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Short Communication

New species, nomenclatural changes and recent taxonomic studies in the genus *Stylosanthes* (Leguminosae): An update

Especies nuevas, cambios nomenclaturales y recientes estudios taxonómicos en el género Stylosanthes *(Leguminosae): Una actualización*

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Abstract

Since the last taxonomic overview during the 1982 *Stylosanthes* Symposium in Townsville, Australia, 10 new species: *S. falconensis*, *S. longicarpa*, *S. maracajuensis*, *S. nunoi*, *S. quintanarooensis*, *S. recta*, *S. salina*, *S. seabrana*, *S. vallsii* and *S. venezuelensis*; and 1 botanical variety: *S. guianensis* var. *pauciflora*; have been validly described. Furthermore, 2 nomenclatural changes have been proposed, both being elevations of botanical varieties to the rank of species: *S. gracilis* and *S. rostrata*. In the major taxonomic databases, The Plant List and GRIN, the taxonomic status ("accepted" vs. "synonym" vs. "unresolved") of some of these new taxa, however, differs. In addition, this paper reports on *Stylosanthes* names that can be found in the post-symposium literature but have not been validly published, and on recent regional studies of *Stylosanthes* taxonomy. Suggested research needs as perceived by non-botanists include an updated *Stylosanthes* monograph and taxonomic studies within the *S. guianensis*, *S. hamata* and *S. scabra* species complexes.

Keywords: Taxonomy, validly published names.

Resumen

Desde la última sinopsis taxonómica del género *Stylosanthes* realizada en 1982 con ocasión del Simposio sobre *Stylosanthes* llevado a cabo en Townsville, Australia, se han descrito válidamente 10 nuevas especies y una variedad botánica: *S. falconensis*, *S. longicarpa*, *S. maracajuensis*, *S. nunoi*, *S. quintanarooensis*, *S. recta*, *S. salina*, *S. seabrana*, *S. vallsii* y *S. venezuelensis*, y la variedad botánica: *S. guianensis* var. *pauciflora*. Por otra parte, se han propuesto 2 cambios nomenclaturales; los mismos son elevaciones de variedades botánicas al rango de especie: *S. gracilis* y *S. rostrata*. No obstante, existen diferencias entre las principales bases de datos taxonómicos, The Plant List y GRIN, con respecto al estatus taxonómico ("aceptado" vs. "sinónimo" vs. "sin resolver") de algunos de estos nuevos taxones. Adicionalmente, en el artículo se presentan una serie de nombres, los cuales no han sido válidamente publicados, pero sí aparecen en la literatura posterior al Simposio de 1982, y un listado de recientes estudios regionales sobre taxonomía de *Stylosanthes*. Las sugerencias sobre necesidades de investigación incluyen, según la percepción de investigadores no botánicos, una monografía actualizada del género *Stylosanthes* y estudios sistemáticos dentro de los complejos taxonómicos de *S. guianensis*, *S. hamata* y *S. scabra*.

Palabras clave: Nombres válidamente publicados, taxonomía.

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Introduction

Stylosanthes Sw. is an important tropical and subtropical forage plant genus (Chakraborty 2004). To date, more than 80 *Stylosanthes* species have been described (IPNI 2014). Nine of them are or were of economic importance (Chakraborty 2004; Cook et al. 2005): *Stylosanthes capitata* Vogel, *S. fruticosa* (Retz.) Alston, *S. guianensis* (Aubl.) Sw., *S. hamata* (L.) Taub., *S. humilis* Kunth, *S. macrocephala* M.B. Ferreira and Sousa Costa, *S. scabra* Vogel, *S. seabrana* B.L. Maass and 't Mannetje and *S. viscosa* (L.) Sw.

