JOURNAL
OF THE BROMELIAD SOCIETY

Volume 53, Number 5: 193–240 September – October 2003

Photograph by Jason Grant

FIGURE 1. *Tillandsia francisci* W. Till & J. R. Grant, in natural habitat in Venezuela, Mérida State, Páramo La Negra, at 2600 m above sea level.

Photograph by Jason Grant

FIGURE 2. Detail of *Tillandsia francisci* flowering branch.

FIGURES 3 (left) and 4 (below): Holotype of *Tillandsia clavigera* Mez, from Ecuador, Prov. Pichincha, Llaló, 3000 m elevation. *Stübel 208-A* (B).

Photographs by Walter Till

Photograph by Walter Till

FIGURE 5. *Tillandsia clavigera* Mez, Ecuador, Prov. Pichincha, Tambillo Viejo, 3000 m elevation. *W. Till 13008a* (QCA), See also cover photo.

the upper 7.5 cm , the terminal 13.5-22.0 cm stipitate, ***stipes*** covered by a bicarinate prophyll and 4-6 sterile bracts. Rachis glabrous, angled to subalate when dry, internodes 10-11 mm long. ***Floral bracts*** broadly elliptic but navicular, carinate in the upper third, bicarinate below, acute, apex straight to slightly incurved but not beaked, 38-42 mm long, 10-12 mm wide seen from the side, greenish-yellow with violet-brown tips and margins in life, drying stramineous with violet-gray tips and margins, about 3 times as long as the internodes, equaling the sepals. ***All bracts and sepals*** abaxially glabrous, adaxially densely lepidote with minute, brownish to brown, non-overlapping appressed peltate trichomes. ***Flowers*** sessile to short pedicellate on a stout pedicel to 2 mm. ***Sepals*** 38-42 x 12-14 mm, lanceolate to ovate-lanceolate, acute, rather chartaceous, free, the abaxial ecarinate, the adaxial pair strongly subalate carinate, keel 1-2 mm wide. ***Petals*** lavender, linear-long, acute, free, unappendaged, 42-46 x 5-6 mm; the exserted petal lobes 5-10 x 2-3 mm. ***Stamens*** 36-38 mm long, ***filaments*** 26-30 x 1 mm, ***anthers*** linear-long, basifixed, 8-10 x 0.75-1.0 mm. ***Pistil*** 33-36 mm long, ***ovary*** 7-9 x 2.5-3.0 mm, pyramidal, ***style*** 23-33 x 0.5-0.75 mm, ***stigma*** 2-3 x 1 mm, with conduplicate-spiral type morphology. ***Capsule*** cylindric, 32 mm long with a 3 mm long slender beak, brown outside and transversely rugose, blackish-brown and smooth along the septae; ***seeds*** about 23 mm long including the whitish pseudopappus, with a 2 mm long undivided chalazal appendage, the seed body brown.

Paratypes: Colombia. Cundinamarca: Bogotá, Cerro de Monserrate, trail from the north side that winds around back to the base on the SE side, 04° 36' 035" N, 074° 03' 238" W, 3133 m, 30 April 1999, *Jason R. Grant 99-3441* (US, flowering). **Venezuela**. Mérida: Páramo La Negra along the road from Bailladores to Pregonero, before the first bifurcation to La Grita, 2600 m, 22 Feb. 2000, *W. Till 16098* (WU, fruiting); Páramo La Negra along the road from Bailladores to Pregonero, 2420 m, 22 Feb. 2000, W. Till 16096 (WU, immature).

The name honors Francisco Oliva-Esteve (1932-), landscape architect, author of several books and long term promoter of interest and knowledge of Venezuelan Bromeliaceae.

Tillandsia francisci is a large lithophyte of near vertical shear rock faces. Large populations have been observed colonizing the rock faces in a narrow canyon. It has not been observed as a terrestrial or epiphyte. The difficulty to collect material from such a remote and difficult habitat is likely the reason it was unknown to science until now.

This conspicuous plant has previously been identified as *Tillandsia clavigera* Mez by Hornung & Gaviria (1999) and Oliva-Esteve (2000), or *T. fendleri* Griseb. by Oliva-Esteve & Steyermark (1987) and Oliva-Esteve (2003). It differs, however, by its much larger habit, longer and strongly compressed spikes, larger flowers and coloration. FIGURES 3 and 4 show the type specimen of *T. clavigera* at Berlin-Dahlem (B), and the FRONT COVER and FIGURE 5 a plant collected in the province of Pichincha, Ecuador, close to the type area that matches the type of *T. clavigera*.

Using the keys of Smith & Downs (1977; especially subkey IX) *Tillandsia francisci* (greenish-yellow flower-bracts with violet-brown tips and margins, 38-42 mm long) belongs to a group of closely related species comprising *T. denudata* André (dark castaneous flower-bracts 15-22 mm long), *T. clavigera*, *T. brevicapsula* Gilmartin, and *T. nervisepala* (Gilmartin) L.B. Sm. (flower-bracts pale and concolorous in all species, 24-30 mm long). The measurements of flower-bracts and sepals of *T. clavigera* are incorrect (i.e., too large, likely due to inclusion of discordant elements) in the key of Smith & Downs (1977) and *T. clavigera* is probably nothing more than a somewhat depauperate form of *T. nervisepala*, however, the former name having priority over the latter. *T. clavigera* var. pendula Rauh (1985) does not belong to the above mentioned group but is much closer related to *T. francisci* differing immediately in its much shorter scape and pendulous inflorescence with more densely and polystichously arranged spikes.

Some similarity also exists with *Tillandsia fendleri* Griseb. However, the habit, the secund, pendulous linear (vs. lanceolate) spikes and the coloration clearly separate the two species. Photographs of *T. francisci* have been published under the name of *T. fendleri* in Oliva-Esteva & Steyermark (1987) and Oliva-Esteve (2003).

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Diving (Beetles) in Bromeliads

Michael Balke[3]

Diving beetles of the family Dytiscidae (order Coleoptera) are a commonly encountered group of water beetles in wet tropical and subtropical forests worldwide (Balke 2003). They utilise a wide variety of aquatic habitats ranging from small streams to large rivers and small water holes to the largest lakes. However, most species diversity is concentrated in smaller or shallower aquatic habitats such as richly vegetated freshwater swamps and small water bodies in primary forests. Diving beetles are ferocious predators as larvae and adults, consuming any kind of prey they can overwhelm, such as other insect larvae and small worms. Adults are also known to scavenge on carcasses.

Species of the subfamily Copelatinae (FIGURE 6) are particularly diverse in tropical forests, and more than 400 species have been described so far. These beetles often inhabit ephemeral water bodies such as temporary cups of rainwater on large fallen leaves, and thus they can easily be attracted to artificial water bodies such as plastic trays with shallow water and some leaves. Copelatinae must reproduce very quickly, and tests with flight interception traps prove that they are active dispersers, flying around in the forest in search for aquatic habitats (Balke, experiment in French Guiana 2003).

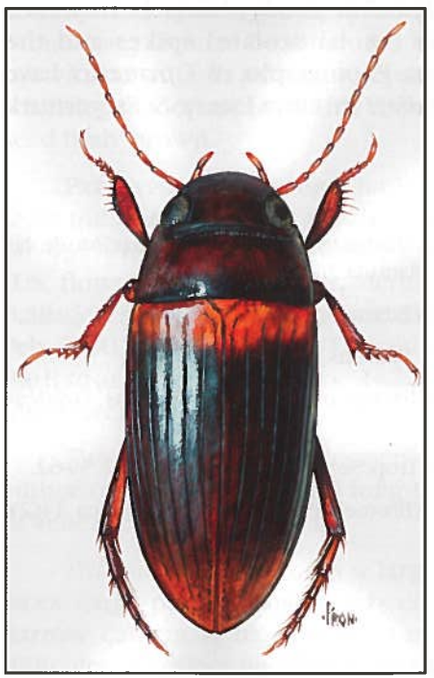

FIGURE 6. Habitus of a typical Copelatinae (*Copelatus*; length 5 mm). Most species have conspicuous longitudinal lines.

These properties make Copelatinae very likely candidates for entering bromeliad water tanks, and several species have already been found in these plants in Trinidad (Scott 1912), Guyana (Balfour-Browne 1938), and Brazil (Resende & Vanin 1992). Kitching (2000) suggested that these beetles only occasionally enter water tanks, "merely exploiting the container water bodies as a source of prey for these generalist predators." This is certainly true for some species. Two *Copelatus* species described from bromeliads in the grasslands of Guyana closely resemble non-bromeliad species and are likely to also occur in other habitats. Interestingly though, two *Aglymbus* species have been described from epiphytic bromeliads in Trinidad and the Atlantic Forest of Brazil that have a dorsoventrally strongly flattened body, more so than in other related species. These beetles are most likely specialist bromeliad inhabitants, morphologically adapted to this unusual habitat. This interesting part of the bromeliad fauna apparently remains to be studied in more detail, and hitherto unpublished reports of strongly flattened *Aglymbus* from Brazil and Venezuela suggest a wide distribution of these potential bromeliad specialists.

My research focuses on the evolution of the subfamily Copelatinae, and three questions of particular interest are: How many species occur in bromeliad water tanks? How many of these show morphological characters that suggest they are bromeliad specialists? How many times these beetles have 'invaded' the bromeliad habitat? The principal tools I use are molecular phylogenetic analysis and morphology. So far I only have a few species from bromeliads, but have already achieved a wide coverage of other Copelatinae from all over South America. As more species from bromeliads become available, it will be possible to understand the evolution of these remarkable beetles. Dated molecular phylogenetic trees will help to estimate how long a flattened body seen in some *Aglymbus* species took them to evolve - basically giving us an idea how long it takes to become a bromeliad specialist.

How Can I Help ?

