrogen in solutions 2-5 (table 2);
"+urea" with increasing concentrations of urea in solutions 2-5 (table 3).

Stock solutions were designed so that the composition of treatment solution 1 would be the same in each series, delivering 2 mmols of nitrogen and acting as a control. Treatment solutions 2 to 5 were designed so that they all received the same formula as solution 1, to which was added increasing amounts of nitrate-nitrogen in the nitrate series, increasing amounts of ammonium-nitrogen in the +NH_4 series and increasing amounts of urea in the +urea series. Thus the total amount of nitrogen delivered in each nutient series number was the same, only the nitrogen sources varied. Total nitrogen supply in the dipping solution for each series was 2, 2.5, 3, 3.5 and 4 mmols/litre in solutions 1 to 5.

The five species used were *Tillandsia gardneri*, *T. ionantha*, *T. kautskyi*, *T. polystachia* and *T. stricta*. They were selected because they were reasonably expendable insofar

Fertiliser	nitrate 1	nitrate 2	nitrate 3	nitrate 4	nitrate 5
A solution					
calcium nitrate, g	86.5	100.0	113.5	127.0	140.5
potassium nitrate, g	20.2	32.9	45.5	58.1	70.8
iron chelate, g	1.5	1.5	1.5	1.5	1.5
B solution					
mono-potassium phosphate	27.2	27.2	27.2	27.2	27.2
potasium sulphate, g	17.4	17.4	17.4	17.4	17.4
magnesium sulphate, g	49.3	49.3	49.3	49.3	49.3
60 g/l manganese chelate, ml	0.125	0.125	0.125	0.125	0.125
130 g/l zinc chelate, ml	0.0625	0.0625	0.0625	0.0625	0.0625
copper suphate, g	0.05	0.05	0.05	0.05	0.05
boric acid, g	0.75	0.75	0.75	0.75	0.75
sodium molybdate, g	0.05	0.05	0.05	0.05	0.05

Table 1. Nitrate series of stock solutions, delivering increasing concentrations of nitrate nitrogen.

Fertiliser	+ NH_4 1	+ NH_4 2	+ NH_4 3	+ NH_4 4	+ NH_4 5
A solution					
calcium nitrate, g	86.5	86.5	86.5	86.5	86.5
potassium nitrate, g	20.2	20.2	20.2	20.2	20.2
ammonium nitrate, g		10	20	30	40
iron chelate, g	1.5	1.5	1.5	1.5	1.5
B solution					
mono-potassium phosphate	27.2	27.2	27.2	27.2	27.2
potasium sulphate, g	17.4	17.4	17.4	17.4	17.4
magnesium sulphate, g	49.3	49.3	49.3	49.3	49.3
60 g/l manganese chelate, ml	0.125	0.125	0.125	0.125	0.125
130 g/l zinc chelate, ml	0.0625	0.0625	0.0625	0.0625	0.0625
copper suphate, g	0.05	0.05	0.05	0.05	0.05
boric acid, g	0.75	0.75	0.75	0.75	0.75
sodium molybdate, g	0.05	0.05	0.05	0.05	0.05

Table 2. Ammonium series of stock solutions; level 1 nitrate solution plus increasing concentrations of ammonium nitrogen.

Fertiliser	+ urea 1	+ urea 2	+ urea 3	+ urea 4	+ urea 5
A solution					
calcium nitrate, g	86.5	86.5	86.5	86.5	86.5
potassium nitrate, g	20.2	20.2	20.2	20.2	20.2
urea, g		7.6	15.2	22.8	30.4
iron chelate, g	1.5	1.5	1.5	1.5	1.5
B solution					
mono-potassium phosphate	27.2	27.2	27.2	27.2	27.2
potasium sulphate, g	17.4	17.4	17.4	17.4	17.4
magnesium sulphate, g	49.3	49.3	49.3	49.3	49.3
60 g/l manganese chelate, ml	0.125	0.125	0.125	0.125	0.125
130 g/l zinc chelate, ml	0.0625	0.0625	0.0625	0.0625	0.0625
copper suphate, g	0.05	0.05	0.05	0.05	0.05
boric acid, g	0.75	0.75	0.75	0.75	0.75
sodium molybdate, g	0.05	0.05	0.05	0.05	0.05

Table 3. Urea series of stock solutions; level 1 nitrate solution plus increasing concentrations of urea.

as we had a reasonable number of them, whilst trying to use a range of growth rates with *T. kautskyi* being one of the slowst we have grown, *ionantha* and *gardneri* among the fastest.