Swartz (1788) described the genus and included 2 species, *Stylosanthes procumbens* Sw., nom. illeg. (≡ *S. hamata*) and *S. viscosa*. Vogel (1838) prepared the first revision of *Stylosanthes*; therein he divided the genus into 2 sections and listed 15 species. Mohlenbrock (1957) monographed *Stylosanthes* across its full geographic range, listing 25 species. However, the material that was available to him more than half a century ago was limited in terms of specimen numbers and origins. In a subsequent taxonomic overview presented at the International Symposium on *Stylosanthes* held in November 1982 in Townsville, Australia, Mannetje (1984) listed 24 unambiguous, 5 problematic and 5 doubtful species; this overview was complemented by a study of some Brazilian *Stylosanthes* species (Costa and Ferreira 1984). With these 2 chapters on taxonomy in the symposium book (Stace and Edye 1984), it became evident that the genus presents considerable taxonomic difficulties.

There is no doubt that taxonomy of some *Stylosanthes* species is unclear and names might prove to be synonyms of other described species. However, this paper is not about the identification of synonyms vs. correct names, which should rather be the subject of a comprehensive taxonomic revision of the genus. Instead, our objective is to inform non-botanists about: (1) new validly published taxa; and (2) nomenclatural changes since the 1982 International Symposium. The term "nomenclatural changes" refers here to new combinations, i.e. when a new name, based on a legitimate, previously published name (= the so-called basionym of the species), is published (McNeill et al. 2012). In addition, we present: (3) a list of new variety and species names occasionally found in post-symposium publications, which, however, should not be used because they are invalid; and (4) a brief account of recent taxonomic *Stylosanthes* studies with a regional focus (country, state).

With this update we pretend to contribute to: (1) stimulate continuing interest in the genus; and (2) clarify and prevent potential confusion related to the use of species names.

Methodology

The study is based on analyses of botanical *Stylosanthes* literature partly accessed online from the Biodiversity Heritage Library (www.biodiversitylibrary.org). Literature not available online was obtained from the library of the Royal Botanic Gardens, Kew. New names and combinations and standard abbreviations of plant name authorities were obtained from the International Plant Names Index (www.ipni.org). For information on the taxonomic status of new names and combinations, 2 taxonomic databases were accessed: The Plant List (TPL, www.theplantlist.org) and GRIN, the US Department of Agriculture – ARS Germplasm Resources Information Network (https://npgsweb.ars-grin.gov/gringlobal/taxonomybrowse.aspx).

TPL is a taxonomic database produced through the collaboration of mainly the 2 world-leading research centers for legume taxonomy and nomenclature, Royal Botanic Gardens, Kew and Missouri Botanical Garden, where botanists are in charge of maintaining and updating the respective databases, ILDIS and TROPICOS. Algorithms are used for detecting and resolving conflicting opinions resulting from data coming from such different sources. When this leads to uncertainties, a taxonomic status will be presented as "unresolved". The TPL database is not updated regularly (TPL 2013). On the other hand, the GRIN database is monitored and regularly updated by botanists of the USDA National Germplasm Resources Laboratory (GRIN 2016). It follows a more pragmatic approach: when taxonomic differences arise, GRIN would generally be guided by current usage, if nomenclature of a specific case adheres to the international rules of the "Melbourne Code" (McNeill et al. 2012). We chose TPL and GRIN because of the particular expertise in legume taxonomy of the institutions contributing to these databases.

New species and botanical varieties

Since 1982, 10 new species and 1 botanical variety name have been described within the genus *Stylosanthes* (Table 1, first part): *S. falconensis* Calles and Schultze-Kr., *S. longicarpa* Brandão and Sousa Costa, *S. maracajuensis* Sousa Costa and van den Berg, *S. nunoi* Brandão, *S. quintanarooensis* Gama and Dávila, *S. recta* Vanni, *S. salina* Sousa Costa and van den Berg, *S. seabrana*

B.L. Maass and 't Mannetje, *S. vallsii* Sousa Costa and van den Berg, *S. venezuelensis* Calles and Schultze-Kr. and *S. guianensis* var. *pauciflora* M.B. Ferreira and Sousa Costa. However, though validly published, i.e. in accordance with international nomenclatural rules as specified in the "Melbourne Code" (McNeill et al. 2012), not all new taxa are currently equally accepted by the scientific community (Table 1). For example, *S. nunoi* and *S. maracajuensis* are accepted by both TPL and GRIN, whereas *S. venezuelensis* and *S. salina* are treated as unresolved by TPL and as accepted by GRIN.