It is easy. If you work with bromeliads and have the proper permits, just pour the contents of the tanks on to a white screen and look for beetles. You will also find them hiding in mud and debris in the leaf axils if you dissect a plant. Apparently, montane forests around 500-1500 m above sea level house the most interesting fauna. The Copelatinae are ca. 5 mm long, black, or brownish, with longitudinal lines on the elytron. Some have yellow patches on the shoulders. There might be other water beetles that I could identify for you. It is important for my work that the beetles are properly dehydrated for DNA work. Put the beetle in a tube with 95% or more ethanol. The volume of ethanol should be at least five times more than that of beetles - see www.waterbeetles.info/molecular.htm. My contact information can be found in the footnotes. I can send tubes to you. Any help would be greatly appreciated - I cannot succeed working alone!

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BSI Affiliates in Action

Gene Schmidt[4]

The BSI would like to welcome and congratulate the Sunshine Coast Bromeliad Society of Queensland, Australia on their affiliation with the BSI at this year's Board of Director's Meeting held in Chicago, IL. The Sunshine Coast Bromeliad Society joins a strong group of bromeliad enthusiasts from Australia and New Zealand and can trace its roots back to the Bromeliads X Conference in 1999. Let us all wish them many years of success in furthering the cultivation and understanding of bromeliads in Australia.

The meeting held in November 2002 was the official 40th anniversary of the Bromeliad Society of New Zealand. Three original foundation members, who are also life members, were present: Harry Martin, Patricia Sweeney, and Laurie Dephoff; other founders are Gerry and Margaret Stansfield. Unfortunately, Patron, life member, and acknowledged "mother of the society" Bea Hanson was unable to attend but was very interested to hear all the news. The other life member is Patricia Perratt. The society finds itself doing well including a membership of 525 with active and thriving groups in Kerikeri, Northland, Bay of Plenty, Eastern Bay of Plenty, Hawkes Bay, and Wellington. *(Journal of the Bromeliad Society of New Zealand, Inc., Vol. 43, No. 1, January 2003)*

Another bromeliad society celebrating many years of success is the Bromeliad Society of Central Florida (US), marking the occasion in the fall of 2002. The three founding members present were Brian Wood, Eloise Beach, and Jim Pearce. Charter member Wilma Paulauskas was also introduced. Brian Wood started this society in 1972 and was awarded a 30-year pin by Pam Flescher. There are now approximately 170 members, with the BSCF donating twelve BSI memberships as door prizes last year. *(Orlandiana, Newsletter of the Bromeliad Society of Central Florida, Vol. 28, No. 12, December 2002)*

Congratulations to the Illawarra Bromeliad Society of Australia who were presented with the Molly Morrison Award for "Special Effort within the zone" at the Garden Clubs of Australia 2002 AGM. This award recognized their outstanding effort in hosting the 11th Australian Bromeliad conference in October 2001. In addition to a certificate they received a book for their library. Central Coast of New South Wales Bromeliad Society members who attended "Brom-a-warra" all agreed that this award was well deserved. *(Bromelia Post, Central Coast NSW Bromeliad Society, January 2003)*

There are two websites included in the publication of The Southeastern Michigan Bromeliad Society. For those interested in tillandsias, Andreas Boeker's website www.tillandsia-web.de is a must. It features a gallery of photographs from his collection of over 300 varieties including 40 natural

[4] BSI Affiliated Societies Chair

hybrids and 60 as yet unnamed collected species. This site, which he has conveniently made available in English as well as German, required an immense amount of labor and Mr. Boeker is to be commended for an outstanding job. Also, the Bromeliad Society of Greater Chicago now presents its newsletters online at www.chicago-bromeliad.org. (Rumor has it that the Webmaster, Stan Wen is still in high school...) *(SEMBS, The Southeastern Michigan Bromeliad Society, Jan/Feb 2003)*

Michael and Patricia O'Dea were appointed to life membership in The Bromeliad Society of Queensland (AUS) in recognition of their service to the Society. The Society web page has also been largely completed, and of particular value will be the information page for the upcoming Australian Bromeliads XIII conference in 2005; it can be found at www.bsq.org.au. Congratulations to the O'Deas. *(Bromeliaceae, The Bromeliad Society of Queensland, Inc., Vol. XXXVI, No. 2, March/April 2003)*

Jeffrey Kent gave a fascinating but grim report to the Bromeliad Society of San Francisco (US) last fall of how many different plant genera are being wiped out of Ecuador. Jeffrey has made many different trips to Ecuador over the years and has seen plants disappear because of logging, oil drilling, and slash and burn activities. Orchids are about the only plant family that is in decent shape, because the local people realize their cash value and have saved them. Plants at the highest elevations, and areas protected by Indians are still intact. Jeffrey showed slides of many plants in habitat, those he has not found on his recent trips, and a few bromeliads that have yet to be described. *(Newsletter of the Bromeliad Society of San Francisco, Dec. 2002)*

Lynne Fieber of the Bromeliad Society of South Florida (US) writes of the March meeting, which included Grant Groves giving an entertaining program about a recent trip to Peru to see and collect bromeliads in some spectacular locations. Some of these bromeliads may withstand the test of "progress" due to their ability to thrive on vertical rock cliffs out of reach of both collectors and road-clearing equipment. The trip took Grant's group to 16,000 feet where the strategy of plant hunting could be described as "sitting and looking," because exercise was out of the question at that altitude. Of the numerous plants they collected, not one made it through the shiny, new plant inspection facility at their Orlando, FL, debarkation point. At least there were the photos, and Grant was able to share some of his plants with landscaping artists in Peru. *(The Bromeliadvisory, The Bromeliad Society of South Florida, Vol. 46, No. 4, April 2003)*

In Memoriam

Bromeliad pioneer, Bill Frase died in Orlando, FL, at the age of 90. Bill was a charter member of the Bromeliad Society of Central Florida, joining in the early 1970's. He was also honored as a life member of BSCF. *(Orlandiana, Newsletter of the Bromeliad Society of Central Florida, Vol. 29, No. 5, May 2003)*

Sandy Antle, one of the founding members of The Cryptanthus Society, passed away in November 2002. Sandy and her husband were active bromeliad growers and hard working members of the Bromeliad society of Houston. Sandy's special interest in cryptanthus led her and Jimmy to join with other local growers to formulate plans for a worldwide cryptanthus organization. The efforts of this group, which included Bob Whitman, Warren Loose, and Don and Betty Garrison, resulted in the formation of The Cryptanthus Society in 1986. She was also instrumental in early efforts to bring order out of the chaos of Cryptanthus hybrids, and in fact acted as the first Chairman of the Hybrid Registration Committee. The Cryptanthus Society will always be grateful for Sandy's many contributions. *(The Cryptanthus Society Journal, January-March 2003)*

The Bromeliad Society of Queensland, Australia lost one of its long serving members, Don Hobbs. Don served the society for 18 years in a variety of roles, including being editor of The Bromeliaceae; as well as organizer of Bromeliads VII, the seventh Conference of Australian Bromeliad Societies held in1993. As editor, Don made changes that included color photographs on the front and back covers with descriptions. *(The Bromeliaceae, The Bromeliad Society of Queensland, Inc., Vol. XXXV No. 6, November-December 2002)*

Events Calendar

April 24-25, 2004. *BROMELIAD SOCIETY OF NSW AUTUMN SHOW.*

May 29-30, 2004. *BROMELIAD SOCIETY OF AUSTRALIA AUTUMN SHOW.*

June 17, 2004. *BOCA RATON BROMELIAD SHOW.* Boca Raton Bromeliad Society. For more information, see www.bsi.org/webpages/boca_raton.html.

August 10-15, 2004. *WORLD BROMELIAD CONFERENCE.* Bromeliad Society International/Bromeliad Society of Greater Chicago. Rosemont, Illinois, USA.

August 11, 2004. *SCHOOL II OF THE WORLD CONFERENCE BROMELIAD JUDGES SCHOOL SERIES.* Held at the World Bromeliad Conference in Chicago. All day. There is a nominal fee and you must be registered for the school one week prior to the conference. For more information, contact Betty Ann Prevatt, 2902 Second St., Ft. Myers, FL 33916. Phone 239-334-0242 or e-mail bprevattpcc@aol.com.

Taxonomic Categories and the Quest for a Natural Classification Scheme

Dorothy E. Tuthill and Gregory K. Brown[5]

Classification of entities seems to come naturally to human beings, as we seek generalizations that make communication easier between us. For professional and non-professional botanists alike, it is much easier to say "bromeliad," by which we mean members of the family Bromeliaceae, than it is to say something like, "I enjoy working on/looking at/growing those herbaceous plants that form perennial rosettes with short axes, that may be terrestrial, saxicolous or epiphytic, having roots that may be modified into holdfasts, and with terminal inflorescences that may be scapose or simple, compound or simple," and so on until we have included all of the characters that comprise "bromeliad." Scientific classification, called taxonomy, endeavors to provide names and descriptions at all levels of classification, from the very broad, such as the kingdom Plantae, to the smallest unit that we can recognize, such as *Tillandsia fasciculata* var. *densispica* forma *alba*, a name that conveys a wealth of information to someone familiar with it.

The fundamental taxonomic unit is the species, whose name is the Latin binomial that we are familiar with. For example, the species name *Tillandsia fasiculata* Swartz includes the genus name *Tillandsia*, indicating a bromeliad with leaves having smooth margins and scales (usually), plumose seeds, separate petals that lack appendages, etc., and *fasiculata*, the specific epithet, which means clustered (perhaps the flower spikes or maybe the plants themselves), but implies also a number of other characters that separate *T. fasiculata* from other Tillandsias (see TABLE 1).

TABLE 1. Taxonomic placement of *Tillandsia fasciculata* in the grand scheme of living organisms.

Category		Common name
Domain	Eukaryota	organisms with nuclei
Kingdom	Plantae	plants
Division	Magnoliophyta	flowering plants
Class	Liliopsida	monocots
Order	Poales	grass order
Family	Bromeliaceae	pineapple family
Subfamily	Tillandsioideae	tillandsia subfamily
Genus	*Tillandsia*	tillandsia
Species	*Tillandsia fasciculata* Swartz	cardinal airplant (Florida)

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The third part of a species name is the name of the person who originally described the species. This is necessary because sometimes two people, unaware of each other's work, use the same name for different plants. Although only one of the uses can be retained according to the rules of botanical nomenclature it is important that subsequent botanists know which concept of the name is in use. If a later taxonomist decides that a species has been assigned to the wrong genus, his (or her) name gets added also. For example, when Jason Grant moved *Vriesea penduliscapa* Rauh to *Tillandsia* (Grant 1993), the species' new name became *Tillandsia penduliscapa* (Rauh) J.R. Grant.