Results and discussion.

The trials were conducted over late spring and summer (southern hemisphere) and the 75 seedlings were weighed individually at the beginning and end of the trial. After photographing and weighing, the 15 sets of plants were dried and analysed.

	Nov 11, 2005	Mar 11, 2006	growth grams	growth %
nitrate				
soln. 1	3	5.6	2.6	86.66
soln. 2	3.4	7.5	4.1	120.58
soln. 3	4.3	9.1	4.8	111.63
soln. 4	3.7	8.9	5.2	140.54
soln. 5	2.9	6.6	3.7	127.59
+ NH_4				
soln. 1	4.0	8.5	4.5	112.50
soln. 2	3.2	7.4	4.2	131.25
soln. 3	2.5	6.6	4.1	160.78
soln. 4	3.2	6.9	3.7	115.62
soln. 5	3.1	6.6	3.5	113.00
+ urea				
soln. 1	3.9	7.3	3.4	87.18
soln. 2	3.4	7.5	4.1	120.59
soln. 3	3.35	7.5	4.15	123.89
soln. 4	3.2	7.2	4.0	125.00
soln. 5	3.5	8.1	4.6	131.40

Table 4. Combined weights, in grams, of five tillandsia species dipped in trial solutions

The goal of our trials is to optomise the growing of tillandsia species from seed, so this one was set up to mimic our actual production system. At any one time we have around 30,000 seedlings and the batches of any one population are mainly in the 30 to 50 range: very occasionally we raise 2-300 in a batch. Seeds are germinated on strips of mesh in an incubator, then moved to two growing-on houses where they are grown on hanging up on the meshes until they are large enough to be glued onto community sticks, then individual mounts. From germination until they leave the growing-on houses the seedlings are watered by hand using nutrients dissolved in demineralised water from the reverse osmosis plant. As mentioned before, the trial plants were dipped 95 times over 120 days, the same number of times the remaining plants in the growing-on houses were sprayed by hand using a single low throughput, fine SprayJet nozzle (young seedlings with a nozzle delivering 0.3 l/min., older seedlings with one delivering 1.9 l/min. This is enough to wet their leaves thoroughly). The growing-on house in which the

trial plants were hung was receiving carbon dioxide pumped in at night - the epiphytic tillandsias use a process called "CAM respiration" to take in carbon dioxide through their leaves at night to avoid doing it in the heat of the day when excessive loss of moisture cannot be quickly replaced because they have no ground-roots.

In reading the growth rate results, I find it is helpful to bear in mind the standard curve used to visualise the relationship between nutrient concentration and growth rate (Figure 2). At low nutrient levels growth will be retarded, and growth rates will increase as the supply of nutrient increases. At a certain nutrient level the growth rate will stabilise at the plant's maximum growth rate - this is shown in figure by the green column marked "adequate nutrition." But plants will not sustain their optimal growth rate if the nutrient concentration increases, and eventually a point will be reached when the nutrient becomes toxic and will kill the plant - this phase is shown by the red column. The optimal nutrient supply point is at the beginning of the green column in figure 2, just below 100 on the growth scale.

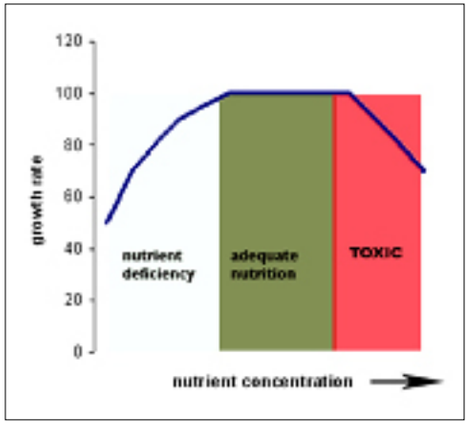


Figure 2. Relationship between plant growth and increasing nutrient levels.

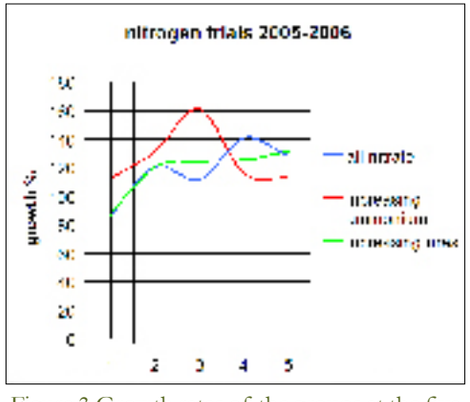


Figure 3.Growth rates of the groups at the five nutrient levels.

