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Back—*Aechmea caesia* habit. Photo by Elton M.C. Leme.

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Editorial

In This Issue

Scientific

This month we start with a bromeliad first collected over 20 years ago by Elton Leme, in the mountains of Rio de Janiero State. Recent advances in taxonomic knowledge have finally allowed Elton to describe his collection as a new species, *Aechmea lilacinantha.*

Harry Luther and Karen Norton describe a new Vriesea species on page 204, *Vriesea altomayoensis,* that is already in cultivation. Following this, on page 206, we have some detailed molecular studies of a couple of *Tillandsia* species, *T. califinii* and the controversial *T. tomasellii* (linked to *T. xerographica.)* The team reporting this work is headed by Dr Olga De Castro of the University of Naples.

Cultivation

Cultivar Registrar Geoff Lawn wrestles with the background of a hybrid Aechmea that has been around Australia and New Zealand for some years - at least since the 1980's - together with a variegated sport from it. The plants have been distributed commercially by NZ grower Andrew Steens, who has now registered them as *Aechmeas* 'Exotica Candy' and 'Exotica Candystripes' - see page 219.

Completing the "Down-Under" domination of the cultivar section is Victorian identity Maurice Kellett, a long-time champion of rooting. Maurice takes us on a fascinating account of his work with tillandsias since the 1960's, with particular emphasis on the relationship between root-formation and how it applies to growing plants in cultivation.

General Interest

Late last year one of our British members, Chris Lee, visited the Princess of Wales Conservatory and photographed for us some of the bromeliads on display there - page 230. Next we have some photographs sent to us from the Bromeliad Society of South Florida, taken at their 2009 Bromeliad Show.

On page 234 we have a mystery for you to ponder... do puyas self-destruct in nature? spontaneous combustion? Or do local farmers just burn them? Check this photo from the de Fray Jorg National Park in Chile, and tell us your theory!

Aechmea caesia is illustrated for the first time in this Journal, see photos by Elton Leme on page 235 and the back cover. We conclude by introducing Vicky Chirnside, a new Florida Director replacing Dr Larry Giroux, and announce a Judge's School to be held on Tuesday, July 27, 2010 at the World Conference in New Orleans.

Our March-April 2008 issue carried a letter from then-Cultivar Registrar Derek Butcher concerning the plant illustrated above. The plant was exhibited at a BSI Show by Joe Quijada as *Dyckia marnier-lapostolle* var. *estevesii* x (*D. fosteriana* x *D. platyphylla*), and the experts opined it was Dyckia 'Snowball' registered by Bob Spivey.

Subesquently, Bob Spivey advised: "The Dyckia...is not D. 'Snowball'. There is only a few out and all of them are in the Houston Texas area. That plant was probably bought from Tropiflora nursery several years ago. If he likes the plant he can name it whatever he likes. I know this does not solve the over-all problem but it would be a start."

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A New *Aechmea* Species from the Mountains of Rio de Janeiro State, Brazil

Elton M. C. Leme.[1] Illustrations by the author (except fig. 4).

Figure 1. Close up of the inflorescece of. *Aechmea lilacinantha* (Leme).

Over 20 years ago, during a visit to the mountainous region of Rio de Janeiro State, in Petrópolis county, an unusual *Aechmea* was encountered growing side by side with a new *Neoregelia* species which was years later described as *N. petropolitana* Leme. However, the collected *Aechmea* remained without a precise identification due to the poor knowledge on the complex of species in which it belongs, headed by *A. ornata* Baker, sometimes considered a member of subgenus *Pothuava* (Baker) Baker (e. g., Smith & Downs, 1979; Wendt, 1997), sometimes included in subgenus *Chevaliera* (Gaudich. ex Beer) Baker (e. g., Sousa, 2004).

1 Herbarium Bradeanum, Rio de Janeiro, Brazil. leme@tj.rj.gov.br

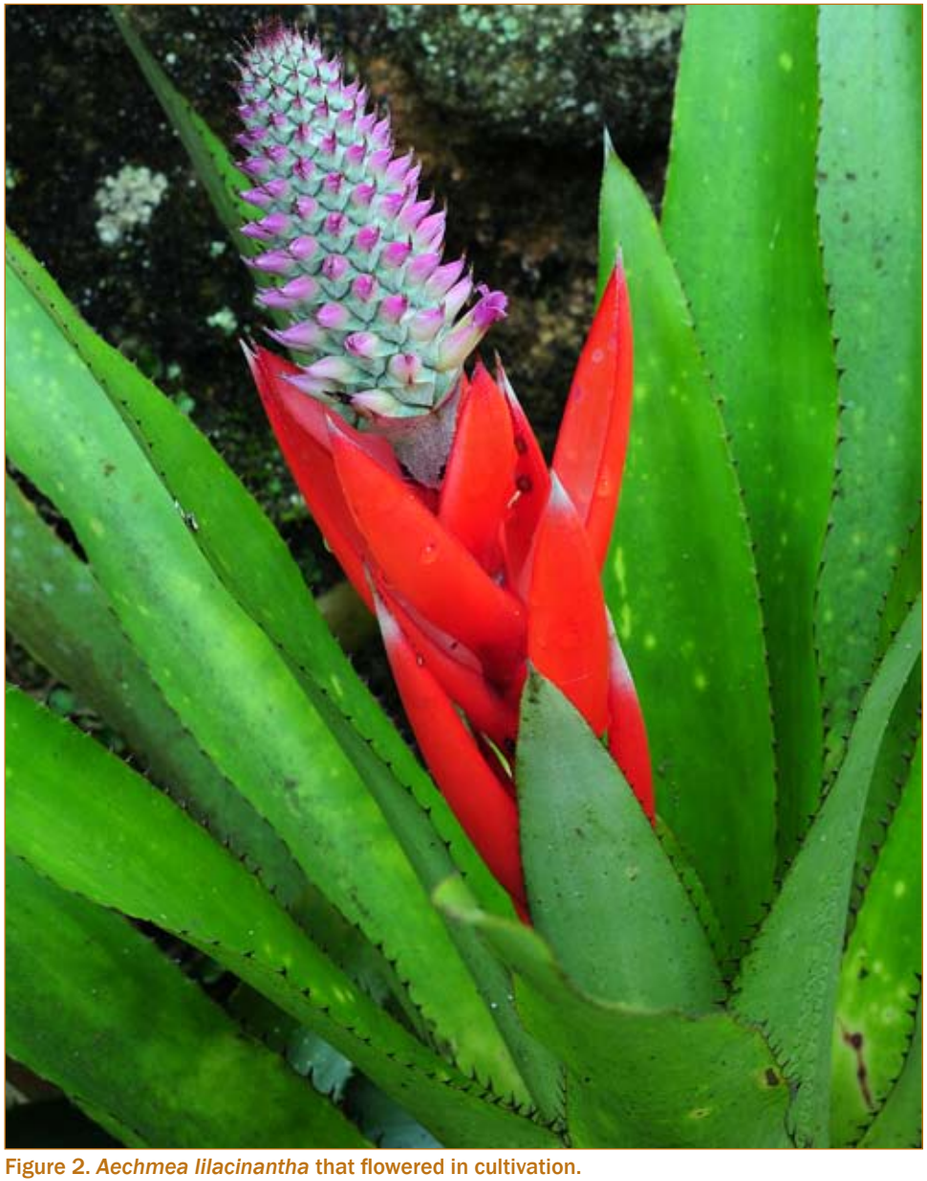

Figure 2. *Aechmea lilacinantha* that flowered in cultivation.

Recently, specimens of this aechmea maintained in cultivation for all these years flowered once more and were re-examined on the basis of the taxonomical information accumulated mainly during the last decade, revealing it to be an undescribed species.

Aechmea lilacinantha Leme, sp. nov. Type: Brazil. Rio de Janeiro: Petrópolis, road Rocio to Pati do Alferes, Mata do Facão, ca. 1,270 m elev., 22º29.40'S 43º16.16'W, Oct. 1986, *E. Leme 997*, fl. cult. Dec. 2008. Holotype: HB. Isotype: RB.

A *A. squarrosa* Mez cui affinis, sed scapo dense albo-lepidoto, bracteis scapalibus suberecto-ascendentibus haud imbricatis, inflorescentia breviora, bracteis floriferis dense albo-lepidotis marginibus prope apicem remote et irregulariter denticulatis, sepalis dense albo-lepidotis et ovario dense albo-lepidoto differt; A *A. ornata* Baker proxima, sed laminis foliorum spinis longioribus, bracteis floriferis altitudinem sepalorum distincte brevioribus, apice spina minori, sepalis majoribus asymmetricis, dense albo-lepidotis, apice lilacino, petalis prope apicem manifeste recurvatis et apice acutis apiculatisque, stigme altitudinem antherarum distincte breviore lobis erectis et poris pollinis binis differt.

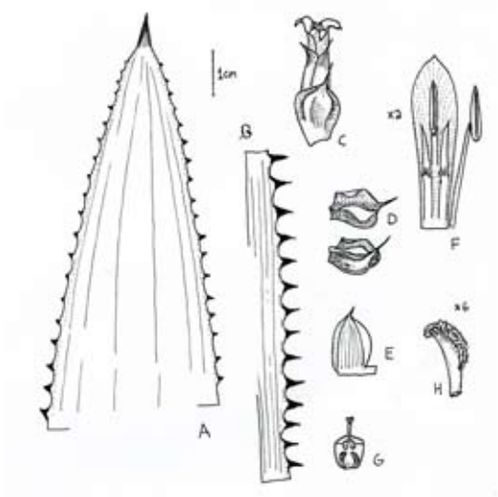

Figure 3: *Aechmea lilacinantha* Leme: A) leaf blades apex; B) leaf blade basal marginal spines; C) floral bract and flower; D) floral bracts; E) sepal; F) petal and stamens; G) ovary cross-section; H) stigma blade.

