The diversity of Bromeliaceae in Brazil is highest in areas of Atlantic rainforest, and a decrease in species richness is observed toward the drier inland territory (Reitz 1983; Versieux and Wendt 2007; Martinelli et al. 2008; Versieux et al. 2012). Nevertheless, drier areas may harbor endemic and xerophytic species, the systematics, taxonomy, and conservation of which have yet not received much attention (e.g. Miranda 2001; Versieux and Wendt 2007; Versieux et al. 2010b).

The state of Mato Grosso do Sul (MS) in central-western Brazil is covered by three different biomes: cerrado (savanna), the Pantanal wetland (including part of the chaco) and part of the Atlantic rainforest (IBGE 2004). The cerrado savanna has a mosaic of physiognomies. It is severely threatened, and it is considered to be one of the areas of greatest human impact in the state of MS (Cavalcanti and Joly 2002). The region of the Bodoquena Mountain Range in the western portion of MS has, in addition to the savannas, both tropical seasonal deciduous and semi-deciduous forest along the rivers that are severely threatened due to deforestation for logging or expansion of agricultural and cattle raising areas, making the forest a high priority for biodiversity conservation (Baptista-Maria et al. 2009). The Bodoquena Range is nearly 300 km in length, varying from 20–50 km in width. It is mainly composed of limestone and is surrounded by the Paraguay River depression (Pantanal Plain) towards the north and west, the Miranda River basin to the east, and the Apa River basin to the south (Boggiani and Coimbra 1995).

\textit{Tillandsia} L. encompasses nearly 610 species (excluding several natural hybrids), and it is the largest and most widely distributed genus within Bromeliaceae, occurring throughout the American tropics and subtropics (Smith 1934; Luther 2010). \textit{Tillandsia} is an extremely polymorphic genus and is considered to be a young lineage within the morphphyletic subfamily Tillandsioideae (Barfuss et al. 2005). \textit{Tillandsia} was traditionally divided into seven subgenera: \textit{Allardtia}, \textit{Anoplophytum}, \textit{Diaphoranthema}, \textit{Phytarrhiza}, \textit{Pseudalcantarea}, \textit{Pseudocatopsis}, and \textit{Tillandsia} (Smith and Downs 1977; Gilmartin 1983). More recently, systematic changes segregated \textit{T. subgen. \textit{Pseudocatopsis}} as the genus \textit{Racinacea} M.A. Spencer & L.B. Sm. (Spencer and Smith 1993), and six species formerly included in \textit{T. subgen. \textit{Allardtia}} were grouped into the genus \textit{Viridantha} Espejo (Espejo-Serna 2002). So, \textit{Tillandsia} is currently divided into six subgenera: \textit{Allardtia}, \textit{Anoplophytum}, \textit{Diaphoranthema}, \textit{Phytarrhiza}, \textit{Pseudalcantarea}, and \textit{Tillandsia} (Till 2000). However, recent molecular phylogenetic work indicates the para- or polyphyly of all these subgenera (Barfuss et al. 2005). \textit{Racinacea} and \textit{Viridantha} appear monophyletic, but separation of these from \textit{Tillandsia} makes the remainder paraphyletic (Barfuss et al. 2005). In summary, the subgeneric classification of \textit{Tillandsia} is far from being satisfactory (Espejo-Serna 2002; Barfuss et al. 2005).

After examining a blooming specimen of \textit{Tillandsia} collected during recent field expeditions to the Parque Nacional da Serra da Bodoquena, close to the border of Brazil with Bolivia, we concluded that it is a new species. This taxon corresponds to the ninth species of \textit{Tillandsia} recorded for the state of Mato Grosso do Sul, including two other species (\textit{Tillandsia bucchlohi} Rauf and T. \textit{streptocarpa} Baker), which have been cited in the literature (Smith and Downs 1977; Till 1996) but were missing in the Brazilian Bromeliaceae checklist (Forzza et al. 2011). Here we provide an updated key for the species of \textit{Tillandsia} from Mato Grosso do Sul, aiming to contribute to the future monograph of Bromeliaceae for the Flora of the State of Mato Grosso do Sul.