Trial plant growth during the trial is shown as percentages - a plant that doubled its weight in the trial period would show a 100% growth rate. My primary focus is on figure 3, the comparative growth rates between the full group of five plants in each sample. This is because we do not have the facility to tailor nutrient mixes to individual species, so must use the same nutrient mix and concentration for all seedlings across a wide range of species and from seed to flowering-size plant. Individual species growth is also shown in figures 4, 5 and 6.

Root development was quite strong in all samples, and a visual estimate showed the strongest development, by a small margin, was in the nitrate-only solution 1 series with 4 plants showing strong growth and 6 moderate growth (figure 7).

Figure 7. Strong root development on *Tillandsia polystachia* (top) and *T. gardneri* in nitrate-only solution 1.

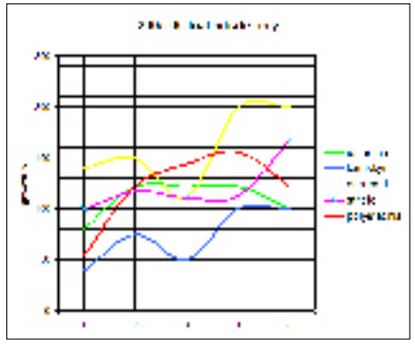


Figure 4. Growth rates of the individual species in the nitrate-only group.

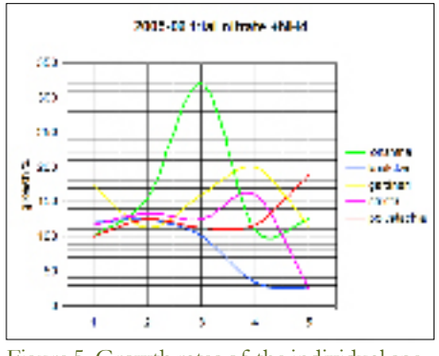


Figure 5. Growth rates of the individual species in the nitrate + ammonium group.

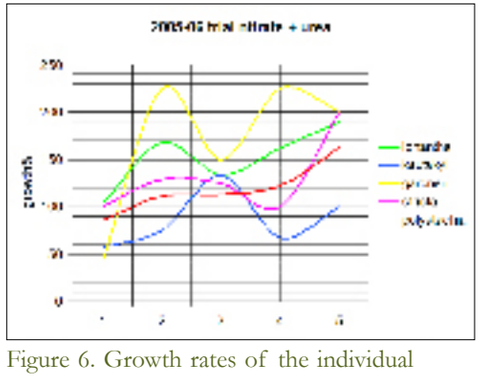


Figure 6. Growth rates of the individual species in the nitrate + urea group.

At the conclusion of the trial, the plants were packed up in their groups of five and sent off to Hill Laboratories in Hamilton to be dried and the ash analysed for mineral content. The analyses are shown in table 5, together with some comparative analyses under the heading "wild" at the bottom of the table. These are two samples of wild-grown *Tillandsia circinnata* reported in Benzing (1980, p. 61 & 63) and a benchmark list of the concentrations of mineral elements necessary for plant survival as formulated by Epstein (1972) and listed in Benzing (1980) and Taiz & Zeiger (1998).

Conclusions

These trials cannot be considered scientific: the samplings are way too small, and the experiments have not been duplicated. Our weighing and measuring equipment and their operation do not meet quality laboratory standards. But I do think this type of investigation beats the hell out of "shooting blind," and it has certainly helped us to bring the seedlings on much faster than we used to. The years taken to bring a tillandsia from seed to flowering-size are now half what they were ten years ago.