Plant **a** terrestrial or epiphyte, propagating by stout basal shoots, flowering 60-70 m high; ***Leaves*** ca. 22 in number, suberect, coriaceous, forming a funnelform rosette; s***heaths*** elliptic-ovate, 14-19 x 8.5-10 cm, purplish-wine inside, pale colored outside, densely pale lepidote on both sides; ***blades*** sublinear, not narrowed at base, channeled toward the base, 32-65 x 4.5-5 cm wide, apex acuminate, ending in a pungent spine 5-6 mm long, adaxially subdensely to sparsely and inconspicuously white-lepidote, abaxialy densely white-lepidote, margins densely to subdensely spinose, spines narrowly triangular, spreading or nearly so, straight or sometimes slightly antrorse-curved, dark brown, 2-5 mm long, 3-7 mm apart; ***Scape*** stout, erect, 30-50 cm long, ca. 1 cm in diameter, dark purple, completely covered by white trichomes; ***scape bracts*** the basal ones subfoliaceous, the upper ones narrowly lanceolate, apex acuminate-spinescent, pungent, distinctly exceeding the internodes, densely white-lepidote at apex, red, suberect-ascending and not imbricate, subtending the inflorescence, strongly channeled, 5-11 x 2.3-3 cm, margins inconspicuously and irregularly spinulose toward the apex to subentire; **Inflorescence a** simple spike, very densely strobilate, narrowly ovate to cylindrical, erect, 8-15 x 3.5-4 cm long (excluding the petals), apex subrounded and bearing a distinct apical coma of small sterile bracts; ***floral bracts*** navicular, thickly coriaceous and lignified, tricarinate, enfolding the ovary, light green near the base, dark green toward the apex, outside densely white-lepidote but trichomes not obscuring sepals color, inside glabrous, apex acute and aristate-spinescent, ca. 16 x 12 mm, including the 4-5 mm long, brown, suberect apical spine, distinctly shorter than the sepals, margins remotely and irregularly denticulate near the apex; ***Flowers*** sessile, densely and polystically arranged, subspreading, 27-29 mm long, odorless; **sepals** broadly suboblong-ovate, asymmetrical

with the subrounded lateral wing distinctly shorter than the midnerve, apex acute and distinctly mucronate, ca. 15 x 8 mm, including the 2.5-3 mm long, brown apical mucro, densely white-lepidote, thickly coriaceous except for the menbranaceous, whitish-hyaline lateral wing, lilac at apex and on the apical-central portion, greenish toward the base, ecarinate, connate at base for 1-1.5 mm, margins entire; ***petals*** subspatulate, apex acute and minutely apiculate, basal 3/5 greenish-white, apical 2/5 lilac, erect to suberect toward the apex except for the distinctly recurved apex, ca. 20 x 5 mm, free, apical margins bearing 2 well developed longitudinal callosities ca. 12 x 1 mm, as well as 2 appendages ca. 7 mm above the base with fimbriate-lacerate apex; ***filaments*** whitish, partially concealed by callosities, 12-13 mm long, subterete, the antepetalous ones adnate to petal for 7-8 mm, the antesepalous ones free; ***anthers*** sublinear, base obtuse, apex acute and apiculate, dorsifixed slightly below the middle, 6.5-7 mm long; ***pollen*** broadly ellipsoidal, biporate, pores small, exine psillate or nearly so; ***style*** cylindrical, whitish, ca. 6 mm long, ca. 1 mm in diameter; ***stigma*** conduplicate, lobes erect, slightly if at all twisted, ca. 1.5 mm long, pale lilac, margins crenulate-lacerate, wavy, densely papillose; ***ovary*** subglobose, nearly terete, greenish-white, ca. 6 x 6 mm, densely white-lepidote; placentation apical; ovules long caudate, ca. 1.5 mm long; epigynous tube crateriform, ca. 1 x 2.5 mm long, ***Fruits*** unknown.

Paratypes: Brazil: Rio de Janeiro, Petrópolis, Res. Florestal Pati do Alferes, 12 May 1968, *R. Braga* & *P. S. I. Braga 853* (RB); ibidem, 3 Jul. 1977, *G. Martinelli 2582* (RB); ibidem, Pati do Alferes – Petrópolis, 8 Jun. 1978, *G. Martinelli 4574* (RB); ibidem, Faz. Inglesa, 27 Jul. 1978, *G. Martinelli 4857* (RB).

Aechmea lilacinantha is a member of *Aechmea* subg. *Chevaliera*. Its closest relative is *A. squarrosa* Mez, but the new taxon differs from it by its scape densely white-lepidote (vs. glabrous), scape bracts suberect-ascending and not imbricate (vs. erect and imbricate), inflorescence shorter (8-15 cm vs. ca. 20 cm long), floral bracts densely white-lepidote (vs. glabrous or nearly so), margins remotely and irregularly denticulate near the apex (vs. entire), sepals densely white-lepidote (vs. glabrous), and by ovary densely white-lepidote (vs. glabrous). Since *A. squarrosa* is a very poorly known species, without detailed data on some important aspects of its morphology (e. g., petals, stamens, pollen), other differences may come to light when good living specimens of this mysterious taxon are re-collected.

In fact, this new species was identified in Wendt (1997) as *A. squarrosa*, as it is inferred by the listed specimens from Petrópolis-Pati do Alferes, here cited as paratypes. However, inaccurate taxa circumscription and mistaken new synonymy in the process of revising *Aechmea* subgenus *Pothuava* by Wendt (1997) were already reported by Silva & Leme [1999 (*A. triticina* Mez vs. *A. guarapariensis* E. Pereira & Leme)] and Leme & Silva [2002 (*A. cariocae* L. B. Sm. vs. *A. squarrosa* Baker)]. Another problem involves the broad circumscription of *A. ornata*, including *A. roberto-anselmoi* as a new synonym (Wendt, 1997), which was followed by Sousa (2004) in the revision of *Aechmea* subgen.

Figure 4. The holotype of the poorly known *Aechmea squarrosa* deposited in Kew Herbarium (K), the closer relative of *A. lilacinantha* (photo Kew Collection). Photo Kew Collection.

Chevaliera. Both authors did not evaluated the fact the typical *A. ornata*, originally described from Santa Catarina State, presents pollen sulcate and psillate, when *A. roberto-anselmoi*, from Rio de Janeiro state, has porate pollen grains, as cited in its protologue (Pereira & Leme, 1985), with reticulate exine, just to exemplify one striking character of distinction between these taxa. More recently, another circumscription of *A. ornata*

in disagreement with its original concept also appeared in Costa & Wendt (2007), but in their comments the authors discuss the uncertainty of the identification of the taxon they studied from Nova Friburgo, Rio de Janeiro.

Figure 5. A typical specimen of *Aechmea ornata* from Santa Catarina State.

When compared to *A. ornata* Baker (sensu Baker, 1889; Reitz, 1983; based on specimens from the States of Santa Catarina and Paraná), this new species can be distinguished by leaf-blades with longer spines (2-5 mm vs. 1-2 mm long), floral bracts (including the apical spines) distinctly shorter than the sepals (vs. distinctly longer than the sepals), with a shorter apical spine (4-5 mm vs. 10-14 mm long), sepals bigger (ca. 15 x 8 mm vs. 9-13 x 4-5 mm), asymmetrical (vs. subsymmetrical), densely white-lepidote (vs. glabrescent), lilac at apex (vs. completely green), petals strongly recurved at apex (vs. suberect), apex acute and apiculate (vs. broadly emarginate and apiculate), pollen biporate (vs. sulcate), and by stigma distinctly shorter than the anthers (vs. equaling the anthers), with lobes erect (vs. densely spirally-contorted).

Despite not being close relatives, *A. lilacinantha* may be confused with *A. roberto-anselmoi*. However, the morphological differences are: leaf-blades with longer spines (2-5 mm vs. ca. 2 mm long), floral bracts distinctly shorter than the sepals (vs. distinctly longer than the sepals), with a shorter apical spine (4-5 mm vs. ca. 17 mm long), sepals bigger (ca. 15 x 8 mm vs. 10-12 x 7 mm) with the lateral wing distinctly shorter than the midnerve (vs. equaling the midnerve), and mainly by pollen with psillate exine (vs. reticulate, with rounded lumina).

In order to better observe *A. lilacinantha* in habitat, we returned to the exact place where it was collected 22 year ago, which is now located inside the limits of the recently created Reserva Biológica do Tinguá, a federal conservation unit. Without an official permission to collect, we were happy to only take notes of GPS information (provided above), and photograph the original population, nowadays reduced due to the proliferation of a native bamboo species, which is increasingly shading terrestrial bromeliads and gradually disturbing their growth.

Aechmea lilacinantha is a typical terrestrial or sometimes epiphytic species of the high altitude Atlantic Forest, mostly composed by short trees, sharing the habitat with *A. nudicaulis* (L.) Griseb., *Neoregelia carolinae* (Beer) L. B. Sm., *N. chlorosticta* (Baker) L. B. Sm., *N. leucophoea* (Baker) L. B. Sm., *N. petropolitana*, *Quesnelia lateralis* Wawra, *Tillandsia organensis* Ehlers, *Vriesea heterostachys* (Baker) L. B. Sm., *V. longicaulis* (Baker) Mez, *V. philippo-coburgii* Wawra to name the more conspicuous elements. Certainly, its population is spread over the higher sites of the Reserva Biológica do Tinguá, suggesting the need of a survey to monitor its occurrence and evaluate any current risk for its survival in the whole area.

Figure 6. *Aechmea roberto-anselmoi* from Rio de Janeiro State, a distinct species when compared to *A. ornata*.