**Materials and Methods**

The morphological description of the new species is based on a living specimen cultivated at the Rio de Janeiro Botanical Garden and on its freshly collected flowers, as well as on the herbarium specimens prepared when the plant was collected in the field (RB; \textit{Martinelli} 16923, 16923a, 16923b). Conservation assessment for the new species was based on field observation, applying the IUCN red list category criteria (IUCN 2001). Transversal and paradermal sections were taken using a razor blade, bleached by the use of sodium hypochlorite, stained with 0.05% astra blue and safranin (Bukatsch 1972) and mounted in water for temporary observation and to obtain photomicrographs. To observe trichomes, the abaxial epidermis was gently scraped with the razor blade and the material was then stained as described above. A stigma and an ovule conserved in 70% ethanol were directly mounted on temporary slides and observed under the microscope.

**Results**


**Diagnosis**—The new species is placed in the genus *Tillandsia* due to the presence of petals lacking appendages and an inflorescence of a distichous flowered, double spike and in *T. subgen. Anoplophytum* due to the presence of symmetric sepal, included stamens, slender style, and stamens presenting plicate filaments (Smith and Downs 1977). The following combination of characters distinguishes the present species from *Tillandsia bonita* from *T. didisticha* Baker (sensu Tardivo 2002): the size of the flower (2.6 vs. 1.8–2.0 cm respectively), length of the sepal (1.5 vs. 1.1 cm), length of the petals (2.4 vs. 1.5–2.0 cm), length of the style (13 vs. 9 mm), floral bracts color (green vs. red), floral bract size (1.9–2.2 × 0.7–0.9 cm vs. 1.1–1.5 × 0.5 cm), and floral bract indumentum (glabrous to inconspicuously lepidote vs. entirely lepidote or lepidote only toward the apex) (Table 1).

**Description**—Rupicolous herb, ca. 30 cm tall when flowering, short caulescent (Fig. 1). Rosette ca. 22 cm in sicco, coriaceous; leaf blade 13–17 × 1.5–2.4 cm, narrowly triangular, wine-red, concolorous on both surfaces, densely lepidote on both surfaces, trichomes densely arranged in rows abaxially, canaliculate, coriaceous, suberect, arched, distinctly nerved with 1–2 prominent nerves; apex acute, attenuate, wine-red, straight. Peduncle ca. 15 × 0.4–0.6 cm, erect, straight to slightly curved, terete, green, sparsely lepidote close to the nodes; internodes 8, 1.5–2.0 cm long; peduncle-bracts 2–5 × 1.7–2 cm, ovate, apex acuminate, the proximal ones wine-red, the distal ones wine-red but green along the margins, erect, finely nerved, the proximal ones coriaceous, the middle and distal ones chartaceous and concealing the internode, densely white-lepidote toward the apex; margins green, thinner, white-lepidote. Inflorescence ca. 12 × 10 cm (not including the peduncle), a once-compound double-spike, obovoidal, erect, rachis straight, internodes 0.7–1.4 × 0.6 cm; primary bracts longer than the stipes, green, densely white-lepidote toward the apex, erect, tightly clasping the base of the spike, finely nerved, chartaceous; inflorescence branches ca. 8, 5–13-flowered; stipes ca. 15–20 × 5 mm, weakly complanate, distinctly nerved, green, glabrous; sterile bracts 1–3, similar to the floral bract; rachilla 3.0–5.5 cm, flexuous, green, glabrous, not visible in vivo but with the nodes apparent in sicco; internodes ca. 0.8 × 0.2 cm; floral bract 1.9–2.2 × 0.7–0.9 cm, elliptic, apex acute, green, sparsely hyaline-lepidote abaxially, inconspicuously lepidote to glabrous axadally, chartaceous, ecarinate, margins membranaceous, hyaline in sicco. Flowers ca. 2.6 cm long, odorless, diurnal, distichously arranged, erect, shortly pedicellate; pedicels ca. 2 × 1 mm; sepal ca. 1.5 × 0.4 cm, shortly connate (ca. 2 mm) at the base adaxially, elliptic, apex rounded, symmetric or nearly so, not exceeding the floral bracts, green to greenish-hyaline along the margins, glabrous, ecarinate, margins membranaceous; petals ca. 2.4 × 0.25 cm, ligulate, apex obtuse, slightly recurved at anthesis, white; stamens included; filaments 1.3–1.5 cm × 1 mm, complanate, shortly plicate below the connective, white; anthers ca. 13 × 1 mm, linear in vivo to sagittate in sicco, yellow, dorsifixed near the base; style ca. 13 mm long, gradually diminishing in diameter toward the apex, terete, white; stigma tridif, lobes spreading (Fig. 3H), ca. 4 × 1 mm, white, simple-erect (type I sensu Brown and Gilmartin 1984, 1989) with tubular papillae (Fig. 3I); ovary ca. 4 × 2 mm, ovoidal, trisulcate, brownish-green in sicco; ovules (Fig. 3J) ca. 0.05 cm long, ovate, numerous. Figures 1–2, 3H–J.