	nitrogen	phosphorus	potassium	sulphur	calcium	magnesium	sodium	iron	manganese	zinc	copper	boron
	N	**P**	**K**	**S**	**Ca**	**Mg**	**Na**	**Fe**	**Mn**	**Zn**	**Cu**	**B**
nitrate	%	%	%	%	%	%	%	ppm	ppm	ppm	ppm	ppm
soln. 1	1	.26	1.5	.22	.68	.32	.10	277	64	100	25	26
soln. 2	1	.27	1.5	.21	.66	.29	.08	175	50	69	33	22
soln. 3	1	.25	1.6	.22	.62	.26	.09	163	47	61	24	24
soln. 4	1.1	.27	1.8	.28	.74	.24	.08	172	44	97	26	19
soln. 5	1.1	.25	1.8	.22	.71	.36	.07	158	45	73	21	23
+ NH_4												
soln. 1	1	.29	1.4	.28	.6	.36	.07	136	45	73	17	19
soln. 2	1.1	.31	1.4	.28	.6	.36	.08	138	51	130	17	18
soln. 3	1.1	.28	1.2	.26	.6	.37	.06	139	47	100	19	20
soln. 4	1.4	.29	1.2	.30	.7	.35	.07	143	54	96	18	14
soln. 5	1.4	.27	1.1	.29	.55	.33	.08	154	50	91	21	19
+ urea												
soln. 1	0.9	.32	1.5	.25	.6	.38	.07	138	52	150	16	14
soln. 2	1.1	.29	1.4	.29	.6	.35	.07	130	49	90	13	15
soln. 3	1.2	.31	1.4	.30	.66	.39	.07	114	51	67	12	15
soln. 4	1.2	.29	1.3	.29	.62	.37	.06	137	54	83	12	16
soln. 5	1.3	.31	1.4	.27	.59	.36	.07	118	52	97	11	16
"wild"												
Benzing A	0.41	.10	0.49		.67	.25		153	27	38	9.2	16
Benzing B	0.46	.068	0.40		.68	.22		124	32.5	36.8	16.2	13.3
minimum	1.5	.20	1.0	.10	0.5	.20	.001	100	50	20	6	20

Table 5. Dry weight analysis of plant groups by dipping solution. Comparative analyses shown on bottom 3 rows are two samples of wild tillandsia (Benzing 1980) and the minimum level of nutrients said to be necessaery to sustain plant life (Epstein 1972)

Element		ppm
nitrogen	N	40
phosphorus	P	11
potassium	K	55
calcium	Ca	1.5
magnesium	Mg	9
sulphur	S	17
iron	Fe	0.35
+ trace elments		

Table 6. Theoretical delivery of major elements in our currrent nutrient solution.

This trial showed there is a slight improvement in growth rates at the lower nitrogen concentration (2.5 mmol/litre) if either urea or ammonium-N was added. But the ammonium nitrate addition showed a tendency to get toxic rather quickly from the 3.0 mmol N level onwards and I decided this is not an acceptable risk. I changed the nutrient formula for our nursery use over to the one used in the +urea series 2 trial.

I keep "bellweather" samples in our main growing-on houses to monitor growth by monthly weighing. Currently these are plastic strips with 12

plants of the same species glued on them. We changed to the new nutrient formula on June 14 2006, and in the 173 days between July 13, 2006 and January 2, 2007 the weight gain of each group of 12 plants was: *Tillandsia butzii* 37%, *T. tenuifolia* 40%, *T. ionantha* 35%. This period ran through late winter and a poor spring, reflected by the fact that seedlings were watered 91 times over 173 days whereas the nitrogen trial plants were dipped 95 times over 120 days. During this time we were not supplying extra carbon dioxide to the plants at night, as we were when the nirogen trials were being held.

Our seedlings are now being sprayed with the nitrate + urea series 2 stock solutions diluted at 2 litres of each "A" and "B" solution per 250 litres of demineralised water. At this rate the nitrogen delivery is a theoretical 2.8 mmols/litre. For the benefit of readers who think in terms of ppm, the delivery of mineral elements by this solution is shown in table 6. For those who always ask at conferences, the cF is around 4 - but bear in mind that urea does not ionize in water, so it has no effect on cF.

I acknowledge the assistance of our horticultural advisor, Dr. R.A.J. White.

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Taiz, L. and E. Zeiger (1998). Plant Physiology. Sunderland, MS, Sinauer Associates, Inc.

Bromeliad Society International. Membership Rates

United States Membership (includes bulk mail rate—first class add $10 per year)

	1 Year	2 Years	3 Years
Individual	$30	$58	$85
Dual	$35	$68	$100
Society	$30	$58	$85
Institution	$30	$58	$85
Commercial	$60		
Fellowship	$45		
1st class mail	+$10	+$20	+$30

International Membership (includes Airmail delivery)

	1 Year	2 Years	3 Years
Individual	$40	$78	$115
Dual	$45	$88	$130
Society	$40	$78	$115
Institution	$40	$78	$115
Commercial	$70		
Fellowship	$55		

Life Membership (*one time only fee*) $800.