References

Baker, J. G. (1889). *Handbook of the Bromeliaceae*. London, George Bell and Sons.

Costa, A. F. d. and T. Wendt (2007). "Bromeliaceae na Região de Macaé de Cima, Nova Friburgo, Rio de Janeiro, Brasil." *Rodriguésia* **58**(4): 905-939.

Leme, E. M. C. and B. R. Silva (2002). "On the Ressurection of *Aechmea cariocae* L. B. Sm. ." *J. Bromeliad Soc.* **52**(6): 262-268.

Pereira, E. and E. M. C. Leme (1985). "Notes from Herbarium Bradeanum, No. 2: *Aechmea roberto-anselmoi*; A new Species from Brazil." *J. Bromeliad Soc.* **35**(4): 171-173.

Reitz, R. (1983). "Bromeliáceas e a malária-brornélia endêmica." *Fl. Ilustr. Catarinense* **I. Fasc. Brom**: 518.

Silva, B. R. and E. M. C. Leme (1999). "Rediscovering *Aechmea triticina* Mez." *J. Bromeliad Soc.* **49**(4): 168-173.

Smith, L. B. and R. J. Downs (1979). *Flora Neotropica Monograph No. 14, Part 3 Bromelioideae (Bromeliaceae)*. New York, The New York Botanical Garden.

Sousa, G. M. (2004). Revisão taxonômica de Aechmea Ruiz & Pav. subg. Chevaliera (Gaudich. ex Beer) Baker Bromelioideae-Bromeliaceae. São Paulo, Universidade de São Paulo. **PhD**.

Wendt, T. (1997). "A review of the subgenus Pothuava (Baker) Baker of Aechmea Ruiz & Pav. (Bromeliaceae) in Brazil." *Bot. J. Linn. Soc.* **125**(3): 245-271.

A New *Vriesea* species from Northern Peru

Harry E. Luther & Karen F. Norton[1]

Figure 1. *Vriesea altomayoensis*, overall habit

I hesitate to describe new Bromeliaceae which have a nebulous or unstable generic placement, but when they are already in cultivation and occur in a regional flora study site, it seems best to forge ahead. This new species is closest to taxa presently classified in ***Vriesea*** section ***Xiphion*** and ***Tillandsia*** subgenus ***Allardtia***. More specifically, a group of mesic Andean species related to ***Vriesea rubra*** and ***Vriesea dubia***. These of course, have nothing to do with "true" Vriesea, ie ***V. psittacina*** and relatives from Southeastern Brazil.

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Vriesea altomayoensis H. Luther & K. Norton, sp. nov.

TYPE: Peru, Amazonas, Alto Mayo region, 1600 m elev, grown from field collected seed, *J. Kent legit;* fl. in cult. 21 April 2009, *J. Kent s.n.* (Holotype: SEL).

A ***V. dubia*** (L.B. Sm.) L.B. Sm. cui affinis sed planta majoribus, inflorescentia ramosisimus, bracteis florigeris et sepalis minoribus differt.

Plant flowering 35 – 50 cm tall. ***Leaves*** rosulate, laxly spreading, 12 to 18 in number, 30 – 45 cm long, thin coriaceous. ***Leaf sheaths*** narrowly elliptic, 4 – 6 x 3 – 4 cm, densely brown punctate-lepidote throughout, dark castaneous abaxially. ***Leaf blades*** lingulate, acute to attenuate, 15 – 24 mm wide, subdensely brown punctate-lepidote throughout, light or bright green. ***Scape*** erect, stiff, 25 – 30 cm x 3 – 5 mm, very sparsely punctate-lepidote, reddish. ***Scape bracts*** erect, densely imbricate, narrowly elliptic, acute to attenuate, subdensely brown punctate-lepidote, green or green proximally, red distally. ***Inflorescence*** bipinnate, 10 – 15 x 3 – 7 cm, 6 to 15-branched. ***Primary bracts*** like the upper scape bracts, nerved, red. ***Branches*** spreading at 15° -- 30° form the main axis, each with a 4 – 6 mm long, naked or 1 bracteate peduncle, each 5 to 10-flowered. ***Floral bracts*** elliptic, acute, 14 – 19 x 6 – 10 mm, very thin-coriaceous, nerved, carinate, glabrous, yellow-green. ***Flowers*** with a 1 – 2 mm long pedicel, spreading at ca 30° from the slightly flattened and excavated rachis, opening during the day. ***Sepals*** free, the adaxial pair carinate, thin coriaceous, 14 – 17 mm long, glabrous, green. ***Corolla*** spreading at the apex. ***Petals*** narrowly lanceolate, rounded and retuse at the apex, 18 – 20 mm long, each with a pair of basal appendages, cream tipped with white.

Figure 2. *Vriesea altomayoensis*, inflorescence detail.

This new species seems most closely related to ***Vriesea dubia***, from Colombia to Peru, but differs by being larger overall with broader leaves, an inflorescence more richly branched with shorter floral bracts (14 – 19 vs. 28 – 30 mm long), that are yellow-green (not red margined white), and shorter (14 – 17 vs. 27 mm long) sepals. A small population grown from the wild collected seed appears uniform in all features.

We thank Mr. Jeffrey Kent for the plant material and Dr. Phil Nelson for the photography.

Molecular Studies about Two Rare Species of the Genus *Tillandsia* L. (*T. califanii* Rauh and *T. tomasellii* De Luca, Sabato et Balduzzi)

Olga De Castro, Paola Cennamo, Mario Vázquez-Torres & Paolo De Luca

Abstract. This study is a contribution to the phylogenetic positions of two peculiar species of the genus *Tillandsia*: *T. califanii* and *T. tomasellii*. These species are endemic to Mexico (Puebla and Oaxaca State) and very rare (especially for *T. tomasellii*). Relatively little has been published on these species because of the difficulty in sampling them. The available data for *T. califanii* are concerned with taxonomical characterisation and ecology. There are no studies published on *T. tomasellii*, except one about species classification. The phylogenetic relationships between these two *Tillandsia* species were performed using the nucleotide sequences from six regions of the chloroplast genome [*rps*16 intron, *trn*L$^{(UAA)}$ intron, *trn*L$^{(UAA)}$-*trn*F$^{(GAA)}$ intergenic spacer, *atp*B-*rbc*L intergenic spacer, *rbc*L gene with a part of *rbc*L-*acc*D intergenic spacer, and partial *mat*K gene with a part of the flanking *trn*K$^{(UUU)}$ intron], which have already been employed in an earlier phylogenetic study on Tillandsioideae, and compared them with Tillandsioideae sequences in GenBank and other *Tillandsia* species sequenced. According to the molecular results, *T. califanii* is very close to *T. achyrostachys*, but differs from it by habitat, size, and morphology; and the clade of *T. tomasellii* is not completely resolved due to a collapse with *T. paucifolia* and *T. klausii*.

Keywords: Mexico, phylogeny, plastidial markers, *Tillandsia califanii*, *Tillandsia tomasellii*

Running Title: Molecular analysis of *T. califanii* and *T. tomasellii*

Introduction

During the late 1960s, two independent botanical expeditions to Mexico were undertaken to study the genus *Tillandsia*. Two unusual specimens were collected. In 1966, Prof. Werner Rauh (University of Heidelberg, Germany) collected a specimen that grew on big cacti in the Tehuacán region of Puebla State, and classified it as a new species with the name *T. califanii* (Figure 1) (Rauh, 1971). In 1969, Prof. Paolo De Luca, Sergio Sabato, and Alberto Balduzzi (the first two of the University of Naples, and Pavia the third one, Italy) encountered a species of *Tillandsia* on the tree trunks along the river Río Hondo in Oaxaca State, which was successively identified as *T. tomasellii* (Figure 2) (De Luca et al. 1979).

These plants have some coincidence as: **(1)** they have been dedicated to two botanical Italians (Prof. Luigi Califano, Pathologist Doctor, a keen collector of *Tillandsia*, and Ruggiero Tomaselli, Professor of Botany, very good phytosociologist); **(2)** morphologically similar to other *Tillandsia* species (Rauh, 1971, Smith & Downs 1977, De Luca et al. 1979); **(3)** endemic to Mexico (Smith & Downs 1977); and **(4)** very rare plants (Smith & Downs 1977). Relatively little has been published on these species because of the difficulty in sampling them. The available data for *T. califanii* are concerned with taxonomical characterisation (Rauh, 1971, Smith & Downs 1977) and ecology (García-Suarez et al. 2003, 2006). There are no studies published on *T. tomasellii*, except one by De Luca et al. (1979) about species classification.

In the present study, we assessed the phylogenetic relationships between these two *Tillandsia* species. We used nucleotide sequences from six regions of the chloroplast genome, which have already been employed in an earlier phylogenetic study on Tillandsioideae (Barfuss et al. 2005), and compared them with Tillandsioideae sequences in GenBank and other *Tillandsia* species sequenced. The plastidial markers investigated were: *rps*16 intron, *trn*L$^{(UAA)}$ intron, *trn*L$^{(UAA)}$–*trn*F$^{(GAA)}$ intergenic spacer, *atp*B–*rbc*L intergenic spacer, *rbc*L gene with a part of *rbc*L-*acc*D intergenic spacer, and partial *mat*K gene with a part of the flanking *trn*K$^{(UUU)}$ intron. The utility of these sequences for resolving phylogenetic relationships has been highlighted by several authors, as described by Barfuss et al. (2005).

Materials and Methods

Plant accessions: A total of 133 species of Tillandsioideae (121 from GenBank) were considered for the present investigation. Twelve samples (nine species) have been analysed directly by the authors, including some from herbaria and living specimens (Table 1). Parts of the fresh leaves from each specimen were frozen at –80°C prior to use. The taxa are: *Tillandsia califanii* and *T. tomasellii*, *T. achyrostachys*, *T. exserta*, *T. fasciculata*, *T. lepidosepala*, *T. matudae*, *T. paucifolia* and *T. xerographica*. These taxa have not been sequenced (except for *T. fasciculata*). The other 121 GenBank taxa have been analysed by Barfuss et al. (2005). The complete list of taxa is available from the correspondence-author upon request.