**Phenology**—Flowering in cultivation from August through October.

**Distribution**—So far the species is only known from Parque Nacional da Serra do Bodoquena, Bodoquena, in the western portion of the state of Mato Grosso do Sul, central-western Brazil.

**Ecology**—It grows forming dense heliophilous populations over limestone outcrops along the semi-evergreen riverine tropical forest.

**Conservation**—IUCN (2001): provisionally treated as Least Concern (LC), because it is protected within a Brazilian national park.

**Etymology**—The epithet chosen is a reference to the municipality of Bonito, which is a famous place and an ecological sanctuary along the Serra da Bodoquena. This region has several rivers with clear and bicarbonated water and harbors a noteworthy biodiversity (e.g. Bueno et al. 2007; Uetaanabaro et al. 2007; Dalzochio et al. 2011) including ornithophilous species of Bromeliaceae (e.g. Araujo and Sazima 2003; Faria and Araújo 2010). Additionally, the word “bonita” is the Portuguese adjective equivalent to good-looking, which is indeed an attribute of the contrasting wine-red foliage, green bracts, and white flowers of this plant.


**Leaf Anatomical Characterization**—The epidermis in front view presents rectangular cells with sinuous and thick walls (Fig. 3F). The abaxial and adaxial epidermis are covered by nearly circular trichomes, which are radially symmetric or nearly so (Fig. 3C, F, G). Trichome cells are organized concentrically, following the 4 + 8 + 16 + 64 pattern (Fig. 3G). The trichomes emerge from a lower level than the other epidermal cells, and the stalk is uniseriate and composed of few cells. The mesophyll is composed of a multicellular water storage parenchyma that usually presents elongated or rounded, thinned walled cells and occupies nearly 1/3 of the upper mesophyll (Fig. 3A). The remaining 2/3 of the mesophyll are filled with rounded chlorenchymatous cells and a water storage parenchyma. The first is positioned immediately below

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**Table 1. Morphological comparison between *Tillandsia bonita* and *T. didisticha* sensu lato (according to Tardivo, 2002).**