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Vriesea platynema, *Atta* (leaf-cutting ants), and other insects: student experiences in Venezuela

Howard Frank[1]

As well as being an amateur bromeliad enthusiast, I teach a course in Tropical Entomology at the University of Florida, the State's oldest and largest public university, with about 48,000 students (website, www.tropent.ifas.ufl.edu). Its objective is to introduce graduate and undergraduate students to the diversity of tropical insect life. The major pre-requisite (a basic university course in entomology) is to ensure that incoming students are able to recognize insects that they see and hear about, and classify them to order and (with growing expertise) to family, and with that information have some idea of their life cycle and food requirements. There is a set of 15 lectures on campus in Gainesville dealing with all-too-few aspects of tropical insect life. Fifteen lectures, of course, just scratch the surface of this huge subject. No instructor can know all there is to know about the (maybe) 750,000 described species of insects that inhabit the tropics, not to mention the estimated millions that remain to be described, so there is always something new to learn. Are bromeliads, with maybe 3,000 species, a large family?

Ants eating an alcantarea leaf in Brazil. Photo by Oscar Ribeiro.

I give only about half the lectures. The rest are given by selected colleagues ("guest lecturers") having exceptional expertise such as in the entomology of tropical fruits, tropical termites, ants, and insects of mangrove forests. Some of these guest lecturers get spontaneous rounds of applause from the students for their really insightful and beautifully illustrated presentations. Once the students have taken the lectures, there is an optional 10-day field trip to Venezuela in early July. The course takes place in odd-numbered years, beginning in 1997 and now approaching 2007 (the 6th offering). Venezuela was chosen because we have exceptional support from faculty members of Universidad Central de Venezuela, and use of a wonderful field site there, with megadiversity. So those students who want to do so, and can afford the cost (the students' costs are not subsidised, but we economise as best we can), accompany me to Parque Nacional Henri Pittier. Organised events occupy most of their days, but each

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student is required to design a small research project to carry out close to Rancho Grande, the park headquarters, in otherwise unoccupied time. Each project is written up on return to Florida and presented for evaluation for a grade.

Brazilian ant taking home its prize. Photo by Oscar Ribeiro.

Leaf-cutting ants (genus *Atta*) are present in the park. The students learn about them (and other tropical ants) in a lecture on campus. Night and day these ants can be found foraging along trails leading from sometimes huge underground nests, and returning along those same trails carrying pieces of leaves that they have snipped from plants. Deep underground, the ants pile these leaf fragments in gardens, using them as the substrate for a special fungus which is their food. Yes, they bite (any ant that can deftly snip a disc out of a leaf can deftly snip your skin), but they do not sting. The park has many bromeliads, among which *Vriesea platynema* Gaudichaud is accessible by growing on trees so close to the headquarters building that the bromeliads can be reached from the roof balcony. Anyone who has seen the book *Bromeliaceaes of Venezuela* by Oliva-Esteva and Steyermark (1987) will surely have noticed the tiny insects trapped in a sticky secretion on an inflorescence of this bromeliad, in the photograph on page 291. Two of the students on the 2005 trip chose to design projects involving this bromeliad.

Undergraduate student Miriam Shapiro set out to learn something of the preference by *Atta* ants for leaves of plants of several families. She used scissors to cut 4×4 cm squares from leaves of plant families Anacardiaceae (mango), Araceae (probably *Alocasia macrorhiza*), Bromeliaceae (*V. platynema*), Heliconiaceae (*Heliconia caribaea*), Melastomataceae, and Zingiberaceae. She kept these squares separated from each other to avoid contamination, and positioned them alongside an *Atta* trail, each square pinned to the ground with a toothpick. In one trial she used two squares of Bromeliaceae, and one each of Anacardiaceae, Araceae, Heliconiaceae, and Zingiberaceae. After 6 hr of exposure on a Saturday afternoon, the leaf remains were replaced with fresh squares for 21 hr (Saturday night and Sunday morning), then again for 3.5 hr (Sunday afternoon).. The leaf remains were measured in terms of cm^2 consumed against a grid of 4×4 cm drawn on paper, and recorded. The results are expressed on a scale of 0 (nothing consumed) to 16 (the entire square consumed) and were for the 6

Oscar Ribeiro of Bromeliário Imperialis in Brazil sent us these interesting photos of his local ants feasting on *Alcantarea imperialis*, which is available locally in large quantities. Subsequently we learned of the interesting work being done in Venezuela by Dr. Frank. Ed.

bromeliad squares 1,0,0,0,1,0. For the other families they were 16,16,4 (Anacardiaceae), 2,12,1 (Araceae), 0,5,0 (Heliconiaceae), and 7,15,0 (Zingiberaceae).

We can at least conclude that leaves of *Vriesea platynema* are not preferred to the leaves of those other families tested. Before Miriam's test I guessed that mango leaves might be least preferred because of chemicals in plants of that species (and other species of Anacardiaceae) that are toxic to humans. I was wrong: the ants did not avoid those leaves, so perhaps they are not toxic to the ants or to the fungus that they grow.