DNA extraction from herbarium specimens: Several DNA extraction protocols have been tested because of the difficulty in obtaining a good DNA to amplify. DNA was extracted as follows: 50–100 mg leaf tissue were ground to a fine powder in liquid nitrogen and transferred to a 2-ml tube that contained 0.9 ml 2× CTAB extraction buffer [100 mM Tris–HCl, pH 8.0, 1.4 M NaCl, 20 mM EDTA, 2% (w/v) CTAB, 0.2% β-mercaptoethanol], and incubated for 30 min at 60°C. The homogenate was extracted by an equal volume of chloroform–isoamyl alcohol (24:1), and then centrifuged at 7000 g for 5 min. The top aqueous phase was recovered, and two more extractions with chloroform–isoamyl alcohol (24:1) were carried out. The top aqueous

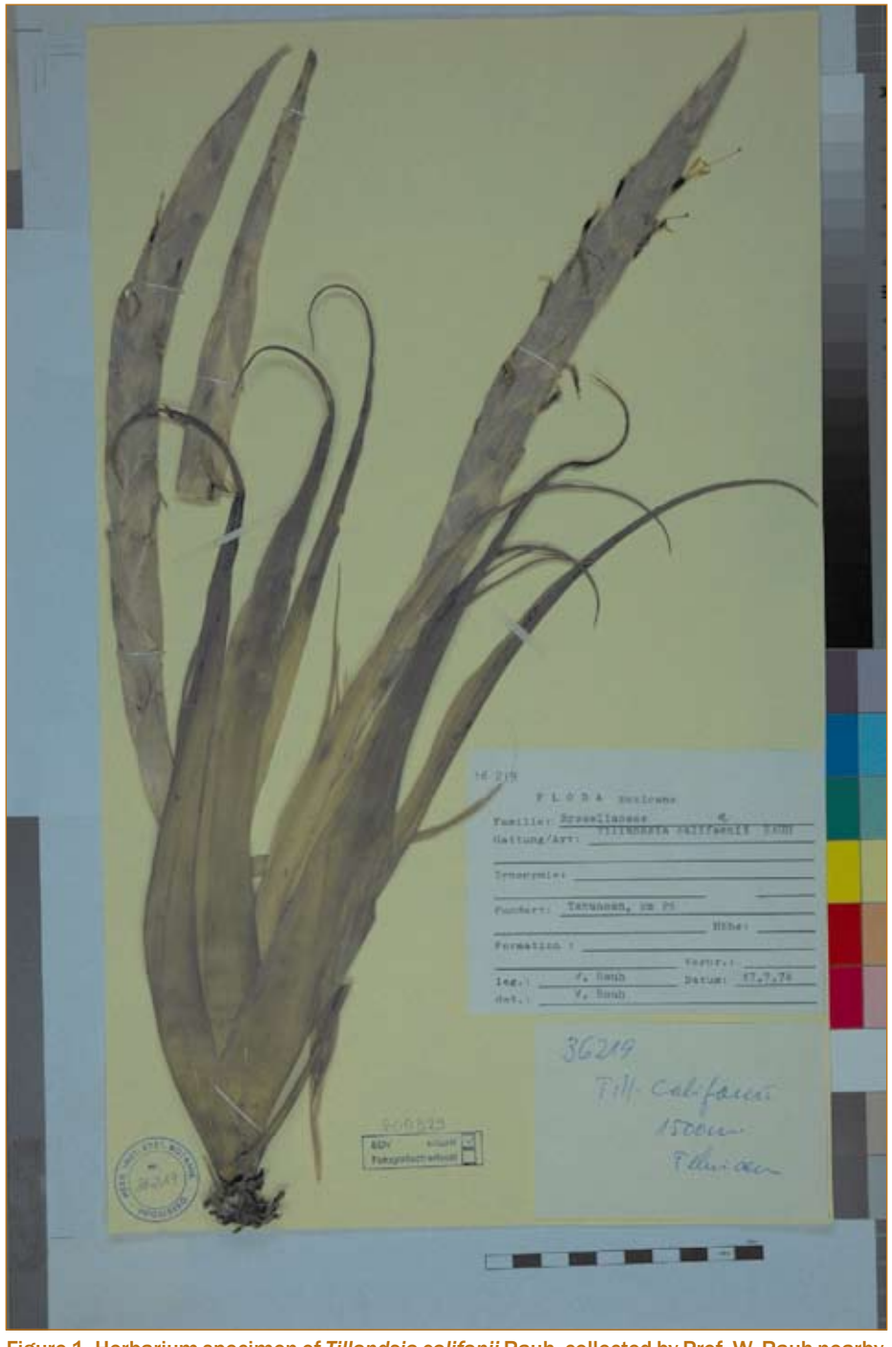

Figure 1. Herbarium specimen of *Tillandsia califanii* Rauh, collected by Prof. W. Rauh nearby Tehuacán (Puebla State, Mexico) (17 Jul 1974). Herbarium sheet no. 36219. Copyright Herbarium HEID, University of Heidelberg Institut for Plant Science.

Figure 2. Herbarium specimen of *Tillandsia tomasellii* De Luca, Sabato et Balduzzi, collected by the Authors near Río Hondo on the road to Santo Domingo Tehuantepec (Oaxaca State, Mexico) (12 Jul 1969). Isotype PAV. Herbarium sheet no. 3777.

Taxa	Locality and Voucher	GenBank No.s
Tillandsia achyrostachys-1 E. Morren ex Baker	Mexico (cultivated in NAP), *Dötterer TA1* 10.2007	FM211650, FM211661, FM210798, FM211061, FM210787
T. achyrostachys-2	Mexico, *Larson TA2* 11.2007 (NAP)	FM211653, FM211662, FM210799, FM211062, FM210788
T. califanii-1 Rauh	Mexico, *Rauh 36219* 17.07.1974 (HEID)	FM211651, FM211663, FM210800, FM211063, FM210789
T. califanii-2	Mexico (cultivated in NAP), *Wrinkle TC5* 10.2007	FM211652, FM211664, FM210801, FM211064, FM210790
T. exserta Fernald	Mexico, *Larson TE2* 11.2007 (NAP)	FM211654, FM211665, FM210802, FM211065, FM210791
T. fasciculata Swartz	Mexico (cultivated in NAP), *Wrinkle TF2* 10.2007	FM211655, FM211666, FM210803, FM211066, FM210792
T. lepidosepala L. B. Smith	Mexico (cultivated in NAP), *Kak.Haa.TL001* 07.2007	FM211656, FM211667, FM210804, FM211067, FM210793
T. matudae L.B. Smith	Mexico (cultivated in NAP), *Kak.Haa.TM001* 07.2007	FM211657, FM211668, FM210805, FM211068, FM210794
T. paucifolia Baker	Mexico, De Luca & Vázquez-Torres 01.2009 (NAP, HEID)	FN550873, FN550872, FN550870, FN550874, FN550871
T. tomasellii De Luca, Sabato & Balduzzi	Mexico, *De Luca & al. 3777 Isotype* 12.07.1969 (PAV)	FM211658, FM211669, FM210806, FM211069, FM21079
T. xerographica-1 Rohweder	Mexico, (cultivated in NAP), *De Luca s.n.*	FM211659, FM211670, FM210807, FM211070, FM210796
T. xerographica-2	Mexico, *Lozada s.n.* 08.2007 (NAP)	FM211660, FM211671, FM210808, FM211071, FM210797

Table 1. Specimens analysed directly by authors and their GenBank accessions (*rps*16 intron, *trn*L intron and *trn*L-*trn*F intergenic spacer, *atp*B-*rbc*L intergenic spacer, *rbc*L with a part of *rbc*L-*acc*D intergenic spacer, and partial *trn*K intron and *mat*K).

phase was recovered again, and 70% cold isopropanol was added and mixed gently to precipitate the nucleic acids. After 5 min on ice, the sample was directly centrifuged at 10,000 g for 8 min. The DNA pellet was washed with 70% ethanol, dried and resuspended in 0.5 ml sterile distilled water. Another extraction with chloroform–isoamyl alcohol (24:1) was performed, and the DNA was successively precipitated with 1/10 of 3.5 M sodium acetate 3M (pH 5.2) and double volumes of 100% ethanol. The pellet was washed with 0.8 ml 70% ethanol followed by centrifugation for 3 min. The

supernatant was removed, and the pellet was dried for 10 min and dissolved in 0.05 ml sterile distilled water.

DNA extraction from fresh tissue: Total DNA was isolated according to the method of Doyle & Doyle (1990), using 100 mg leaf tissue, with the addition of a chloroform–isoamyl alcohol (24:1) purification step. DNA was resuspended in 0.08 ml sterile distilled water.

PCR amplification and sequence analyses: Chloroplast markers were amplified using the primers described by Barfuss et al. (2005). For herbarium specimens, additional internal primers were designed for *Tillandsia* sequences. All primers used are listed in the Table 2. According to *mat*K, only the first part was amplified, because it yields the most variable portion through a preventive alignment of all GenBank sequences. PCR was carried out under conditions described by Barfuss et al. (2005). 7 □l of herbaria PCR reactions were reamplified in a 50 □l reaction volumes with internal primers and the PCR conditions were the same as for the fresh tissue samples. The amplified fragments were sequenced using a modification of the method of Sanger et al. (1977), using a fluorescent dye (Big Dye™ Terminator Cycle Sequencing Kit; Applied Biosystems) in an ABI PRISM® 3100-Avant Genetic Analyzer (Applied Biosystems). Complete sequences of both strands of each PCR product were processed, aligned, and visually checked by using Sequence Analysis ver. 1.8 and Sequence Navigator ver. 1.0.1 software (Applied Biosystems).