Taxonomists don't all agree as to what constitutes a species. Zoologists often use the biological species concept (BSC) of Ernst Mayr (1963), which defines a species as a group of interbreeding or potentially interbreeding populations, but this concept is often not useful to botanists. Plants, and bromeliads in particular, tend to breed across what appear to be reasonable species boundaries, and even across genera. In a practical sense, plant taxonomists look for groups of individuals (or populations) that are alike, and that can be distinguished from other similar groups. Traditionally, this has meant "look alike" since plant taxonomy has relied heavily on morphology. If we see variation within species we can call particular groups subspecies, varieties or forma. Technically, the category subspecies is greater than variety, but usage tends to be a matter of preference, with authors using one or the other. Smith and Downs (1974, 1977, 1979) recognized varieties but did not consider any subspecies in the Bromeliaceae. Forma refer to particular characters that are known to be variable, such as flower color.

Genera are made up of species that share one or more characters. To continue with the *Tillandsia* example, species in *Tillandsia* are very much like species in the genus *Vriesea*, with the exception that all *Tillandsia* have petals that lack appendages, while all *Vriesea* have appendages on their petals (FIGURE 7). In defining genera, taxonomists try to pick characters that they think show evolutionary signal; that is, they want genera that are natural products of evolution, and not artificial collections of unrelated species.

The morphological concepts of species and genera have worked pretty well in some groups of bromeliads, but poorly in other groups. The characters that are visible to humans are also the characters that provide the interface between the plant and the entire ecosystem of which it is a part. Therefore, these characters tend to be under strong selective pressure to ensure survival of the species. Consider leaves, for example. Bromeliads that live in shaded environments such as forest floors tend to have broader leaves because a large leaf surface helps the plant intercept more light. If the environment in which the plant lives becomes drier, then there may be less overhead leaf cover and more sunshine, and over generations leaves may become more narrow as light is no longer limited. Narrow leaves are more resistant to water loss, an advantage in a drier habitat. Likewise, features of the inflorescence are determined in large part by the need to attract

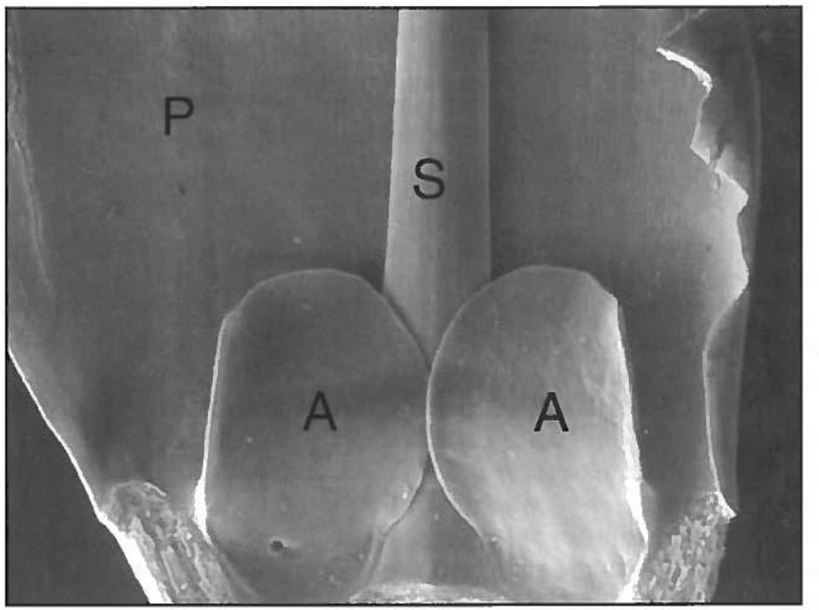

FIGURE 7. Scanning electron micrograph of petal appendages on *Vriesea carinata*. In this case the appendages (A) are also called scales because of their shape. S = stamen filament. P = petal.

pollinators, so that unrelated species relying on similar pollinators share characters that are attractive to those pollinators.

Evolutionary change has been rapid in the Bromeliaceae. We know that the family as a whole is quite young, (younger than the South American continent), yet the number of species in the family exceeds that of all other New World families. Within this short time period bromeliads have diverged greatly, both in number of species and morphological characters. However, it is often the case that only some characters evolve while others remain the same. Flowers may change radically to attract a new pollinator, while the rest of the plant remains unchanged, so that plants look alike except when in flower. In another lineage the flowers may remain similar though the vegetative parts become drastically different, so that the plants look very different until they bloom. And, as mentioned before, unrelated plants can evolve to look alike as a response to similar selective pressures. All of these changes in myriad directions can make the sorting out of species and genera very difficult.

Fortunately, plant taxonomists have acquired new tools to help with the sorting, and to help determine how species and genera are related. The study of evolutionary relationships is called systematics, and a favored tool of systematists is phylogenetics. Phylogenetic analyses involve searching for patterns of character changes within lineages, which in turn involves

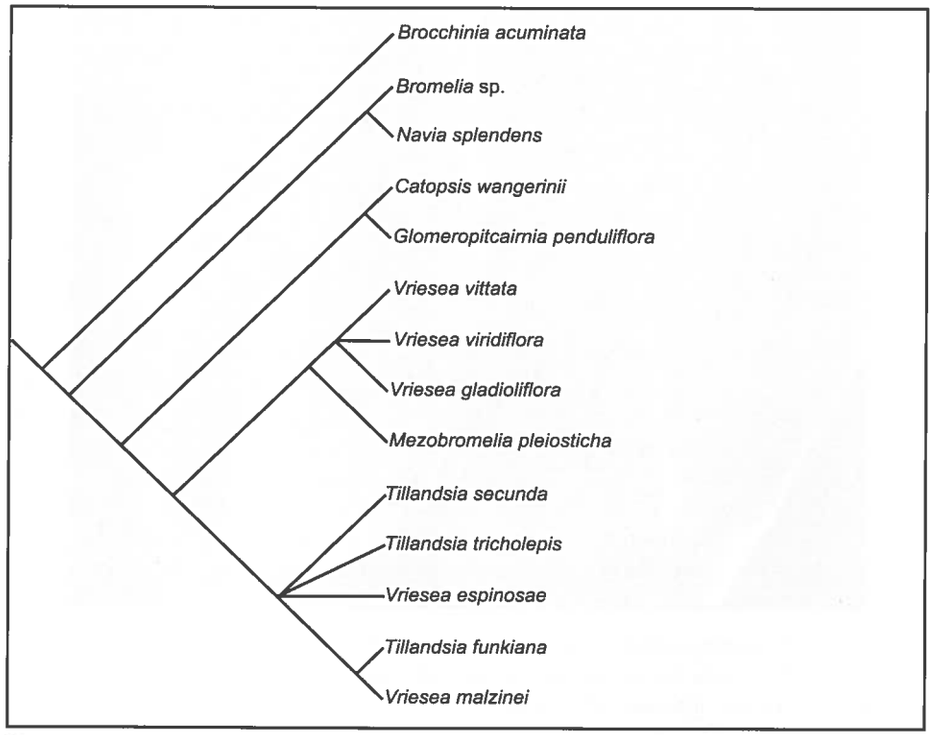

FIGURE 8. A phylogenetic tree depicting the relationships among some members of the Tillandsioideae. *Brocchinia, Bromelia* and *Navia* are "outgroup" taxa, included to determine which character states are primitive (possessed by all bromeliads) and which are derived within the subfamily. *Catopsis* and *Glomeropitcairnia* appear to be more closely related to each other than to other tillandsioids. *Vriesea vittata*, *V. viridiflora* and *V. gladioliflora* are together on a branch near *Mezobromelia*, but *V. espinosae* and *V. malzinei* are on a different branch with representative species of *Tillandsia*. This tree indicates that *Tillandsia* and *Vriesea*, as currently recognized, are not natural groups. Tree based on *ndh*F sequences; redrawn and simplified from Terry et al. (1997).

determining which characters are primitive and which are derived (advanced). The result is a "tree" diagram, where related species are found on the same branch and most closely related species are on adjacent twigs. These analyses can be performed on morphological data, but are more commonly done with molecular data, i.e. DNA sequences. DNA sequences provide many more characters than morphology and are independent of morphology, thus allowing systematists to test the traditional, morphology-based taxonomic ideas with new molecular data.

The hope, of course, is to find all members of a genus on the same branch, all members of the same subgenus on the same subbranch and so on. When that is not the case we need to reevaluate our traditional concepts of the group. For example, Terry et al. (1997), using sequences from the chloroplast gene *ndh*F, found some *Vriesea* species on the *Tillandsia* branch

of the tree (FIGURE 8). This supported earlier suggestions (Utley 1983, Gardner 1986, Brown and Terry 1992, Grant 1993) that presence or absence of petal appendages, traditionally used to separate those two genera, is not always a "good" taxonomic character, because it places species into groups that do not reflect their true relationships.

Because bromeliads have diversified rapidly and recently, most gene sequences that are used for phylogenetic analyses in other plants don't show enough differences to fully resolve the relationships within groups of closely related bromeliads. Therefore, bromeliad systematists are still searching for genes and gene regions that show enough variation to help answer these questions. And to further complicate matters, we know from previous experience that not all genes tell the same evolutionary story. Because of these problems, and the conservative nature of most systematists, Terry et al. (1997) did not propose to change the names of any *Vriesea* species to *Tillandsia* based on their work with the ndhF gene. However, if more analyses based on more genes support their conclusions, name changes may be in order. Although changes may be frustrating to non-systematists, when based on sound and thorough information they improve the value of the taxonomic system. Ideally, taxonomic groups should be natural groups; natural classification systems provide maximum information because evolutionary history is included. And maximum information is what taxonomy is all about, so that we don't need to describe our favorite plants in detail every time we want to express our admiration of a single beautiful bromeliad!