Vriesea platynema growing on trees beside Rancho Grande in Venezuela, and seen from the roof balcony. Some of the inflorescences are real, and some are on paintings on transparent acrylic plastic. Photo: Teresa Cooper.

Graduate student Teresa Cooper undertook a more ambitious project. She took rectangles of clear acrylic plastic and painted on them the likeness of *Vriesea platynema* inflorescences (she has artistic talent). When the paint had dried, she coated the paintings with a sticky glue (Tanglefoot®) that typically is used to paint barrier bands onto trunks of fruit trees to prevent harmful insects from climbing. The acrylic rectangles were hung from tree branches close to real *V. platynema* inflorescences. They caught just the same sorts of tiny insects (tiny flies, small winged ants, and tiny wasps) that were caught by the secretions of the plants. Identification of these insects to the species level would have required taxonomic help from specialists, and could not be done in

the time available. So it may be that such insects just happen to be flying about when they encounter the secretion of *V. platynema* inflorescences, and they just happen to get trapped. So far as Teresa could determine, the insects were not pests against which the plants were defending themselves by production of a sticky secretion, and the insects were not being attracted by an aroma (scent) from the unopened flowers of the plants (because the paintings on acrylic would not have had such an aroma). Why these bromeliads use energy to produce a secretion that traps tiny insects remains an unanswered question. Our trip ended before the flowers had opened, so Teresa could not observe insect visitors to the opened flowers.

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Oliva-Esteve, F. and J. A. Steyermark (1987). *Bromeliaceaes of Venezuela: Native and Cultived* [original spelling] Caracas, Gráficas Armitano, C.A.

Pineapple Appliqué

Calandra Thurrott, a member from Port Orange in Florida, entered this fine example of appliqué in the original art section at last year's World Conference in San Diego. Photograph by Karen and Michael Andreas.

According to the Wikipedia internet encyclopaedia, "The word appliqué comes from the French word appliquer, meaning to put on or to lay on. As a method of decoration, appliqué has been a popular technique and has a long history, with the earliest known example being a canopy of leather in Egypt believed to date from 980 BC. However, it is highly likely that other cultures were using appliqué before this time.

Over the centuries many different materials have been used in appliqué, including beads, fabric, fish scales, and leaves. They have been sewn on to almost any stitchable material imaginable: linen, beaten bark, leather, etc. Needles are the main tools used in appliqué. In the past needles made from bone or twigs were used but nowadays metal needles are used."

Nutans Nocturne

Ken Marks, BSI Webmaster

Golden petals finally spreading high overhead. Photograph by Rick Cruz.

In my quest to see and photograph all of Florida's native bromeliads, I had a little bit of unfinished business. The three catopsis species present in Florida (*bertero-niana*, *floribunda*, and *nutans*) bloom in early autumn (September-October). The Autumnal Equinox seemed an apropos time to rejoin both my quest and Mike Owen, Park Biologist from the Fakahatchee Strand State Park, on a swamp walk. The goal was to see *Catopsis nutans*—Florida's rarest native bromeliad (which only occurs in the Fakahatchee). Mike is aware of fewer than a hundred of these plants in the park. So, together with fellow intrepid explorers Rick Cruz and Jay Staton, we were heading to the largest known grouping of them.

Catopsis nutans is a small (palm-sized) species with few leaves, each covered in a white, powdery wax near its base. Most plants of blooming size will only produce an inflorescence containing 2-4 flowers. Since each flower opens for only a few hours the window of opportunity for catching this species in bloom is understandably quite narrow. In addition (as if finding this rare plant and being there at the right time weren't difficult enough) this species only blooms at night.

As dusk approached we stepped off a tram road (a relic of the days when narrow-gauge rail cars were used to extract old-growth cypress logs from the area) and entered the cool tea-colored water. We trudged along through the knee-deep water for nearly an hour, GPS and compass in hand, looking for openings in the dense underbrush that was standing between us and our intended destination. Like some kind of weird reverse moat in this watery realm, our attempts were thwarted by this hedge of vegetation that blocked our progress at every turn. We eventually found a slight gap in this green barrier that finally allowed us to close in on our objective. When we spotted the first nutans perched on a branch, we knew we were "in the zone". In a few more minutes

Three generations of *Catopsis nutans* amid a cloud of mosquitos. Photograph by Rick Cruz.

we were able to locate a plant that had a flower spike. The species name, *nutans*, is Latin for "nodding or swaying" and it aptly describes the plant's wiry inflorescence. With its relatively large flower buds, the inflorescence hangs pendently down the side of the plant. The plant's common name of "Nodding Catopsis" is just a direct translation of its scientific name. These catopsis, however, were not nodding on this night—the air was dead calm. The only movement was provided by thick clouds of mosquitoes made visible when within the beams of our flashlights but heard as an ever-present, droning hum.