Phylogenetic analyses: Sequences were aligned using ClustalW ver. 1.4 software (Thompson et al. 1994) with default values. Alignments were carried out as daughter processes of BioEdit ver. 7.0.9 software (Hall, 1999).

Outgroups were the same as those used by Barfuss et al. (2005) and corresponded to two species of Bromelioideae (*Aechmea nudicaulis* var. *nudicaulis*, and *Bromelia plumieri*), eight species of Pitcairnioideae (*Brocchinia micrantha*, *B. reducta*, *B. steyermarkii*, *B. tatei*, *Hecthia carlsoniae*, *Lindmania guianensis* var. *guianensis*, *Pitcarnia punicea*, and *Puya laxa*) and two taxa of Rapateaceae (*Stegolepsis ligulata*, and *S. parvipetala*).

Aligned sequences were then visually inspected to correct gap distributions devoid of biological meaning, and to reduce the number of gaps. After alignment, all the sequenced markers were used for cladistic analysis (gaps scored as missing data), carried out using a combined matrix.

Merging of matrices and tree editing were carried out by using the cladistic software Winclada ver. 1.00.08 (Nixon, 1999–2002). Maximum parsimony (MP) analysis was carried out using Nona ver. 20.0 (Goloboff, 1999) and TNT ver. 1.0 software (Goloboff et al. 2000); the latter was also used for the bootstrap analysis (Felsenstein, 1985). One hundred replications were carried out, saving 100 trees per replication, in

Primer	Sequence (5'-3')	Reference
rps16 intron		
Forward - rpsF	GTG GTA GAA AGC AAC GTG CGA CTT	Oxelman et al. 1997
Reverse - rpsR2	TCG GGA TCG AAC ATC AAT TGC AAC	Oxelman et al. 1997
Internal-rps-For	AGA TGC TCT TGG CTC GAC AT)	De Castro*
Internal-rps-Rev	TTC CTC ATA CGG CTC GAG AA	De Castro*
trnL intron and trnL-trnF intergenic spacer		
Forward - c	CGA AAT CGG TAG ACG CTA CG)	Taberlet et al. 1991
Reverse - d	GGG GAT AGA GGG ACT TGA AC	Taberlet et al. 1991
Forward - e	GGT TCA AGT CCC TCT ATC CC	Taberlet et al. 1991
Reverse - f	ATT TGA ACT GGT GAC ACG AG	Taberlet et al. 1991
atpB-rbcL intergenic spacer		
Forward - Oligo 2	GAA GTA GTA GGA TTG ATT CTC	Manen et al. 1994
Reverse - Oligo 5	TAC AGT TGT CCA TGT ACC AG	Manen et al. 1994
Internal-spacer-For	TTA GTT GGT ACC GCC CAA	De Castro*
Internal-spacer-Re	TTG AGG AGT TAC TCG GAA TGC	De Castro*
rbcL gene with a part of rbcL-accD intergenic spacer		
Forward - 1F	ATG TCA CCA CAA ACA GAA AC	Fay et al. 1998
Reverse - 1460R	TCC TTT TAG TAA AAG ATT GGG CCG AG	Fay et al. 1998
Internal-rbc-For	TTT GGT TTC AAA GCC CTA CG	De Castro*
Internal-rbc-Rev	CTA GCT CAG GGC TCC ATTT G	De Castro*
partial matK gene with a part of the flanking trnK intron		
Forward - -19F	CGT TCT GAC CAT ATT GCA CTA TG	Molvray et al. 2000
Reverse - 1326R	TCT AGC ACA CGA AAG TCG AAG T	Cuénoud et al. 2002
Internal-mat-For	CCT GCC TCT GGC TCA AGT AG	De Castro*
Internal-mat-Rev	AAT CGG TCC AGA TTG GCT TA	De Castro*
* primers designed by the first author for herbarium specimens.		

Table 2. Primers used for PCR amplification, reamplification and cycle sequencing of plastidial regions of fresh and herbarium specimens of *Tillandsia* sequenced in the present study.

a tree-space of 100,000; the resulting trees underwent a further cycle of TBR swapping. A distance tree was also obtained by using a Neighbour-Joining algorithm (Saitou & Nei 1987), which was estimated with the Jukes–Cantor distances method (Jukes & Cantor 1969) available in PAUP* ver. 4.0b10 software (Swofford, 1998).

Results

For a major resolution of the phylogenetic trees, the author have modified the trees, proposing in detail the single species of *Tillandsia*. The complete trees are available from the correspondence-author upon request.

The obtained results from the parsimony analysis of the single sequences are not described, being equivalent to the results of Barfuss et al. (2005). In fact the *mat*K gene is the marker with the greatest number of variable characters (19.5%) unlike the *rbc*L gene (7%).

The total alignment of the 121 Tillandsioideae and 12 sequences outgroups (2 Bromelioideae, 8 Pitcairnioideae and 2 Rapateaceae) has produced a matrix of 5910 characters of which 5098 not informative. The matrix has yielded 46000 MP trees, length of the cladograms was 2280, C.I. = 0.66, R.I. = 0.81 (by removing uninformative characters, L = 1754, C.I. = 0.56, R.I. = 0.81). A majority-rule consensus tree is shown in the Figure 3. Examining the bootstrap value, the position of the taxa analysed are well supported in cladistic analyses (Figure 3).

The topology of the tree shows a subdivision in clades in accordance with the molecular results of Barfuss et al. 2005. The arrangement of the taxa under examination is in agreement with the available morphological data in literature (Rauh, 1971, Smith & Downs 1977, De Luca et al. 1979). In fact *T. califanii* is sister-groupto *T. achyrostachys* and *T. tomaselii* is in basal polytomy together with *T. paucifolia* and *T. klausii*. This polytomy is a sister group to another collapsed clade formed by *T. xerographica* and *T. fasciculata*, *T. caput-medusae*, *T. juncea, T. ionantha* var. *ionantha* (Fig. 3). The analysis of the Jukes-Cantor distances has produced a phenogram (not present) where the same groups are recognizable in the cladistic analysis (Figure 3). The distances and sequences alignment matrix is available from the correspondence-author upon request.

Discussion

Tillandsia califanii - The plant lives in dry and semiarid region of Tehuacán-Zapotitlán de las Salinas Valley System (Puebla State, Mexico). It is epiphyte on columnar cacti or succulent Liliales [e.g., *Cephalocereus columna-trajani* (Karwinsky ex Pfeiff.) K. Schum., *C. hoppenstedtii* (F.A.C. Weber) K. Schum., *Neobuxbaumia tetetzo* (J.M. Coult.) Backeb., or *Beaucarnea gracilis* Lem.]. According to Garcia-Suarez et al. (2006), most *T. califanii* individuals (90%) use *B. gracilis* as phorophyte, and only 2% live on the columnar cactus *C. columna-trajani*.

Considering the molecular data, two accessions of *T. califanii* have been examined: the first corresponds to the sample of herbarium collected by the author of the species (Prof. W. Rauh) (Figure 1); the second is a sample cultivated in the greenhouse. Both samples have produced the same results (the sequences have resulted identical) and according to the parsimony analysis they are sister to the two accessions of *T. achyrostachys* with a good bootstrap support (Figure 3). The analysis of the genetic distances has confirmed these results; in fact the *T. califanii* sequences have more similarity with *T. achyrostachys* sequences. These results confirm the hypothesis of Rauh (1971), according to which *T. califanii* is very close to *T. achyrostachys*, but differs from it by habitat, size, and morphology. *T. achyrostachys* prefers tropical dry forest (e.g., *Acacia* Mill., *Bursera* Jacq. ex L.), but some varieties are also epiphytes on cacti and trees in dry habitat. The main differences to *T. achyrostachys* are the pale carmine-red, nearly whitish, densely white lepidote flower bracts, the dark blue-violet flowers, while these are pale yellow green in *T. achyrostachys* and the flower bracts of a bright carmine red with prominent nerves (as reported in Rauh, 1971).

According to the parsimony analysis, the clade organization is well structured and supported. The *T. califanii* clade is sister group to a clade where most *Tillandsia* spp. sequenced in this research (except for *T. lepidosepala*) are present. These two clades have in common an ancestor which very probably was an epiphyte in dry environments. In fact in basal position there is *T. disticha* and successively *T. paniculata*. Both species do not live in Mexico but are epiphytes in xeric regions of South America (Colombia, Perù, Ecuador for *T. disticha*, and Haiti, Dominican Republic for the second one). This ecological feature (i.e., epiphytism in xeric regions) lost in other species of *T. califanii* clade (i.e., *T. punctulata*, *T. andrieuxii* and *T. carlos-hankii*) has reappeared in *T. califanii* and *T. achyrostachys*.

Tillandsia tomasellii - It is epiphytic on trees (e.g., *Amphipterigium adstringens* (Schltdl.) Standl., *Andira inermis* (Sw.) Kunth ex DC, *Astronium graveolens* Jacq., *Lysiloma microphyllum* Benth., and *Stenocereus chacalapensis* (Bravo et Macdoug.) Buxb.) in semiarid regions (low deciduous tropical forest) of the Municipality of San Carlos Yautepec (Oaxaca State, Mexico). Nowadays the only well-known station is that of the type collection (De Luca et al. 1979).

Only one specimen has been analysed which corresponds to the Isotype (PAV) (Figure 2), in fact other Botanical Gardens, and *Tillandsia* lovers or sellers have been contacted unsuccessfully to find other samples. In August of 2007, a botanical expedition of ours was undertaken to sample *T. tomasellii* specimens. Unfortunately, no samples have been found because of a strong anthropogenic impact which has compromised the habitat of *T. tomasellii*.