<table>
<thead>
<tr>
<th></th>
<th><em>T. bonita</em></th>
<th><em>T. didisticha</em> s.l.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flower length (cm)</td>
<td>2.6</td>
<td>1.8–2.0</td>
</tr>
<tr>
<td>Sepal length (cm)</td>
<td>1.5</td>
<td>1.1</td>
</tr>
<tr>
<td>Petal length (cm)</td>
<td>2.4</td>
<td>1.5–2.0</td>
</tr>
<tr>
<td>Style length (mm)</td>
<td>13</td>
<td>9</td>
</tr>
<tr>
<td>Floral bracts color</td>
<td>Green</td>
<td>Reddish</td>
</tr>
<tr>
<td>Floral bract size (cm)</td>
<td>1.9–2.2 × 0.7–0.9</td>
<td>1.1–1.5 × 0.5</td>
</tr>
<tr>
<td>Floral bract indumentum</td>
<td>Glabrous to</td>
<td>Entirely lepidote</td>
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<tr>
<td></td>
<td>inconspicuously</td>
<td>lepidote</td>
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<td></td>
<td>lepidote</td>
<td>only toward</td>
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<td>the apex</td>
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**Fig. 1.** *Tillandsia bonita*. A. Habit of the cultivated plant. B. Detail of the inflorescence at full-bloom. C. Floral bract. D. Sepal. E. Flower. F. Detail of the petal and stamens. G. Stamen. H. Pistil. I. Ovary. J. Detail of the trifid stigma. From Martinelli 16923b. Illustration by Paulo Ormindo.
Fig. 2. *Tillandsia bonita*. A. Habit of the cultivated plant. B. Detail of the inflorescence in the beginning of blooming. C. Final stage of blooming. D. Photomicrograph of abaxial surface of the leaf blade showing the densely arranged appressed trichomes. E. Detail of the peduncle, showing the denser indumentum close to the node. F. Detail of the flowering bracts margins. G. Detail of the leaf apex. H. Detail of the petal apex. I. Detail of the liquid preserved ovary (all photos from Martinelli 16923b).
the upper water storage parenchyma and between the vascular bundles. The water storage parenchyma is also deposited below each vascular bundle (Fig. 3B) and idioblast containing raphides can be seen within this tissue (Fig. 3D). Collateral vascular bundles are present in a single series and have similar diameter (Fig. 3A). Stomata complexes are tetracytic and restricted to the abaxial face. The subsidiary cells are parallel to the guard cell (Fig. 3E).

**Artificial key to the species of *Tillandsia* from Mato Grosso do Sul, Brazil**

1. Inflorescence compound ........................................................................................................ 2
2. Petals purple to blue .............................................................................................................. 3
3. Leaf apex strongly coiled, stiff; leaf blade trichomes appressed .............................................. *T. duratii* Vis.
3. Leaf apex straight to weakly curved, thin and flexible; leaf blade trichomes spreading ............ *T. streptocarpa* Baker
2. Petals white .................................................................................................................. 2
4. Leaves wine-red; floral bract green, inconspicuously lepidote to glabrous adaxially ................................................................. 4
4. Leaves green or cinereous; floral bract reddish to pinkish, sparsely lepidote to densely lepidote toward the apex adaxially ................................................................. 5
5. Plant long-caulecent (>10 cm); floral bract longer than 1.6 cm .................................................. 5
5. Plant acucentes or very short-caulecent (<5 cm); floral bract shorter than 1.6 cm; ......................................................................................... 6

1. Inflorescence simple ........................................................................................................ 6
2. Petals white .................................................................................................................. 2
4. Leaves wine-red; floral bract green, inconspicuously lepidote to glabrous adaxially ................................................................. 4
4. Leaves green or cinereous; floral bract reddish to pinkish, sparsely lepidote to densely lepidote toward the apex adaxially ................................................................. 5
5. Plant long-caulecent (>10 cm); floral bract longer than 1.6 cm .................................................. 5
5. Plant acucentes or very short-caulecent (<5 cm); floral bract shorter than 1.6 cm; ......................................................................................... 6

2. Petals white .................................................................................................................. 2
4. Leaves wine-red; floral bract green, inconspicuously lepidote to glabrous adaxially ................................................................. 4
4. Leaves green or cinereous; floral bract reddish to pinkish, sparsely lepidote to densely lepidote toward the apex adaxially ................................................................. 5
5. Plant long-caulecent (>10 cm); floral bract longer than 1.6 cm .................................................. 5
5. Plant acucentes or very short-caulecent (<5 cm); floral bract shorter than 1.6 cm; ......................................................................................... 6

Discussion

This new species is placed in T. subgen. Anoplophytum due to its transversely plicate filaments (Smith 1934). Although originally published as a genus by Beer (1854), Anoplophytum is now treated as a subgenus of Tillandsia (Smith and Downs, 1977; Till, 2000). It is characterized by the presence of transversely plicate filaments (Evans and Brown 1989), spiral phylotaxis, odorless flowers, symmetric sepals, and usually blue, rose, or white flowers with a tubular corolla (Till 2000). Simple erect stigmas are also frequent within this subgenus (Brown and Gilmartin 1989) and are present in T. bonita.