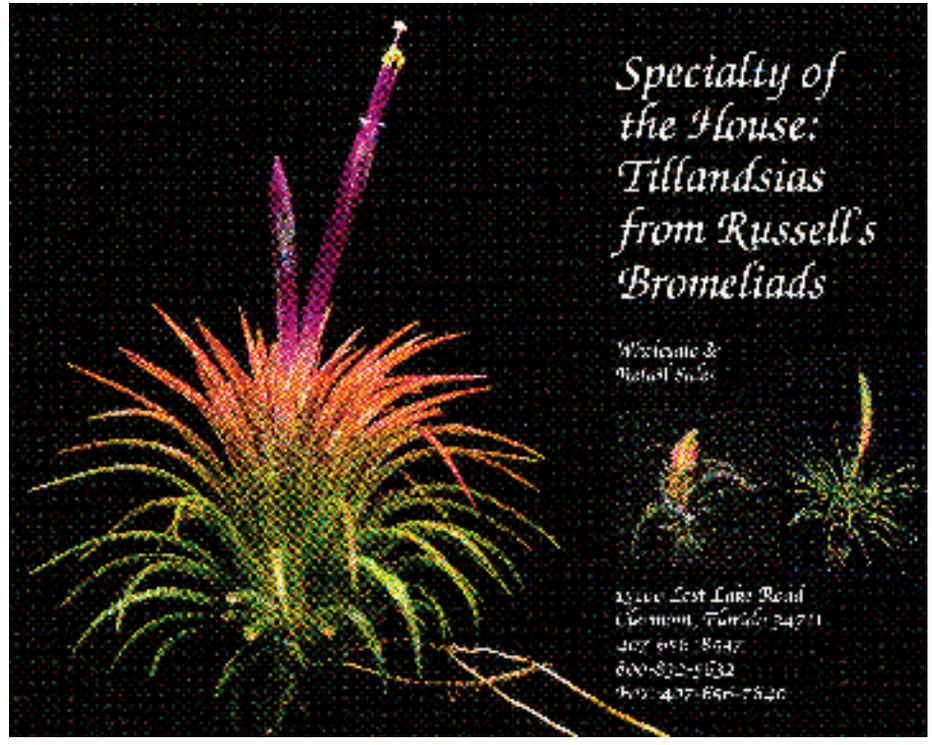
The sighting of the first flower spike confirmed that we were here at the right time of the year. Mike spotted a golden glimmer from a nutans attached to a pop ash tree about six feet overhead. The yellow petals, forming a thin tube, had emerged from one of the flower buds. Elated by this additional validation of our timing, we continued our search nearby for more blooming plants, preferably ones that were not so high. Before long we had found one at eye level and were able to get a closer look at the flower. This plant had four buds and the first two flowers had already bloomed and withered, the petals turning from bright lemon yellow to dingy mustard brown. Tonight's flower had extended its tight tubular corolla but there were no signs of the petals opening. In fact, of the few flowers that we were able to locate, none had spreading petals and we were considering the possibility that this night-bloomer might be pollinated by a moth with a long proboscis that didn't require unfurled petals.

After about an hour of searching for new blooming specimens we had had enough of the mosquitoes (several of which I had choked down while talking). We had accomplished our objective and decided to call it a night. The batteries in my primary flashlight had died already and my backup flashlight was starting to grow dim. As we began retracing our steps to find our way back out, I made a mental note to check my flashlights before trying something like this again. Stopping to take a quick peek at the first yellow flower that Mike had spotted high overhead, we were amazed to see its

petals had flared and the flower was now fully open! I guess we had arrived in time for the opening act but that the main event probably wouldn't start until later that night.

We were ecstatic that we had managed to witness this ephemeral event. If the individual flowers open on successive evenings and last just a single night, most of these plants would only remain in bloom for a couple of days. It was only by knowing when and where to go that we stood any chance of pulling off this caper with hope for success. Perhaps someday, with a case of batteries, a substantial supply of caffeinated beverages, and possibly a few units of type-matched blood to replace what the mozzies extract, we might attempt to monitor one of these plants from dusk to dawn, recording when the petals open and close, and possibly catching a glimpse of its pollinator.