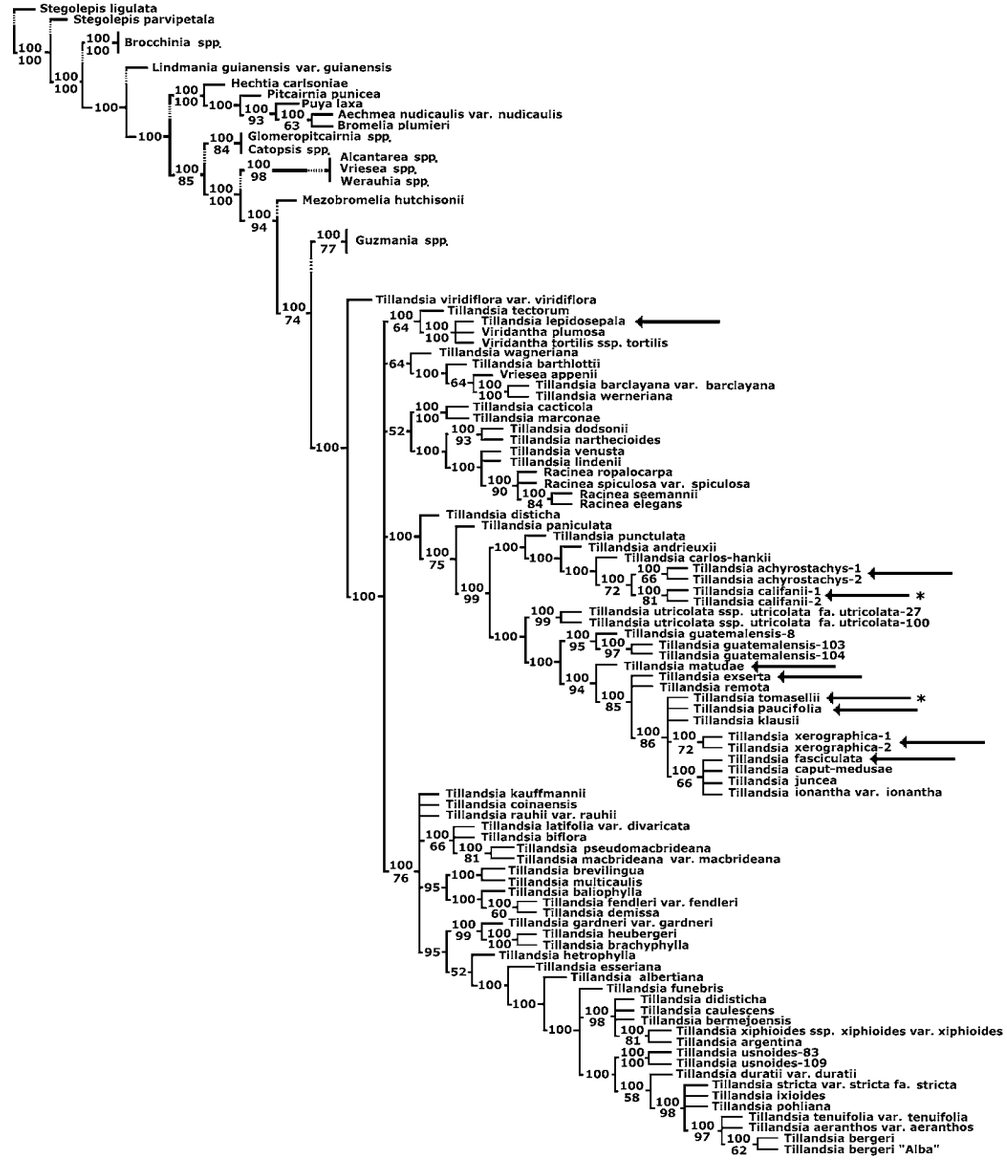

Figure 3. Majority rule consensus tree of 46000 most parsimonious trees of Bromeliaceae dataset obtained from analysis of combined *rps*16 intron, *trnL*$^{(UAA)}$ intron, *trnL*$^{(UAA)}$-*trnF*$^{(GAA)}$ intergenic spacer, *rbc*L, *atp*B-*rbc*L intergenic spacer, and partial *mat*K with a part of the flanking *trnK*$^{(UUU)}$ intron (length = 2280, C.I. = 0.66, R.I. = 0.81). First numbers on the branches indicate the percentages of trees in which the given node appears, the second numbers indicate bootstrap values (1000 replicates; only values >50% are shown). The arrows indicate the specimens amplified in this study.

According to the morphology, this species presents some likenesses with two *Tillandsia* spp. (De Luca et al. 1979). On the basis of its carinate posterior sepals it is related to *T. xerographica* and to *T. fasciculata*; but it is different from the second because its leaves are more cretaceous-coated, its spikes are few-flowered and smaller, its inflorescence is denser and much longer; and from *T. xerographica* because it is larger, its inflorescence is denser and much longer, its spikes are more numerous, its flowers and its floral bracts are smaller, its primary bracts are very pale pink and not yellow-red.

The molecular results confirm the above, even though the clade of *T. tomasellii* is not completely resolved due to a collapse with *T. paucifolia* and *T. klausii* (Figure 3). It is possible to observe a closeness of *T. tomasellii* with *T. xerographica* and *T. fasciculata*. This last species is part of another collapse with *T. caput-medusae*, *T. juncea* and *T. ionantha* var. *ionantha*. Worthy of note is the genetic distances matrix, where *T. tomaselli* has an elevated similarity of sequence with *T. xerographica*. Overall the clade of *T. tomasellii* is well structured as that of *T. califanii* (Figure 3). Both belong to a greater clade.

The species analyzed additionally place among other members of the subgenus *Tillandsia*, except for *T. lepidosepala,* confirming the new taxonomical collocation performed by Espejo-Serna (2002), in fact according to the author this species belongs to *Viridantha* genus. This could be possible due to the morphological complexity of these plants, in fact until now an exhaustive taxonomical treatment is not present in literature determining some inaccuracies in the taxonomical collocations in this genus.

Acknowledgements

Mr Luca Paino and Dr Chiara Marzano are thanked for the technical help. We are also grateful to the Dr José Armando Lozada García for the field activity and Dr Walter Till for help with *T. paucifolia*.

Literature Cited

Barfuss, M.H.J., R. Samuel, W. Till and T.F. Stuessy. 2005. Phylogenetic relationships in subfamily Tillandsioideae (Bromeliaceae) based on DNA sequence data from seven plastid regions. Amer. J. Bot. 92: 337-351.

Cuénoud, P., V. Savolainen, L.W. Chatrou, M. Powell, R.J. Grayer and M.W. Chase. 2002. Molecular phylogenetics of Caryophyllales based on nuclear 18S rDNA and plastid *rbc*L, *atp*B, and *mat*K DNA sequences. Amer. J. Bot. 89: 132-144.

De Luca, P., S. Sabato and A. Balduzzi. 1979. *Tillandsia tomasellii* (Bromeliaceae), a new species from Oaxaca, Mexico. Brittonia 31(4): 474-477.

Doyle, J. J. and J.L. Doyle. 1990. Isolation of plant DNA from fresh tissue. Focus 12: 13-15.

Espejo-Serna, A. 2002. *Viridantha*, un género nuevo de Bromeliaceae (Tillandsioideae) endémico de México. Acta Bot. Mex. 60: 25-35.

Fay, M.F., C. Bayer, W.S. Alverson, A.Y. De Bruijn and M.W. Chase. 1998. Plastid *rbc*L sequence data indicate a close affinity between *Diegodendron* and *Bixa*. Taxon 47: 43-50.

Felsenstein, J. 1985. Confidence limits on phylogenies: an approach using the bootstrap. Evolution 39(4): 783-791.

García-Suarez, Ma.D., V. Rico-Gray and H. Serrano. 2003. Distribution and abudance of *Tillandsia* spp. (Bromeliaceae) in the Zapotitlán Valley, Puebla. México. Plant Ecology 166: 207-215.

García-Suarez, Ma.D., V. Rico-Gray, N. Molina-Aceves and H. Serrano. 2006. In-vitro germination and clonal propagation of endemic *Tillandsia califanii* Rauh (Bromeliaceae) from Mexico. Selbyana 27(1): 54-59.

Goloboff, P.A., J.S. Farris and K.C. Nixon. 2000. TNT (Tree analysis using New Technology) (BETA) ver. Xxx. Published by the authors, Tucumán. Available from http://www.cladistics.com.

Goloboff P. (1999) NONA (NO NAME), ver. 2. Published by the author, Tucumán. Available from http://www.cladistics.com.

Hall, T.A. 1999. BioEdit: a user-friendly biological sequence alignment editor and analysis program for Windows 95/98/NT. Nucl. Acids. Symp. 41: 95-98. Available from http://www.mbio.ncsu.edu/bioedit/bioedit.html.

Jukes, T.H. and C.R. Cantor. 1969. Evolution of protein molecules. In: Munro H.N. (ed.) Mammalian protein metabolism. Academic Press, New York, pp. 21-123.

Manen, J.F., A. Natali and F. Ehrendorfer. 1994. Phylogeny of the Rubiaceae-Rubieae inferred from the sequence of a cpDNA intergene region. Plant Syst. Evol. 190: 195-211.

Molvray, M., P.J. Kores and M.W. Chase. 2000. Polyphyly of mycoheterotrophic orchids and functional influences on floral and molecular characters. Pp. 441-448 *in* K.L. Wilson and D.A. Morrison, eds. Monocots: systematics and evolution. CSIRO Publishing, Collingwood, AU.

Nixon, K.C. 1999-2002. WinClada ver. 1.0000. Published by the author, Ithaca. Available from http://www.cladistics.com.