These discrepancies among databases are the result of different species concepts. A good example is the case of *S. seabrana*; Maass and Mannetje (2002) compiled morphological, karyotypic and molecular evidence to describe a new species, *S. seabrana*, which was subsequently accepted by both TPL and GRIN. Under this name, the species has found entrance in tropical forage legume research worldwide and 2 commercial cultivars of *S. seabrana* were released in Australia (Cook et al. 2005). However, Vanni and Fernandez (2011), based on morphological and karyotypic characteristics, concluded that *S. seabrana* should be treated as a synonym of *S. scabra*. While TPL follows Maass and Mannetje (2002) and continues to accept the species as *S. seabrana*, GRIN now follows the broader concept of Vanni and Fernandez (2011) and treats it as a synonym of *S. scabra*.

Table 1. New taxa, nomenclatural changes and taxonomic status within the genus *Stylosanthes*, during period 1982–2014.

Taxon	Taxonomic status[1]		Reference	Distribution	Related species[2]	Comments in the original description
	TPL	GRIN				
New taxa						
S. guianensis var. *pauciflora*	----	Synonym of *S. guianensis* var. *guianensis*	1	Brazil, Venezuela	*S. guianensis* var. *guianensis*	• Tolerant of anthracnose and drought • Late-flowering; inflorescences few-flowered
S. nunoi	Accepted	Accepted	2	Brazil	*S. hippocampoides*	• Collected in Cerrado vegetation on sandy, very infertile soil
S. longicarpa	Unresolved[3]	Accepted	3	Brazil	*S. nunoi*	• No comments reported
S. recta	Unresolved	Accepted	4	Paraguay	*S. macrosoma*	• Collected in Chaco vegetation on sandy soils
S. salina	Unresolved	Accepted	5	Mexico	*S. viscosa*	• Collected in mangrove ecosystem, in sandy, salty fields • Annual
S. seabrana	Accepted	Synonym of *S. scabra*	6	Brazil	*S. scabra*	• Collected in Caatinga vegetation, in areas with low rainfall and long dry season • Collected on medium- to heavy-textured soils
S. maracajuensis	Accepted	Accepted	7	Brazil	*S. sericeiceps*, *S. leiocarpa*, *S. viscosa*	• Collected in shallow soils over rocky outcrops and within rock cracks
S. venezuelensis	Unresolved	Accepted	9	Venezuela	*S. scabra*	• Collected in shady environments
S. quintanarooensis	Unresolved	Accepted	10	Mexico	*S. calcicola*, *S. macrocarpa*, *S. mexicana*	• Collected on sandy soils
S. vallsii	Unresolved	Accepted	11	Brazil	*S. maracajuensis*, *S. leiocarpa*	• Collected on shallow basaltic lithosols, Paraná state
S. falconensis	Unresolved	Accepted	12	Venezuela	*S. hamata*	• Collected at 900−1,200 masl, low-montane deciduous dry tropical forest
Nomenclatural changes						
S. rostrata	Unresolved	Accepted	8	Argentina, Uruguay	*S. hippocampoides*	• Elevation to the species rank from *S. gracilis* var. *rostrata*
S. gracilis	Synonym of *S. guianensis*	Accepted	13	South and Central America	*S. guianensis*	• Elevation to the species rank from *S. guianensis* var. *gracilis*

[1]Information at December 2015. [2]According to information provided in the respective original publication. [3]Unresolved names are those to which a status of "accepted" or "synonym" cannot be assigned. References: (1) Brandão et al. 1985; (2) Brandão 1991; (3) Brandão and Costa 1992; (4) Vanni 1995; (5) Costa and van den Berg 2001; (6) Maass and Mannetje 2002; (7) Costa and van den Berg 2003; (8) Vanni 2009; (9) Calles and Schultze-Kraft 2009; (10) Gama-López and Dávila 2009; (11) Costa and van den Berg 2009; (12) Calles and Schultze-Kraft 2010a; (13) Calles and Schultze-Kraft 2010b.