Species of T. subgen. Anoplophytum occur in mesic or xeric environments (Till 2000). According to Smith and Downs (1977), as reviewed by Till (2000), this subgenus groups two assemblages of species: (1) strongly xeromorphic species mostly bearing dense distichously white-flowered spikes and concentrated in the Andes and (2) a Brazilian group of xeromorphic and mesomorphic species bearing compound distichous or polystichous spikes mostly with dark rose or blue petals. The first group mentioned above was transferred to T. subgen. Allarditia by Till (2000), and the separation of these two subgenera is still considered problematic and difficult (Tardivo 2002). It now appears that neither of these subgenera is monophyletic (Barfuss et al. 2005), and so we take what we consider to be the more conservative approach of recognizing a broadly circumscribed T. subgen. Anoplophytum (sensu Smith and Downs, 1977; Tardivo 2002), while awaiting the publication of ongoing molecular phylogenetic investigations in Tillandsia (Barfuss et al. 2011). However, if we were to follow the segregation proposed by Till (2000), then we would place T. bonita within T. subgen. Allarditia with T. didisticha.

In Tardivo’s (2002) revision of the T. subgen. Anoplophytum, a broad circumscription was adopted for T. didisticha, proposing three other species as synonyms: Tillandsia barrosoae, T. pucaraensis, and T. pohliana. Tardivo points out that T. didisticha has a broad area of occurrence encompassing Bolivia, Argentina, Paraguay, and Brazil, in the states of Distrito Federal, Goiás, Mato Grosso, Mato Grosso do Sul, and Paraná. According to this author the broad occurrence of T. didisticha has an influence on the great variability seen in leaf position and rosette shapes, size and number of inflorescence branches, and floral bracts size and indumentum. In our diagnosis we adopted for comparison purposes all the measurements presented by Tardivo (2002), who examined more than 50 specimens (not including duplicates). Basically, the main differences seen between the two species are related to flower and flower parts size, as well as the color of the floral bracts. Additionally, T. bonita has nearly glabrous floral bracts, in contrast with most morphotypes seen of T. didisticha.

The leaf anatomy of T. bonita follows patterns seen for the entire genus (e.g. Braga 1977; Loeschen et al. 1993; Mosti et al. 2005; Scatena and Segecin 2005). Many of the characteristics observed here, such as epidermis with thick and sinuous walls, extensive water storage parenchyma, and the density of trichomes may be seen as adaptations to endure a lithophytic lifestyle, as seen in other Bromeliaceae (Freschi et al. 2010; Versieux and Martinelli 2010a). This species is the semimesic type of Gilmartin (1983), presenting a poorly developed or no tank and narrow leaf blades with inconspicuous, appressed scales.

Another distinctive characteristic of the new taxon worth noting is the complete dominance of the wine-red leaves, a character that was observed in all individuals in different populations and that has not changed under cultivation. Anthocyanin accumulation in leaves may be related to abiotic effects such as nutrient deficiency, excess light, UV-B radiation, water stress (osmoregulation), and herbivory (Close and Beadle 2003; Manetas 2006), which may be avoided due to aposematic coloration in red leaves (Cooney et al. 2012). In the case of T. bonita, 10 individuals were taken to Rio de Janeiro Botanic Garden greenhouses and after nearly one year of cultivation no change in color of the leaves was noticed. It would be interesting to check in the future whether the seedlings of this species are already wine-red colored. This color morph pattern has been noticed for other species of Tillandsia (e.g. T. tenuifolia L.) and is much appreciated by horticulturists (Isley 2009).

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