Oxelman, B., M. Lidén and D. Berglund. 1997. Chloroplast *rps*16 intron phylogeny of the tribe *Sileneae* (Caryophyllaceae). Plant Syst. Evol. 206: 393-410.

Rauh, W. 1971. *Tillandsia califanii* Rauh spec. nov., a new species from Mexico. J. Bromeliad Soc. 21: 65-67.

Saitou, N. and M. Nei. 1987. The neighbor-joining method: a new method for reconstructing phylogenetic trees. Mol. Biol. Evol. 4(4): 406-425.

Sanger, F.S., S. Nicklen and A.R. Couson. 1977. DNA sequencing with chain terminating inhibitors. Proc. Natl. Acad. Sci. USA 74: 5463-5467.

Smith, L.B. and R.J. Downs. 1977. Flora Neotropica. Monograph 14, Part. 2. Tillandsioideae (Bromeliaceae). Hafner Press, New York.

Swofford, D.L. 1998. PAUP*. Phylogenetic Analysis Using Parsimony (* and Other Methods), version 4. Sinauer Associates, Sunderland.

Taberlet, P., L. Gielly, G. Pautou and J. Bouvet. 1991. Universal primers for amplification of three non-coding regions of chloroplast DNA. Plant Mol. Biol. 17: 1105-1109.

Thompson, J.D., D.G. Higgins and T.J. Gibson. 1994. CLUSTAL W: improving the sensitivity of progressive multiple sequence alignment through sequence weighting, position-specific gap penalties and weight matrix choice. Nucleic Acids Res. 22: 4673-4680.

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Aechmeas 'Exotica Candy' & 'Exotica Candystripes'

Geoff Lawn, BSI Cultivar Registrar. Photos by Andrew Steens.

Aechmea 'Exotica Candy.'

Aechmea 'Exotica Candystripes.'

It's unwise for a variegate to be registered when there is no record of it's all-green parent as proof of lineage must be established. Such was the recent case of New Zealand grower Andrew Steens who wanted to register a centrally-striped Aechmea thought to be *A. apocalyptica* x *gamosepala*. This situation required details and a photo of the original plant which later sported the variegated form.

To backtrack, in the 1980s fellow N.Z. collector Len Trotman had imported from an undocumented source reputedly in New South Wales, Australia an unnamed Aechmea hybrid in a mixed batch, although there is no official record of it there from then Aussie-hybrids recorder Derek Butcher. By 1993 Len had produced sufficient stock of *Aechmea gamosepala* to fill Andrew's order of several hundred plants for cut flower production. Within this batch were about a dozen related species and hybrids, including this plain green-leaved hybrid with an inflorescence of unusual colour combinations.

Over the next decade Andrew propagated and sold many hundreds of this unknown Aechmea hybrid which remained unidentified and only in 2009 was registered as *Aechmea* 'Exotica Candy'. The inflorescence shape and red stem is more compact than *A. apocalyptica* while the sepals are darker candy pink and the petals a light blue, suggesting *A. gamosepala* var. *nivea* may be involved, toning down the cornflower blue petals of *A. apocalyptica*.

In 2003 Andrew discovered a single variegated pup on an *Aechmea* 'Exotica Candy' which was nurtured and the stripes stabilised so by 2007 he bulked up stocks to sell at his nursery. This sport with cream central stripes over green foliage has an identical spike to it's parent and is now registered as *Aechmea* 'Exotica Candystripes'.

Back to Grass Roots

Maurice Kellett. Photos and captions by Andrew Flower.

Editor's note: Maurice did not supply any illustrations with his article, so to help out readers who may not be familiar with tillandsias in cultivation, I took some photos around my own nursery. I hope these are helpful - if not, please don't blame Maurice!

In the late 1960's a new member from New Zealand, Ron Maunder, joined our local Victorian Bromeliad Society. Ron was a keen orchid grower and confided to me that he had built himself a laminar-flow filter cabinet to research tissue culture of orchids. After two years of solid effort he managed to achieve the culture of orchids using tissue growth techniques. Working after-hours with the set-up in his bedroom, his marriage was put to the test as his wife had to accept a cool breeze coming from the laminar-flow cabinet straight across their bed for hours on end.

With a little encouragement and a sincere promise from me that I would not propagate orchids, Ron helped me build a very cheap laboratory using a frying pan for transfers, a small lamp for sterilizing, and a silver-lined foil cabinet with a thermostat and timer-controlled lamp for growing-on. Flasks were sterilized at a local mental institution laboratory (my friends!!) and we used sugars and Knudson's formula as growth incentives.

We did achieve some tissue growth mainly using sterilized seed where the seed was removed from green pods, and where the seeds were accidentally buried under the medium. Tillandsia stricta, and other tillandsia, were successfully grown up to removal and growing-on mounted on sticks suspended in empty jars. Seeds from Pitcairnia, Aechmea, Neoregelia with hard coats germinated easily in this protected environment… but where is all of this heading?

We noticed that some of the Tillandsia seedlings showed an unusual growth habit (fig. 1) in that their roots were growing up rather than down into the media (as we were taught in school biology that they should) But why? David Benzing noticed similar traits with seedling Tillandsia roots encouraged to grow by the application of indoleacetic acid in his experiments (Benzing, 1970). But *why* did they grow up?

In 1971 after putting pressure on my friendly bank manager for a loan, and attending some basic Spanish language classes, I set off to visit The Dominican Republic, Florida and Mexico to study plants in the wild and to try and find answers to some of the questions. Werner Rauh (1979) portrayed Tillandsia growing in habitat all germinating and growing either on the side of branches or on the top of branches. However I found in habitat many species start their lives on the underside of branches or twigs and over many generations they progressively grow around the branch until we see them happily growing like little soldiers along the topside of branches. All of this makes sense when you consider the higher temperatures on the topside of the branch compared to the cooler microclimate on the underside. Also, if the branch is on a tree growing at altitude, say 3,000 meters, where else can the roots go but up into the host branch!!! This is called a negative geotropic response—compared of course to "normal" root responses to gravity, as in terrestrials, which is called positive geotropism.

Figure 1. Root systems of 15-year old seedlings of *Tillandsia xiphioides* showing their tendency to grow upwards. You can also see how the seedlings tend to grow horizontally for a short distance before curving upwards - possibly due to their ancestor populations having adapted to germinating on the underside of tree or shrub branches, then grown up towards the light. The stick these ones are grown on is 2cm. diameter.

In 1971 on one of my many study trips with Dr. Matuda we visited Tepotzotlan. We went up old roads in the village and climbed part-way up the cliffs to a popular temple. We were surprised to be passed by two Australians jogging up and down the steps while we struggled with the altitude. I don't think they were looking for Tillandsia!

Figure 2. *Tillandsia caput-medusae* in cultivation. The original seedling (nearly died off) put out a few hold-fast roots, then the subsequent three generations of offsets produced only a couple more roots.

We studied many different color combinations of *Tillandsia capitata*, and *T. caput-medusae* growing on the underside of branches with hardly any root attachment (fig. 2) and I managed to find the stub of a plant that had been hacked and dropped over the cliff edge. Dr. Matuda agreed that this plant although un-named and having no roots could possibly survive.

Later in the year, after I returned home with the stub in my collection, it was cleared from quarantine, mounted on a large slab of ordinary pine bark, and it commenced to grow. Now 35 years later I have been rewarded each year by beautiful flowers on this *Tillandsia deppeana*. The plant only sends up one pup to replace the mother plant and has covered the bark with progressive rings of spent roots. It has now reached the top of the mount and thinking of where to go next?

I think that all of these events point to the importance of roots on Tillandsia plants and why we should study the types of roots to correctly grow our plants as close to their natural growth habit as possible. I have always been an advocate of strong attachment of plants to make them stable and to encourage strong root growth. We are lucky to have two very good books written by David Benzing in which he refers at length to the different types of roots, their structure, moisture and nutrient take-up, and why he believes that roots on Tillandsia perform only one function and that is as a "holdfast root."

Figure 3. *Tillandsia matudae* (upper) and *T. tenuifolia* cultivated on Portugese cork.

David Benzing noted the roots of epiphytic species are predominantly aegeotropic (growing upward) since they often germinate on the sides and under-surface of tree limbs (see Fig. 1), and and along with saxicolous (rock-dwelling) species can also be thigmotropic in that they grow against adjacent tree bark or rocks regardless of their orientation relative to gravity (Benzing, 1980 p.33). This was the case when Mulford Foster offered me a nicely grown Tillandsia exserta which had been sitting on his wooden work bench for some time. It was necessary for him to use a wood chisel to remove the roots.

It is important for us to study the different forms of root attachment in Tillandsia so that we can best mount them in cultivation. In my nursery I use net pots which are open weave all over and cannot be over-watered. With a good open mix it is an ideal environment as the orchid growers have found. For most plants, though, branches or cork mounts (Fig. 3) prove to be the most convenient. I have tried to attach plants to rocks to duplicate saxicolous mounts but so far without much success.

After collecting a very large form of Tillandsia usneoides, I hand pollinated the green perfumed flowers and sowed the seeds to increase stocks. After germination the seeds all formed holdfast roots to the cork host; but later generations do not show any interest in forming roots and rely on the plant structure for attachment (fig. 4).

Figure 4. Original seedling roots still present on a batch of *Tillandsia usneoides* seedlings germinated on shadecloth strip 15 years ago.

Now the Brown Wanderer butterflies attracted by the concentrated scent complete the pollination for me. Many other Tillandsias when removed from their host, or divided, do not form roots and can quite successfully complete their life-cycles without them. Are there any other plants that can do this as successfully as tillandsia? I can't think of any!