Rick Cruz provided the images for this article. Rick specializes in photographing the rare and endangered flora and fauna of Florida's last wild places with the hope of evoking passion for conservation. Visit Rick's other work at www.rickcruzphotography.com.



Southwest Bromeliad Guild Show 2006

Carolyn Schoenau, Affiliated Shows Chair.

The Southwest Bromeliad Guild had its Show and Sale, September 8-10, 2006, hosted by the Corpus Christi Bromeliad Society.

There were 164 horticulture exhibits and 41 artistic ehibits entered by 23 exhibitors. In the ribbon count there were 116 Awarts of Merit, 66 blue and 23 red.

Hohenbergia leopoldo-horstii won the Mulford B. Foster Best of Show, exhibited by Nelwyn Anderson.

Cryptanthus pseudoglazioui won Hobbyist Sweepstakes Award, exhibited by Carole Richtmyer

"Flight of the Shorebirds" featuring *Cryptanthus* 'Indian Maiden' won the Morris Henry Hobbes Best of Show Artistic award. Exhibited by Lou Trahan

EVENTS CALENDAR

Australia

April 21-22, 2007. Bromeliad Society of Queensland Show and sale of bromeliads. Over 500 varieties/hybrids on sale. Venue: Mt Coot-tha (Brisbane) Botanic Gardens Auditorium. Saturday 8am-4pm, Sunday 9am-3pm. Entry $3 adults, children under 14 free. Enquiries Bob Reilly phone 07 3870 8029 or bob.reilly@nrm.qld.gov.au

April 28-29, Bromeliad Society of NSW Autumn Show. 9-11 Wellbank Street, Concord. Enquiries phone 9971-6183.

September 21-23, 2007 14th Australian Bromeliad Conference. Rydges resort Hotel, Port Macquarie. Enquiries to 47 Boden Street, Edge Hill QLD 4870 or lynnie@ledanet.com.au

June 24-29, 2008, BSI World Conference in Cairns (Australia.) Enquiries to Lynn Hudson, 47 Boden Street, Edge Hill QLD 4870 or lynnie@ledanet.com.au

United States of America

March 15-18, 2007. Florida East Coast Bromeliad Society 'Everybody's Flower Show'. Ocean Centre, 101 N. Atlantic Avenue (AIA) Daytona Beach.

March 31, 2007. Florida East Coast Bromeliad Society, Volusia County Master Gardeners Sale.

April 14-15, 2007. Bromeliad Society of Broward County 11th Biennial Show & Sale. Show theme "Everything's Coming Up Bromeliads." Venue Trinity Lutheran Church Hall, 11 SW 11th ST, Ft. Lauderdale, FL. Enquireies Ann Schandelmayer, 5529 SW 5th ST, Plantation FL

April 14-15, 2007 Seminole Bromeliad & Tropical plant Society Spring Plant Sale. Sanford Garden Club Bldg., 200 Fairmont Drive, Sanford. Contact Sudi Hipsley 352 504-6162.

April 21-22, 2007. Bromeliad Society of South Florida Annual Show. Fairchild Tropical Botanic Garden, 10901 Old Cutler Road, Miami.

April 21-22, 2007. 26th Annual Sarasota Bromeliad Society Show & Sale. Theme: Pirated Bromeliads. Exhibits, sales, food, rare plant auction. Admission $12 incl. sale and show. Venue Marie Selby Botanic Gardens. Enquiries: Dr. Theresa Bert, 914-795-6012 or Rob Branch 941-358-4953

May 11-13, 2007. Bromeliad Society of Central Florida Show and Sale. Orlando Fashion Square, Orlando.

June 30, 2007. DEADLINE for early registration (discounted rate)
for the **World Bromeliad Conference 2008** in Cairns
Registration forms available from
Dan Kinnard, 6901 Kellyn Ln, Vista CA 92084-1243.

The Bromeliad Society International

The purpose of this nonprofit corporation is to promote and maintain public and scientific interest in the research, development, preservation, and distribution of bromeliads, both natural and hybrid, throughout the world. You are invited to join.

Members-Only web site access: *Username*: Forest *Password*: leviathans

Vriesea friburgensis Mez. Photograph by Vern Sawyer

This medium size (flowering to 80cm tall) vriesea is widespread in southern Brazil. It is variable with three described varieties, this is var. *friburgensis*.

Harry Luther, Mulford B. Foster Bromeliad Identification Centre.
811 South Palm Avenue, Sarasota, Florida 34236.