Acknowledgements

This project has received partial funding from a National Science Foundation grant (DEB-0129446) to G.K.B.

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Introducing: *Aechmea guaratubensis* Pereira

Harry Luther[6]

When Pereira described *Aechmea guaratubensis* in 1972 in the journal Bradea (1: 278) it was compared to *A. pitcairnioides* (now *Acanthostachys pitcairnioides*). It is actually quite similar to *A. recurvata*, differing primarily by having many narrow leaves, a generally smaller inflorescence with white, lilac, or pale blue petals. The type specimen of this species is oddly contorted with secund leaves. Possibly it was collected from the side or bottom of a cluster. No information was given about its habitat or ecology in the protologue but the label on the type specimen records it as rupicolous.

Aechmea guaratubensis is easily grown, though not an especially exciting species. The late John Anderson submitted the pictured plant (FIGURE 9) to the Bromeliad Identification Center. No origin for the specimen was given.

Photograph by Vern Sawyer

FIGURE 9. *Aechmea guaratubensis* in cultivation at the Marie Selby Botanical Gardens.

[6] Mulford B. Foster Bromeliad Identification Center

Growing Grey-Leafed Tillandsias in Pots

Robert W. Reilly[7] **Photographs by Susan Reilly**

Grey-leafed, or atmospheric tillandsias are often grown by securing them to mounts such as pieces of cork or wood. This approach has the advantage of effectively utilising a limited growing space, as the plants can be suspended from a shade house's walls or roof, instead of using scarce bench space. However, many grey-leafed tillandsias can be grown successfully in pots. Such plants are usually more symmetrical in appearance, larger; produce more offsets (pups), and have larger inflorescences, than their mounted brothers and sisters. Furthermore, the shape and size of some tillandsias makes them difficult to mount successfully.

The use of freely draining potting mixtures is important, otherwise plant rot and death often occur. I use a mixture comprised of pine (*Pinus radiata*) bark chunks (such as is often used to grow cymbidium and dendrobium orchids), and charcoal. Six parts of pine bark are combined with one part of charcoal to form the potting mixture. The chunks vary in size, but most are about 15 mm in diameter.

FIGURE 10. A plant of *T. xerographica* growing in an open mesh pot.

FIGURE 12. A "forest" of hanging tillandsias (mainly *T. fasiculata* clones).

FIGURE 11. The plastic hanger's legs help hold the pup of *T. disticha* in position.

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Aeration of the potting mixture can be improved by using open mesh, rather than solid, pots (FIGURE 10). The pots I use have diameters ranging from 50 to 200 mm. The original design was derived from swimming pool filters. However, some tillandsias prefer not to have any potting mixture around their roots, and in such cases, I simply place the plant in the pot where they appear to grow quite well.

I live in a location where frost does not occur, so the plants are grown under shade cloth throughout the year. The plants are usually watered twice a week in summer, and once a week for the balance of the year.

The plants respond well to applications of liquid fertiliser. I use a fertiliser which has a Nitrogen (N), Phosphorous (P) , and Potassium (K) ratio of 14:4.4:22.5. No doubt there are liquid fertilisers with a similar chemical composition available throughout the world. I apply the fertiliser weekly.

When potting pups, it is important that they are firmly held by the potting mixture, or growth is slow (perhaps non-existent!). It is difficult to hold tall pups firmly in the relatively loose bark/charcoal mixture. One way of dealing with this issue is to place a plastic "hanger" on the pot. The hanger's three legs help hold the pup in position (FIGURE 11).

As I have a limited amount of bench space, I hang the pots wherever practical. I have seen several approaches used successfully:

Pots can be suspended from the horizontal supports holding up a shade house's roof using the plastic hangers referred to previously. However, the hangers can impede developing leaves on larger plants.

Long wire hangers, with one end ring-shaped so as to hold a pot can also be used. However, larger, heavier plants tend to tilt outwards from these devices.

Lengths of galvanised steel rod can be wrapped around a galvanised pipe placed in the ground. The outer ends of these rods are then shaped so as to hold a pot. The rods are positioned at various heights and orientations on the galvanised pipe, so that the plants' leaves do not vertically overlap.

Depending upon how one grows bromeliads, a large number of tillandsias can be suspended from a shade house's ceiling (FIGURE 12). This approach maximises the number of plants that can be accommodated in the shade house.

Grey-leafed tillandsias I have successfully grown in pots include: *Tillandsia brachycaulos, T. carlsoniae, T. compressa, T. copanensis, T. ehlersiana, T. extensa, T. fasiculata, T. flabellata, T. hildae, T. jalisco-monticola, T. ortgiesiana, T. rhomboidea, T. rodrigueziana, T. rotundata, T. seleriana, T. subteres, T. triclor, T. variablis, T. vicentina,* and *T. xerographica*.

Acknowledgements

I thank Barry Genn and Nev Ryan for the advice they have given me on growing tillandsias, and Susan Reilly for the photographs used to illustrate this article.

Bromeliad Cultivar Registration Award

Derek Butcher[8]


THE BROMELIAD SOCIETY

Bromeliad Cultivar Registration Award

Presented to

SRED

For providing essential data to the Registrar before releasing cultivars to the public domain in accordance with the rules set down under the International Code of Nomenclature for Cultivated Plants and achieving a high standard of uniqueness with such cultivars.

For the period
January 2002 - December 2002

For and on behalf of the BSI Board of Directors

Tom Wolfe
President

Issued June 2003
Derek Butcher, Cultivar Registrar

As the BSI Registrar since 2000, my task is to ask, cajole, and even push in my endeavours to get hybridists to register their hybrids. Realising that there has been no mechanism to recognize and reward those who do the right thing, I proposed the 'Bromeliad Cultivar Registration Award,' to be presented at each World Conference to the person(s) determined to be the best cultivarist(s) in the previous two years.

The Registrar would select whom he considered to be the best cultivarist/s in the previous two years. Under the control of the BSI, the Registrar operates as the International Cultivar Registration Authority (ICRA) under the International Code for Nomenclature for Cultivated Plants (ICNCP). The BSI Registrar's criteria for determining the recipient of this award are as follows:

1. High volume and diversity of cultivars registered is a positive.
2. High volume released to the public but with only a few hybrids actually registered is a negative.
3. Parentage is indicated.
4. Incidence of duplicate names indicates that the hybridist did not check the BCR to ensure that the name chosen is not already in use. If not corrected this only causes identification problems.
5. Uniqueness of hybrid which makes it really stand out from the rest is a positive. This suggests that culling was done. Interpretation of this would be based mainly on the photographs submitted. Quality before Quantity. Note that although this is encouraged, no judgement as to quality is made when the actual Registrations are logged.

This award could easily come from one plant released by a backyard grower or from a hybridist who supplies the larger commercial concerns. The criteria for this award may change or be altered by whomever fills the BSI Cultivar Registrar position.

CONT'D ON PAGE 232

[8] BSI Cultivar Registrar

Volunteers + Bromeliads = Beautiful Gardens

Tammy Marks[9]

How many volunteers does it take to plant a bromeliad? (I'm a terrible jokester so don't expect a punch line). Actually, it takes three plant societies, and we planted a lot of bromeliads - not just one. The Boca Raton Bromeliad Society (BRBS), Friends of the Arboretum (the Deerfield Beach Arboretum), and the Begonia Society of the Palm Beaches all volunteered services and plants to start our project.

The Deerfield Beach Arboretum, located in Constitution Park, 2841 W. Hillsboro Blvd., Deerfield Beach, Florida is actually a 9-acre tree park. It has an exercise path, a children's playground, two tennis courts, and a little herb and vegetable garden (FIGURE 13). Mainly, though, it is a public park with a meandering path that allows one to walk leisurely past all the beautiful trees. What it lacked were understory plants to fill in the empty spaces under and between the trees. This is where the volunteers came in.

On December 28th, 2002 Jerry Behan and Zeke Landis (President and Corresponding Secretary of the Friends of the Arboretum) joined Lyndall Noyes-Brownell, Ken Marks and myself to start the Deerfield Beach Arboretum Bromeliad Project. We can count Lyndall twice as she belongs to

Photograph by Tammy Marks

FIGURE 13. Bromeliad beds surround the tennis courts at the Deerfield Beach Arboretum in Florida.

[9] 22690 Lemon Tree Ln., Boca Raton, FL 33428

both the BRBS and the Friends of the Arboretum. As you can imagine, a project of this magnitude requires a lot of plants, and indeed, many trips were made to deliver them to the arboretum.

Dr. Karl Green and his wife Kris generously provided the initial loads of plants from the Bromeliad Society of South Florida (in that case this makes four societies who contributed to this project) and Ken's garden. Over several months, plants were hoarded at Ken's and my house until the project could be started. Some of these plants included *Androlepis skinneri, Ananas lucidus, Aechmea rubens, Cryptanthus bromelioides, Pitcairnia rubronigriflora, and Pseudananas sagenarius*.

The difficulty was that the Arboretum required large numbers of the same plants in order to create big beds. Unlike a private garden where one or a few plants can be presented as a specimen plant, the size of the landscaping required 20 or more plants in order to create a statement. In cases where we only had a few plants they were bunched together and tucked into smaller areas using nearby bushes to create a frame around them.

Planting day finally arrived... and incredibly, after six hours, we were done by 2 p.m. on the first day. Of course, that very night a windstorm came by and you could hear the trees, the branches and the leaves making swishing noises all evening. Imagine what this will do to freshly planted bromeliads that have no roots and sitting in sandy soil? Soon after the storm, we stopped by to check on the plants and were pleasantly surprised to find most of them still standing. Only two or three plants needed propping up. Everything held up really well.

Meanwhile, Johanna Kitson reported that the Begonia Society of the Palm Beaches was meeting soon to clear out some bromeliads at Mounts Botanical Garden because the beds were encroaching on the begonia beds. In a fight between bromeliads and begonias, you can bet good money on the bromeliads.