The roots described by Benzing (1970) as "holdfast," although similar to other plant roots in biological structure, exhibit two main structural differences. Although some root growths under ideal conditions can be quite prolific and appear similar to terrestrial roots, they do not form the fine root hairs that explore and take up moisture to the main roots. It is the root hairs that are lost when we transplant terrestrial plants and cause temporary wilt until new root hairs are formed. Tillandsia roots also become thick-walled as the parenchyma cells on the outer region of the root hardens, decays slowly, and stays wiry for many years (see 16 year-old roots in fig. 4). Although Benzing does not fully discount the root's ability to take up moisture and nutrients, there is no solid evidence that I have seen. However we don't fertilize the roots, only the foliage for nutrient uptake. However the plants grown in my nursery in solid-walled pots with the addition of Dynamic Lifter (fowl/chicken manure) have shown enormous growth ability but again the foliage receives foliar sprays and because the potted plant has more material for moisture uptake these could be the reasons. Root viability is usually no more than a year or two, sometimes three to four years.

In many plants the roots of the new offsets travel through the cell structure of the mother plant, right back to the original point of attachment. Rather than destroy the mother plant, these roots can be severed as new roots will replace them. Even in the highly variable orchid species I have never seen this form of growth duplicated, and it may be unique to tillandsia.

The extent of rooting in Tillandsia is inversely related to trichome density. *Tillandsia tectorum*, which is almost totally white with overlapping trichomes, would have a very rudimentary root system (fig. 6). At the other extreme, the green-leafed *T. guatemalensis* develops an extensive and fine root system (fig. 7).

Figure 5. *Tillandsia ixioides* grown sitting on top of a pot of compost (left) and attached to a bark slab (right). Inserts at top are the relative root systems of each plant at same magnification.

Figure 6. *Tillandsia tectorum*, root system on 19-year old seedlings

Figure 7. *Tillandsia guatemalensis*, root system on pot-grown plant.

These examples can be used for many plants when considering whether to pot or mount the plant. Although I have seen T. caput-medusae grown in compost with algae up to the base of the plant, the high temperatures maintained in that nursery ensured their survival. If I tried the same technique the plants would rot away in the first winter as I maintain low temperatures to produce robust plants.

Perhaps the roots of plants that grow on trees and rock faces that accumulate soil materials, animal manures and decaying matter do have some ability to take up nutrients through their roots?

Figure 8. Root formation on young *Tillandsia compressa* seedlings (2 cm. high) - defying the aegeotropic rule!

Figure 9. Straw-coloured coma hairs on germinating *Tillandsia capitata* seeds.

The development of roots in Tillandsia seedlings can take 4-6 months (Fig. 8), so the seedlings must stay attached to their host by the coma hairs (the fine parachute hairs attached to the seed which aid wind dispersal as well as initial attachment - see fig. 9). In the Dominican Republic we were able to study the pattern of seed wind-dispersal as the locals were establishing new pine plantations and we could see the new populations of seedlings on the dark green foliage of the pines. It was interesting to see that Eucalypt trees in the Republic had no epiphytes attached as the species planted regularly shed their bark.

If we like to see our plants firmly attached to their mounts by roots, then it is important to encourage new root growth. This may be achieved by the right fertilizer regime, the use of hormones as contained in the Kiki-root paste used by Orchid growers or by the use of new pots and open-type mixtures to increase moisture application and air access to roots.

If we recorded the times for the first initiation of roots in seedlings, then this would assist in determining the best time to move the seedlings to their mounts.

Summary

- Tillandsia roots are for "holdfast purposes only"
- Tillandsia roots are not proven to be a source of nutrient uptake.
- The type of tillandsia root is directly related to trichome density on the leaves.
- Root initiation is delayed during seedling formation.
- Many plants can live without active roots but we can encourage new root growth if required.
- The type of roots should determine the type of mount.

Epilogue

Although David Benzing has completed many wonderful books and articles on tillandsia, there is still a vast opportunity for collectors to experiment, to observe, and to record information on Tillandsia roots.

Literature Cited

Benzing, D. H. (1970). "Roots in Certain Species of Tillandsia and Vriesea and Their Role in the Epiphytic Environment " J. Brom. Soc. 20(4): 79-84.

Benzing, D. H. (1980). The Biology of the Bromeliads. Eureka, California, Mad River Press.

Benzing, D. H. (2000). Bromeliaceae: Profile of an Adaptive Radiation. Cambridge, UK, Cambridge University Press.

Rauh, W. (1981). Bromelien. Stuttgart, Ulmer Verlag.

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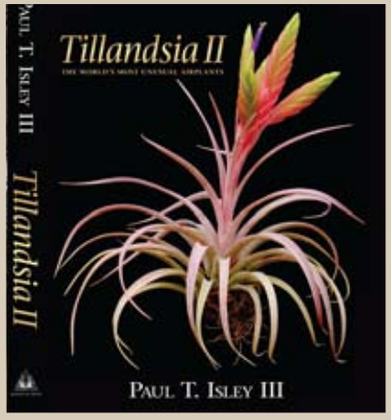

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Bromeliads at Kew Gardens, UK.

Photos taken in the Princess of Wales Conservatory by Chris Lee.

Aechmea leptantha.

Vriesea amethystina. **The silver plants in the background are *Tillandsia xerographica*.**

Deuterochnia lorentziana

Tillandsia rauhii

Bromeliad Society of South Florida Show 2009

Dr. Jeffrey Block's Orthophytum.

Jacquelin Guadio's *Tillandsia dyeriana.*

Left to right: Robert Meyer, Craig Morell and Nat DeLeon.

What Happened to these Puyas?

UBC Botanical Garden's Eric La Fountaine took this photograph, and wrote:

"Spontaneous plant combustion? The photograph shows the charred remains of a large colony of puya, either *Puya chilensis* or *Puya berteroniana*. Both are Chilean endemics. Local botanists who I toured with said that this sight can be witnessed occasionally in the wild. The curiosity is that only the puya are burned--no sign of fire damage occurs around the colony. When the phenomenon is observed, it appears to only occur in mature colonies. Some theorize that a type of spontaneous combustion involving chemicals in the mature plants, possibly ignited by the intense sun, is involved. Close inspection of the material revealed a delicate charcoal, like something that had smoldered without flame. Unfortunately, I can not find any substantiation or even discussion of this phenomenon."

The photo was taken in the Bosque de Fray Jorg National Park in Chile, and posted by Daniel Mosquin on the "Botany Photo of the Day" discussion forum run by the University of British Columbia Botanical Garden and Centre for Plant Research. You can find this fascinating forum at http://www.ubcbotanicalgarden.org/potd/

But what did happen here? Please send your suggestions to the editor!

Aechmea caesia inflorescence, photographed by Elton Leme. See also Elton's habit photo of this species on the back cover of this issue. These are the first photos of *A. caesia* published in the Journal. However, we have published photos of *A. flavorosea* E. Pereira, and in 1989 Harry Luther considered that taxon to be a subspecies of *A. caesia* E. Morren ex Baker. That absorbtion is controversial, see J. Brom Soc. (40) 261-262.

Meet Vicky Chirnside, New 2009-2011 BSI Director for Florida Region.

I have raised bromeliads since 1972 when my neighbor decided my yard was barren (having just moved in) and planted these ugly spiny tube things at my entrance. I did not want to insult him by ripping them out. To my amazement they grew into beautiful rosettes and I was hooked! The neighbors were the sister and brother- in- law of Mulford Foster. I had Bert Foster as one of my teachers when he would come to visit his aunt and uncle.

At the Sarasota County Fair, in the 1980's while admiring a beautiful display of bromeliads that James Elmore had created, I met a couple of people who were also interested in Bromeliads and that was the start of the Sarasota Bromeliad Society. I have served as President of the Sarasota Society for 2- two year terms and many other positions. It was on a collecting trip to Honduras, where I met Gene McKenzie and she invited me to the Caloosahatchee Bromeliad Society in 1981, soon after it had been formed and I have been a member ever since. I have also served 2- one year terms as President of the Caloosahatchee Bromeliad Society and once again various other positions.

I attended the first Judging School taught in Florida and have been a Master Judge for many years. I also served on the JCC committee and also as a Representative to the Florida Council of Bromeliad Societies; holding several offices including Chairperson for two terms, I am now the Southeastern Judges Registrar.

Judge's School V - New Orleans World Conference

JUDGE'S SCHOOL V will be held on Tuesday, July 27, 2010 in New Orleans in conjunction with the World Bromeliad Conference in New Orleans. School V is the study of the Artistic Category and Genus Neoregelia. Anyone interested should contact Betty Ann Prevatt, Judges Certification Committee Chairman, email bprevatt@aol.com or write to 2902 Second Street, Fort Myers, Florida 33916. My home phone is 239-334-0242. There will be a minimal fee and deadline to register is June 30, 2010.

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May 1-2, 2010. Bromeliad Society of Australia Autumn Show. First floor, Burwood RSL Club, 96 Shaftesbury Road, Burwood, NSW. Free Entry.

United States of America

April 16-18, 2010. Sarasota Bromeliad Society Annual Show and Sale at Marie Selby Botanical Gardens 811 South Palm Avenue, Sarasota, Florida 34236. 10am to 4pm each day. Bromeliad sales each day and noon-5pm Friday April 16. Contact Theresa M. Bert 941-795-6012 or email turtle1657@yahoo.com for information.

May 1-2, 2010. La Ballona Valley Bromeliad Society 55th Annual Show & Sale at the Culver City Veteran's Memorial Complex, 4117 Overland Ave., Culver City CA. Sat 12-5:00 and Sun 10-4:00. Free admission and parking, contact Don Misumi 323-2949830 or dgmisumi@aol.com. Sales plants from members and vendors.

July 26 - August 1, 2010. BSI World Conference to be held at the Astor Crowne Plaza in New Orleans.

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