On Day 2, Ken and I arrived early at Mounts Botanical Garden to begin work, but the begonia people were earlier still and a mound of bromeliads was waiting for transport to the Deerfield Beach Arboretum. While we started loading the truck, Stefanie Sagis and Diane Sordo arrived to provide additional assistance. Soon an entire truckload of bromeliads (unidentified maroon species of *Aechmea*, a few *Aechmea bracteata*, lots of billbergias still in bloom) was ready for delivery to their new home. Ken and I ferried the plants the 30-mile trip to the Arboretum, and Stefanie and Diane continued to thin out the beds of *Billbergia pyramidalis*.

While Ken started the planting at the Arboretum, I returned for a second trip to Mounts to get the rest of the bromeliads. This resulted in another truckload of plants. The Friends of the Arboretum were really appreciative of the plants, and the Begonia Society was happy they were going to a good home instead of the mulch pile.

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Variegated Foliage and Photosynthesis

Simon Pierce[10] **Photographs by the Author**

Bromeliads are grown as much for their foliage as for their floral variety, with a range of color variegation apparent for bromeliad leaves. In nature many forms of variegation have a specific function and aid in the survival of the plant, while other forms have no known benefit. Here, I discuss the different types of variegation shown by bromeliad species, and present observations of photosynthesis occurring throughout variegated leaves of *Guzmania musaica* and *Tillandsia butzii*.

Of the many forms of variegation shown by plants, perhaps the most familiar is the white and green variegation of *Ananas comosus* var. *variegatus*. This arises from a fusion, or chimera, of two different cell types, with white cells arising from a genetic mutation in the growing point of the leaf (Bell 1991). Green sectors contain abundant chlorophyll, but white or pale yellow sectors contain much less pigment. This 'chimeral' variegation results in slower growth compared to non-variegated varieties, as only the greener parts of the leaf can photosynthesize sufficiently to provide the sugars and energy for growth, and the white sectors consume these resources. Consequently, chimeral variegation is rare in nature, although it persists in horticulture (Downton & Grant 1994).

Other forms of variegation include the more functional 'developmental' variegation, or the appearance of coloration over time. Many *Guzmania* and *Neoregelia* species advertise flowers using developmental variegation, with younger leaves becoming red immediately before flowering (e.g., Pierce & Gottsberger 2001). Variegation may also result from bands of leaf hairs traversing the leaf (e.g. *Aechmea chantinii*, *Cryptanthus zonatus*) or from variation in the structure of leaf hairs over the leaf surface (e.g., *Tillandsia hildae*; Benzing 2000), although the function, if any, of these bands is not known. Interestingly, the only form of leaf variegation not shown by bromeliads is 'blister' variegation, in which an air pocket beneath the cuticle produces a paler patch (e.g. *Cyclamen* spp., Primulaceae; *Ledebouria* spp., Liliaceae; *Pilea* spp., Urticaceae); these structures also have no known function (Vaughn & Wilson 1981).

However, 'discolor' variegation, in which the underside of the leaf is red and the upper surface green, directly benefits photosynthesis and plant growth. Red undersides to the leaf are thought to act as 'red mirrors', reflecting light back up into the leaf and increasing photosynthesis and growth in shaded situations (Benzing 2000). For example *Guzmania musaica* var. *discolor* grows on the forest floor, shaded by foliage and cloud cover, in the cloud forest at Cerro Jefe, central Panama (Pierce et al. 2002).

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Guzmania musaica var. *concolor* (with no variegation), may also be found in the same locations, but usually grows epiphytically. On the lower slopes of the hill these forms are replaced by a variety with a different form of variegation, *G. musaica* var. *musaica* (FIGURE 14). This is characterized by dark, wavy lines meandering across the leaves - a form of 'pattern-gene' variegation (i.e., a set pattern determined by particular genes). This pattern is made up of darker and lighter green portions, often also mirrored by red anthocyanin pigments on the underside of the leaf. As the principal function of leaves is to capture light and carbon dioxide gas, producing energy and structural materials for the plant, any variation in leaf coloration will affect the absorbance of light and the photosynthetic process. How does pattern-gene variegation modify photosynthesis, and could variegation aid the performance of the leaf?

Recently, I was fortunate to have the use of a prototype of a machine designed to produce images of the variations in photosynthesis over leaf surfaces (Chlorophyll Fluorescence Imager; H. Walz, Effeltrich, Germany). I tested the idea that darker parts of pattern-gene variegated leaves, absorbing more light, would have higher rates of photosynthesis. The machine uses blue light-emitting diodes (LEDs) to bathe the leaf in ambient light. It then shines pulses of low intensity red light onto the leaf. Any light not used in photosynthesis is then re-emitted by chlorophyll as pulses of longer wavelength red light (fluorescence). Then a single pulse of extremely bright blue light is given to the leaf, saturating the leaf with light and triggering the maximum possible fluorescence. At each step, fluorescence is detected using a microscope connected to a miniaturized array of light sensitive diodes, allowing visualization of fluorescence over an area of the leaf surface. A comparison of fluorescence intensities under ambient and saturating light is used to calculate the amount of energy used in photosynthesis throughout this area. The absorbance of light can also be visualized, and the ambient light intensity can be increased or decreased, allowing investigation of photosynthesis in different light conditions.

When *Guzmania musaica* var. *musaica* was viewed, the darker sectors of the leaf were associated with greater absorbance of light than paler sectors, and were characterized by greater use of this light energy in photosynthesis (BACK COVER). This was also true of *Tillandsia butzii*, for which both darker and paler regions showed increased photosynthesis in response to increasing light intensities (FIGURE 15).

These images confirm that, although all parts of the leaf are involved in photosynthesis, patterns of light absorbance and photosynthesis correspond with patterns of variegation. Any significance for plants growing in the wild is unclear. Had the prototype machine been available for more time I would have liked to test the idea that darker sectors perform better in shade and paler sectors in direct sunlight. Most tropical plants respond to seasonal changes in light intensity by producing new 'sun' or 'shade'-adapted leaves (Leigh 1999), and over shorter periods may use specialized physiological

mechanisms to cope with rapidly changing light (Skillman & Winter 1999). For slow-growing bromeliads in nutrient-poor environments, producing fresh leaves in response to environmental changes may not be an option. Indeed, *Guzmania monostachia* responds seasonally by reorganizing the leaf at sub-cellular and tissue scales, to optimize light capture in the wet season (shade-adapted) or to avoid high light damage in the dry season (sun-adapted; Maxwell et al. 1999). Could pattern-gene variegated leaves be composed of sun and shade sectors, optimizing photosynthesis in a rapidly changing light environment, such as the sunflecks punctuating the shade underneath a forest canopy?

Pattern-gene variegated species do occur mainly under forest canopies and experience both shade and sunflecks, as illustrated by *Guzmania musaica* var. *musaica* in FIGURE 14. Similarly, *Cryptanthus zonatus* forma *zonatus* grows terrestrially on the forest floor (Smith & Downs 1979), and banding patterns composed of leaf hairs may modify the absorbance of sectors of the leaf. A range of variegated species from other families also grows on the forest floor, such as those with blister variegation mentioned above, or the bold pattern-gene variegation of many prayer-plants (*Maranta* spp., *Calathea* spp.; Marantaceae). Mottled-leaved *Paphiopedilum* species (Orchidaceae) grow either under a forest canopy or on cliffs, where they encounter both direct sunlight and shade as the day progresses (Cash 1996). There is a stark contrast between diffuse light and direct sunlight, with the latter typically an order of magnitude brighter, and a system optimized for

FIGURE 14. *Guzmania musaica* var. *musaica* encounters sunflecks at Cerro Jefe, Panama, (inset shows var. *concolor*).

two light environments would be appropriate for plants experiencing rapid stepwise transitions between low light intensities and direct sunlight.

The fact that pattern-gene variegation has arisen so many times and has persisted in a wide range of forest-dwelling species, with light absorbance and photosynthesis critical to growth and competition, suggests that this

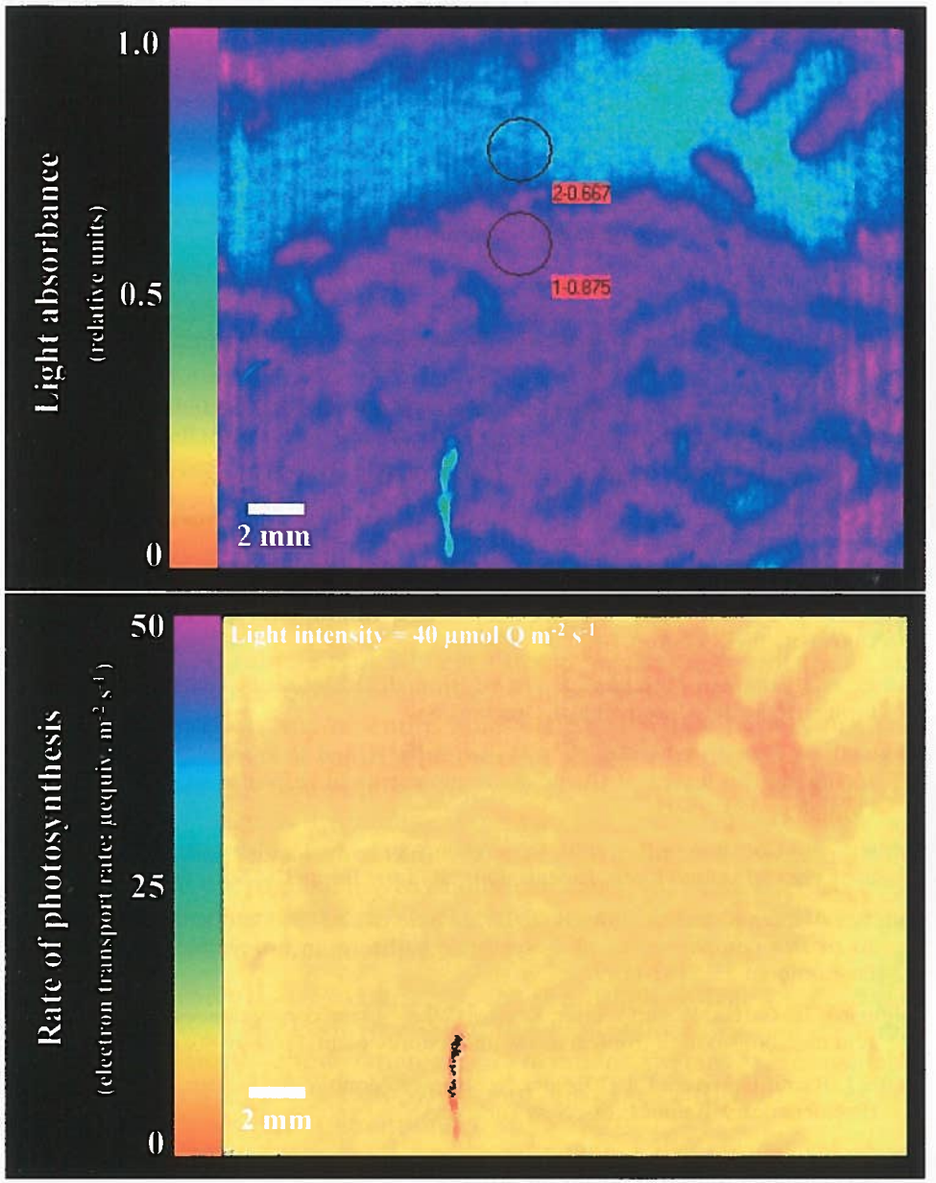

FIGURE 15. False-color images of patterns of light absorbance and photosynthesis for *G. musaica* var. *musaica*.

form of variegation has an important function for plants in nature. If this function is to provide sun and shade-adapted sectors of leaf in a rapidly changing light environment, then this will become apparent the next time a chlorophyll fluorescence imager becomes available. In the meantime we should simply enjoy the striking visual impact of variegation, and perhaps not think too hard about why these species look so magnificent.

Note on Nomenclature

Nomenclature, including authorities, of Bromeliaceae in this text follows Luther (2000).

Acknowledgements

Many thanks are due to Julie D. Scholes (University of Sheffield, UK) for making the chlorophyll fluorescence imager available during its testing phase.

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Observations of a Beetle Herbivore on a Bromeliad in Peru

James Burgess[11], Edward Burgess[12], and Margaret Lowman[13]

Although herbivory in bromeliads has been reported as negligible (Benzing 1990), we have been studying a species where this is not the case (Lowman et al. 1999). *Aechmea nallyi* L.B. Smith grows in the canopy of Amazonian lowland tropical rain forest in northeastern Peru. Although it is relatively rare on a global scale, it is locally common along the canopy walkway at ACEER (Amazon Center for Education and Environmental Research), recently renamed ACTS (Amazon Conservatory for Tropical Studies), located along the Napos River (3°15'S, 72°54' W). We have measured herbivory of these bromeliads over five years, but only found and identified the herbivore responsible for the damage after four years of diligent searching.

In 1995, we first observed damage to the foliage of *Aechmea nallyi* and calculated the leaf surface area consumed as 10.4% (Lowman et al. 1996). Because this damage represented relatively high levels of herbivory for a bromeliad, we thought our results may have been the consequence of an isolated insect outbreak or some other anomaly in the life cycle of these canopy bromeliads. So we returned to the same population in 1997 and re-sampled herbivory levels. Leaf area losses on our second survey represented 9.4% of the average surface area of each bromeliad (Lowman et al. 1999). In all cases, the damage was a characteristic striped mining pattern that suggested one specific herbivore was responsible. The mining pattern consists of brown stripes of dead leaf tissue, paralleling the venation of the bromeliad leaf surfaces. The herbivores fed only on the top layer of tissue (FIGURE 16). Leaf miners typically eat through several layers of tissue and over time, the patches undergo necroses which result in either skeletonized patches, brown spots and/or entire holes where remaining layers of tissue has died back. In cases of some beetle genera we have studied in rain forests where the leaves are similarly sclerophyllous, the larvae act as miners on layers of tissue; whereas the adults eat the younger, softer leaves entirely and occasionally mine the tougher old foliage (e.g. Selman and Lowman 1983). We had marked the original leaves numerically, and two years later over 75% of the original cohort had been replaced by new foliage (so we were not simply measuring the same leaves again).

What herbivore, we wondered, ate the tough foliage of *Aechmea nallyi*? Why would any herbivore select this food source that requires more energy to physically chew, when more succulent species were available throughout the rain forest canopy? In four subsequent trips to the ACEER walkway, we addressed two questions:

[11] Volunteers, Marie Selby Botanical Gardens, Sarasota FL
[12] Princeton University, Princeton NJ
[13] Environmental Studies, New College of Florida, Sarasota FL

- What herbivore(s) was responsible for the characteristic herbivory observed repeatedly on these bromeliads?
- Were the levels of herbivory consistent in subsequent years?

During this trip and two subsequent trips, we logged 560 human hours of observations that resulted in eight beetle sightings. In July 1998, our third trip to the ACEER walkway, we first observed a beetle eating the leaves of *Aechmea nallyi*. Three teams observed feeding of the beetle, and all of them recorded this activity at night. The extensive number of observation hours for such infrequent sightings indicated that this herbivore is relatively rare, at least during our seasons of study (March; July-August). Over all these hundreds of hours with multiple sets of eyes examining bromeliads, only 4 individuals were captured (specific location details available from the authors upon request). We released two specimens back into their respective bromeliads because of their apparent rarity, and shipped two specimens to Charles Staines, Coleoptera expert at the Smithsonian Institution, whom we were advised was the only expert on tropical Coleoptera for this region (Terry Erwin, pers. Comm.).

FIGURE 16. Herbivore damage on *Aechmea nallyi* on a plant in Peru.

Staines identified them as *Calliaspis rubra* (Olivier) (FIGURE17). This beetle was previously known from one individual from British Guiana (pers. comm., Charles Staines). No feeding habits or plant-insect interactions are known for most members of this tribe (Cepohaloleiini).

Because the herbivory of *Calliaspis rubra* was very characteristic (distinct brown lines of tunneling damage), it was obvious that over 95% of the damage to *Aechmea nallyi* foliage resulted from this one herbivorous beetle species. Although we saw adult beetles engaged in feeding directly on the bromeliad foliage, we also hypothesize that the larvae probably tunnel in the young leaves, since larvae often feed more voraciously than adults. More years of study are required to isolate the seasonality of larval emergence in the canopy, oftentimes a very short duration of time (Selman and Lowman 1983). In rain forest canopies, herbivores typically specialize on one plant or a suite of similar plants, resulting in characteristic damage as observed here (Lowman 1998).

To examine the amount of bromeliad herbivory over time, we have returned to Peru for five years to both measure and conduct observations of the beetle larvae. Herbivory of *Aechmea nallyi* was re-sampled during 1998, 1999, and 2000. The same methods of measurement were used as in 1995 and 1997, whereby visual estimates of leaf area lost on 10 leaves of 5 plants were averaged. (See Lowman et al (1996) for details on methods). Herbivory averaged: 10.4% (1995); 9.0% (1997); 8.6% (1998); 8.7% (1999); and 11.8% (2000). A grand mean of 9.8% leaf area was consumed annually over five years. For all measured plants, the individual leaves were numbered with waterproof Pentel pens and checked each year (methods described in Lowman et al 1996). Average leaf lifespan was 20 months, and ranged from 1-3 years duration on these canopy bromeliads.

Many of the logged observation hours of *Aechmea nallyi* were documented during the Jason X Project for Education. The Jason Project involved the live broadcasting of field research back to students in public schools and museums through the Americas and Europe (Lowman 1998). Selected teachers and students joined the live broadcasts and during Jason X and logged extensive hours of observations of the bromeliads. In addition, other students conducted observations during summer months (JB, EB) to add to our database of beetle sightings and beetle feeding confirmations. Observation methods were described in Lowman et al (1999).

FIGURE 17. *Calliaspis rubra*. Illustration by Roohee Mirbaha.

As part of the Jason Project curriculum for schools, a competition was launched to provide a common name for the herbivore on *Aechmea nallyi*. Although this is not a conventional way to name an insect species, it was instigated to encourage young students to take an interest in the science of taxonomy and a possible career in field biology. A panel of Jason Project scientists voted on the final name selection. Over 950 schools responded over the Internet with nominations for names, and the winning entry was the Nutmeg Canopy beetle from Mrs. Baisch's Fifth Grade class in Ft. Myers, Florida. The name was derived from three factors: the nutmeg coloration of the beetle; the fact that this bromeliad often grows in the nutmeg tree (*Myristica* sp.); and the cryptic inclusion of Meg Lowman in the beetle's name. Claire Naponick created the name, and subsequently was funded to join an expedition to the Amazon.

Field research on bromeliads and measurements of herbivory create feasible working units for school classes and young scientists. The unique rosette structure of some bromeliads, and their ability to hold water, essentially create an above-ground swimming pool for different organisms to visit or inhabit. Bromeliads are ideal units for studies of micro-ecosystems in the canopy (e.g., Maguire 1971, Frank 1983). The number of possible uses for bromeliads in fieldwork and experimental ecology for middle and high school science cannot be underestimated.

Achknowledgments

The authors would like to thank the many volunteers and members of Selby Gardens who attended the Rain Forest Workshops at ACEER (now ACTS), and participated in bromeliad observations. Harry Luther and Howard Frank read over the manuscript and provided valuable comments. Claire Naponick of Ft. Myers, Florida, coined the name Nutmeg beetle in her fifth grade class; and Bernie Carozza of Widener University made the first collection of a nutmeg beetle during our nocturnal observations.

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Nominations for the Bromeliad Society International Wally Berg Award of Excellence

Theresa Bert[14]

Deadline for Nominations: April 1, 2004

The Wally Berg Award of Excellence reflects the late Wally Berg's contributions to the bromeliad world and to the Bromeliad Society International (BSI). Wally was an outstanding bromeliad grower, an avid collector of bromeliads, and at the forefront in international outreach for the BSI and bromeliads in general. He was a generous benefactor to the BSI and the Mulford B. Foster Bromeliad Identification Center (BIC). Always willing to share his knowledge of bromeliads, he was a highly active member of his local bromeliad club (Sarasota Bromeliad Society) and frequent lecturer to numerous bromeliad societies.

Following is the criteria for nomination for the Wally Berg Award. Nominees should meet at least four of the seven criteria presented below.

1. The individual should be a bromeliad grower who is nationally or internationally recognized for diversity of species cultivated and excellence of cultivation.
2. The individual should actively pursue one of the following activities:
   - Collecting and identifying bromeliads in their natural environments, including collecting new species/varieties/cultivars (the members of bromeliad societies and organizations, including the BSI and the BIC, should benefit from this activity);
   - Promoting the appreciation and cultivation of bromeliads at the international level, including such activities as organizing and participating in collecting trips with international representation, giving presentations and seminars to national and international audiences, and writing manuscripts for publication in national or international books, journals, or other media (e.g., internet, CD-Roms).
3. The individual should actively support efforts to further the scientific, taxonomic, or cultural understanding of bromeliads through donation of time, effort, or money to recognized organizations, institutions, societies, or groups of individuals working on bromeliads.
4. The individual should be active in a local, regional, or national bromeliad society and be recognized by other members of that society for his/her contributions to the functioning of that society and its activities.
   - If the individual is a bromeliad hybridizer, he/she should be internationally recognized for excellence in one or more of the following categories:

[14] BSI Nominations Chair

- innovation in creating bromeliad hybrids,
- success in cultivation of bromeliad hybrids,
- promotion and distribution of bromeliad hybrids.

6. The individual should be generally recognized as an expert in one or more of the following aspects of bromeliads:
   - ecology, evolution, or taxonomy,
   - cultivation or hybridization,
   - display or exhibition.
7. The individual should be generally recognized for sharing his/her knowledge of bromeliads and for giving of himself/herself for the benefit of other people interested in bromeliads and for bromeliad organizations at all levels.

Any current member of the BSI may nominate any other member of the BSI. The procedure for nominating individuals for the Wally Berg Award is as follows.

- The nominator should submit the nomination in writing, by either letter or email message.
- The nominator should provide a brief resume of the accomplishments of the nominee in bromeliad-related activities (e.g., service, offices held, major awards won) and a letter describing the way in which the nominee meets at least four of the seven criteria listed above.
- Nominations should be submitted to Theresa Bert, BSI Nominations Chair, 9251 13th Ave. Cir. NW, Bradenton, FL 34209 USA or by e-mail to theresa.bert@fwc.state.fl.us.
- Nominations must be postmarked by: March 1, 2004.

The recipient of the 2004 award will be announced at the World Bromeliad Conference in Chicago, August 2004.

Moving?

If your address is changing, even if your move is a temporary or seasonal one, you should notify the BSI Membership Secretary four to six weeks in advance. Even when you are temporarily away, your bulk mail is either discarded by the Post Office or, as in the case of your JOURNAL issue, is returned to us at a postage due cost of .99 cents within the USA.

If you are moving, or have recently moved, please send your name, the old and new addresses, and the effective date to: John Atlee, BSI Membership Secretary, 1608 Cardenas Dr. NE, Albuquerque, NM 87110 or by e-mail to membership@bsi.org.

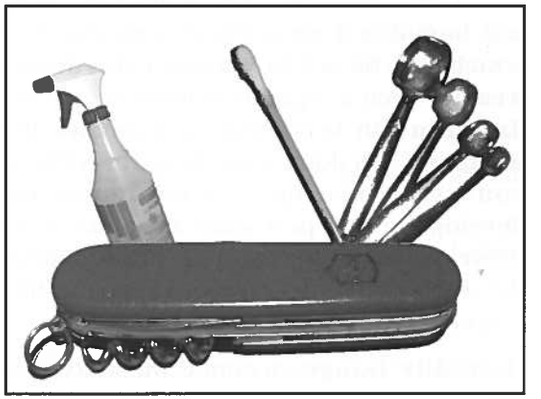
Arsenal for the Bromeliad Grower[15]

Herb Plever[16]

To be ready to confront every cultural problem, the bromeliad hobbyist needs to have at hand a considerable arsenal of tools. Besides the physical tools, three personal traits or habits are important to develop and maintain:

- The discipline to regularly inspect every plant including the tops, undersides and axils of the leaves and the pots;
- a pair of sharp eyes that will notice tiny manifestations of the presence of pests and diseases;
- and the energy and discipline to take action against incipient problems before they explode.

The following array of tools and equipment will help you to keep your plants in optimal condition.



TOOLS

Measuring Spoons. Simple kitchen measuring spoons are useful for measuring the correct quantities of fertilizers and pesticides. I keep two sets handy, with measurements ranging from 1/8 teaspoon to 1 tablespoon.

Hand Sprayer. You should have four 1-quart spray bottles. I keep three filled at all times with fungicide, pesticide soap, and foliage fertilizer mixtures.

Hand Lens, or Pocket Magnifier. A very useful tool to see a suspect spot up close and determine if it is a pest or just a small piece of perlite. On vrieseas, it is especially important to check the underside leaf apices for the very fine webs of spider mites. The leaf is indented there, and it is the mites' favorite starting place,

Sharp Knife. A sharp knife is needed to cleanly cut off pups and to trim the hard leaf coverings at their bases to reveal the root follicles. It should be fairly long to reach down into the leaf axils in large vrieseas. In some big aechmeas, the stolon connecting the offset to the parent is so hard that it is difficult to cut through even with a sharp knife. For these, a blade with a serrated or saw-toothed edge will help, but the best tool for tough stolons is a small utility saw with a 6-inch blade.

[15] Reprinted from Bromeliana 40(8). 2003

[16] 225 Broadway, New York, NY 10007. E-mail: hplever@earthlink.net

Mylar®. If you grow plants under fluorescent fixtures, silver Mylar® with a diffuse pattern makes a wonderful reflector. It comes in 25-inch widths with a peel-off sticky backing. Paste it on the reflecting surface above the tubes and on the back and sidewalls of the unit (if the fixture is not free-standing). This material gives a substantial boost to the intensity of the reflected light.

Scissors. You will need a pair of sharp scissors to properly trim brown leaf tips and for many other purposes.

WATERING/MOISTURE

Humidifier. These are essential for the indoor grower to maintain at least 50% relative humidity from mid-October through April when the cooler and colder temperatures bring low humidity. I prefer cool mist humidifiers with a 3-gallon or more water capacity. Small reservoirs make constant refilling a dreary chore.

These machines have a three-speed fan directed onto a wet wick filter and humidified air is blown into the room. They also have a humidistat, which can be set to maintain the desired humidity level. In really cold weather even a 3-gallon humidifier will need to be refilled every 11/2 to 2 days. You can keep relative humidity at 50% or higher even in freezing weather if you don't mind frequent refilling. It helps to keep the radiator and convector heating to a minimum. High humidity will inhibit the development of pest such as spider mites, scale, and mealy bugs, which thrive on warm, dry air. I add 3 to 4 tablespoons of 3% hydrogen peroxide to the water with every filling to keep the filter clean to up to 2 months before it needs replacing.

Humidity Gauge. Accurate humidity gauges can be purchased for about $10.

Watering Cans. I use a 1-gallon plastic can for general watering; those with long necks are useful. A lighter, 1/2-gallon watering can is handy for hard-to-reach plants and to mix and deliver fertilizer.

Wicks. I use my wife's discarded panty hose to cut strips of wicks. They never fall apart and are decent water conductors. Thin clothesline rope works as well.

CHEMICALS

Fertilizers. Although I make special fertilizer formulas for the main genera, the best all-purpose fertilizer for bromeliads is Peters® Peat Lite Special® (20-10-20). I add a scant 1/8-teaspoon of Epsom Salts (magnesium sulfate) to 2 quarts of fertilized water to supplement the generally low amount of this important ingredient. Slow release fertilizer pellets such as Nutricote® (13-13-13) added to, or on top of the medium are also helpful in promoting good growth.

Safer's Insecticidal Soap®. To keep mealy bugs, mites, or scale at bay I mix 3 teaspoons of soap to 24 fluid ounces of water in a sprayer and keep it ready to use at the first sign of attack. I spray the tops and undersides of the leaves and let it be absorbed without washing it off. It helps to repeat the treatment after one week as a prophylaxis.

Alcohol and Cotton Swabs. A cotton swab (i.e., Q-Tips®) dipped in alcohol is a quick way to wipe out mealy bugs and their cottony nests, as well as scale.

Cygon 2E®. This systemic insecticide should only be used outdoors by experienced growers, as it is a potential carcinogen. Follow the label directions carefully. It is very effective against most sucking pests. I only use it as a last resort to save a heavily infested, valuable plant.

Hydrogen Peroxide (3%). This is easily obtained at drugstores or supermarkets and is an effective and safe fungicide. Just mix 2 teaspoons of peroxide with 24 fluid ounces of water in a sprayer to retard molds from growing on the top of your mix or floating in the leaf axils. I also spray the bases of newly removed pups to keep down possible fungus or bacterial infection until the cut tissue is calloused; I don't pot the pups until this occurs.

POTTING/MOUNTING MATERIALS

Potting Materials. You should keep a good supply of potting media available to make your favorite bromeliad mix.

Cork Bark. This is still the best medium for mounting tillandsias. See below for adhesives.

Mounting Adhesives. I use the industrial adhesive E6000® to mount tillandsias and have found it superior to Liquid Nails®. It is a clear viscous polystyrene formula that creates a chemical bond to either porous or non-porous, even rough surfaces.

Pots. I use an assortment of plastic pots of both the azalea and standard types in sizes ranging from 3 to 5 1/2 inches. Those growers who prefer the heavier clay pots should likewise keep a good assortment and supply handy. Clay pots are more costly and dry out more quickly than plastic ones (wick watering will help keep the potting mix moist).

Trays. I use narrow 30-inch waterproof fiberglass window boxes on some windowsills. You can sit the plants on inverted shallow pots as platforms, and water through them without having to drain. Now that I wick-water all of my potted plants, I have mounted a plastic "egg-crate" platform inside the trays about 2 1/2 inches from the bottom and fill them with water to just below the platform. I use 2-inch high plastic photo developing trays as water reservoirs with the egg-crate platforms sitting on top of the trays. I like wicks better than capillary mats because the mats quickly become coated with algae. I add hydrogen peroxide to the water of the trays to keep them clean.

Galvanized Wire. This wire is a rust-resistant material to make hangers and hooks for bark plaques. You can find it in small rolls in most hardware stores. I use a medium-gauge wire that is quite rigid but can still be bent into shape. You can cut off pieces from the roll or snap them off by bending the wire back and forth until it breaks. I also use it to make a long needle (make a small loop on one end) to thread wick strips up through a bottom drain hole of the pot to the top of the medium. Then, I unhook it and pull the wick down to a little below the top.

Plastic Containers. One-quart plastic containers make excellent reservoirs for wick-watered pots. Empty yogurt containers work well and will accommodate 4 1/2- to 5 1/2-inch pots. Just fill the container with water below the bottom of the pot and let the wick do the rest.

Windowsill Extenders. You can extend a narrow windowsill into the room by mounting a shelf flush with the sill using angle iron brackets. This will permit you to grow medium-sized and medium-large plants in your windows.

Plastic Egg-Crate. These are used to make platforms on trays for wick-watered plants. They come in 4-foot squares, cut easily, and are readily available.

Heavy-Duty Aluminum Foil. I cover the egg-crate platforms and the plastic containers with the foil, bright side out. This keeps the light out of the reservoirs, retards algal growth, and casts light up onto the undersides of the leaves.

Welcome New Members

The following individuals have joined the Bromeliad Society International. Thank you for supporting the BSI!

John Agaciak
Garnett Ahern
James Aldridge
Jose Almandoz
Alternative Solutions
Amy Ambrosch
John Anderson
Sarah Arends
Chuck Armstrong
Kim Bailey
Janette Baker
Maggie Bazzel
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William Winternitz
Gloria Woolf
Shirley Wright
Marcos Zanoni

Butcher - Cultivar Registration Award, continued from page 213

The Award will take the form of a certificate suitable for framing. The BSI Board has decided to give this a trial run at the Chicago World Conference. The first award will be based on registrations made between January 2002 to December 2003. While it is too late to register your plants for this period, I encourage you to submit your registrations for the next (January 2004 to December 2006).

It has also been decided to issue a special certificate when any cultivarist logs a first registration. This will be implemented immediately. I hope this recognition will mean an increase in the number of registrations made because you must be in it to win it.

Visit the BSI website (www.bsi.org) for more information on registering your plants.

Marks - Volunteers, continued from page 215

A lot of work was accomplished by many people, but it was all fun and we managed to make a difference in the look and feel of the Arboretum. If you get the chance, stop by the Arboretum to see our handiwork. Of course, the Arboretum is still nicknamed the "Tree Zoo" but while the visitors are gaping skywards at the foliage they may be wondering what's nipping them at the knee level!

Sixteenth BSI World Bromeliad Conference Chicago, Illinois -August 10-15, 2004

WELCOME TO CHICAGO! We hope to say this many, many times in August, 2004. Things are moving right along and the BSI and BSGC are working diligently to have a great conference here in the northern United States.

Registration forms are available on the BSI web site (www.bsi.org) and in this issue of the Journal.

Questions contact: Jack Reilly, 248 Lawrence St., Illiopolis, IL 62539. Phone: 217-486-5874.

E-mail: jar56@one-eleven.net

Cultivar Corner: Aechmea nudicaulis

Derek Butcher[14]

Aechmea nudicaulis is a popular species in cultivation and occurs in the wild from the Mexico and the West Indies south to southern Brazil. Lyman Smith (1979) recognized four varieties, and since then four additional varieties have been described (Luther 2002). While I love preparing identification keys to help me understand how species are linked to each other and what traits tell them apart, I had great difficulty with the varieties of *Aechmea nudicaulis*. Harry Luther of the Bromeliad Identification Center came to the rescue when he said I would be wasting my time! However, there are clearly identifiable cultivars that can be referred to by their cultivar name in the Bromeliad Cultivar Registry. One that is popular with Bromeliad growers has not been formally described, and yet everybody knows it as *Aechmea nudicaulis* 'Rubra' or *Aechmea nudicaulis* var. *rubra* (FIGURE 18). '*Rubra*' is Latin and is not acceptable under the International Code for Nomenclature of Cultivated Plants (ICNCP), and var. *rubra* has never been described under the International Code for Botanical Nomenclature (ICBN) rules. It is what I call a "nurseryman's name."

Photograph by Peter Franklin

FIGURE 18. *Aechmea nudicaulis* 'Xavante'.

This entity falls in the gap between a cultivar and a botanical variety by being not acceptable under either ICNCP or ICBN rules. It is not in the Cultivar Registry and it is not in An Alphabetical List of Bromeliad Binomials (Luther 2002). I think this situation should be remedied, but given the variable nature of this species, I doubt that any botanist will take the time to describe this plant properly under ICBN rules.

I have discussed a remedy to this problem with my friend Oscar Ribeiro of Bromeliario Imperialis in Rio de Janeiro. Apparently, there are native tribes in Brazil whose members paint themselves red (with the seeds of *Bixa orellana*) for ceremonial occasions. One of the larger tribes is called 'Xavante,' and while there is no direct link between the tribe and the plant, I propose 'Xavante' as the name for this reddish plant. This may necessitate a label change if you are growing this plant, but it will solve the problem of using a Latin name. Plus, we will have a photo in the Registry for identification purposes. There is the problem that 'Rubra' will continue to be used, but at least there will be links in the Registry to point enquirers in the right direction if they wonder about identification. So, remember the name is either *Aechmea nudicaulis* 'Xavante' or *Aechmea* 'Xavante'.

Literature Cited

Luther, H. E. 2002. An Alphabetical List of Bromeliad Binomials. The Bromeliad Society International, Florida.

Smith, L. B. & Downs, R. J. 1979. Flora Neotropica. Monograph No. 14 (Bromeliodeae, Bromeliaceae).

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.

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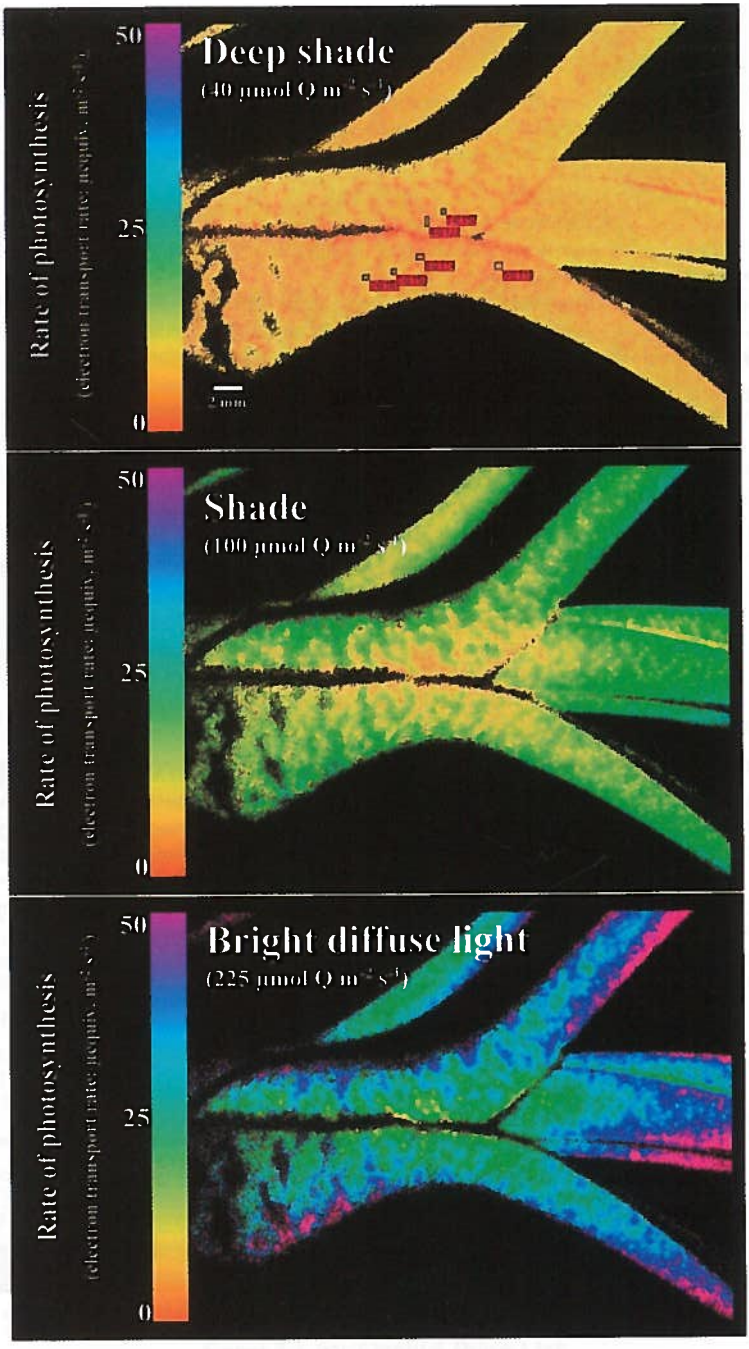

A bromeliad view through new eyes. Simon Pierce employed a prototype Chlorophyll Fluorescence Imager on *Guzmania musaica* and *Tillandsia butzii*. Here, false-color images of *Tillandsia butzii* show the response of photosynthesis to light intensity. Read more about this and an interesting discussion on variegation in bromeliads on page 216.