Nomenclatural changes

Two nomenclatural changes are presented in the second part of Table 1.

Burkart (1939) reported on an Argentinian botanical variety, *Stylosanthes gracilis* var. *rostrata* Burkart. Recently, Vanni (2009) found reasons to elevate this variety to the rank of species as *Stylosanthes rostrata* (Burkart) Vanni. Until now, however, there has been no consensus on the taxonomic status of this name (Table 1).

Stylosanthes gracilis Kunth was originally described by Kunth (1823) as a species, but subsequently treated as a synonym of *S. guianensis* (Mohlenbrock 1957) or as a variety of *S. guianensis* (Vogel 1838; Mannetje 1977, 1984). Ferreira and Costa (1979) suggested elevating the epithet *gracilis* to species rank but it was only recently that sufficient taxonomically relevant evidence to re-establish *S. gracilis* at species level was collected (Calles and Schultze-Kraft 2010b). However, again there is no consensus on the taxonomic status (Table 1).

Invalid *Stylosanthes* names in the post-symposium literature

In Table 2 we mention several names of *Stylosanthes* taxa that have not been validly published or even not been published at all, which, however, can occasionally be found in post-symposium (i.e. post-1982) publications. Since these names have not been validly published, they should be considered as "nomina nuda" [(singular: nomen nudum: any new taxon published without a description or diagnosis; McNeill et al. 2012; Art. 38)]. These names should not be used in scientific literature; in particular cases where this cannot be avoided, such a name should be set in inverted commas and it should be made clear that the name has not been validly published.

Recent regional studies on *Stylosanthes* taxonomy

Although there has been a slow-down in botanical research on *Stylosanthes* during the past 3 decades, several regional studies on the taxonomy of the genus have been carried out recently (Table 3). The areas covered are several Brazilian states, Mexico and Venezuela.

Research needs

We see the following taxonomic research issues as particularly relevant in the interest of non-botanists working with this important forage legume genus and, in particular, its economically most important species:

- A revision of the genus *Stylosanthes* is urgently required. Costa's (2006) dissertation provides such an opportunity, although condensation of the 470-page thesis to produce an international publication would be a prerequisite.
- There are many discrepancies around the so-called "*Stylosanthes guianensis* species complex". Mannetje (1984) recognized 6 botanical varieties within *S. guianensis* [i.e. the varieties *gracilis* (Kunth) Vogel ex Benth., *intermedia* (Vogel) Hassl., *robusta* 't Mannetje, *marginata* Hassl., *longiseta* (Micheli) Hassl. and *dissitiflora* (Robinson and Seaton) 't Mannetje], while Costa and Ferreira (1984) treated the first 5 varieties as species (i.e. *S. gracilis*, *S. campestris* M.B. Ferreira and Sousa Costa, *S. grandifolia*, *S. acuminata* M.B. Ferreira and Sousa Costa and *S. longiseta* Micheli, respectively). At present, there are considerable uncertainties regarding the taxonomic status of these taxa and therefore a revision of this complex, including the newly described variety *pauciflora*, is urgently needed. We suggest that such studies be based on molecular analyses such as the evidence provided by Santos-Garcia et al. (2012).
- In the genus *Stylosanthes*, *S. scabra* is a particularly polymorphic species. This is also indicated by the suggestion made by Vanni and Fernandez (2011) that *S. seabrana* should actually be considered as a synonym of *S. scabra*. In view of the significance of *S. scabra* as a forage species, we suggest that it merits closer examination in order to identify morphological, molecular and karyotypic characteristics that might allow separating distinct groups that could be described as infraspecific taxa (e.g., botanical variety, subspecies) within an eventual "*S. scabra* species complex".
- Likewise, further examination of the variability in *S. hamata*, also an economically very important species, is required, with eventual description of the tetraploid forms as a separate taxon (see comment on "*S. hemihamata*" in Table 2).

We suggest that in the aforementioned taxonomic studies conventional morphological analyses using herbarium material be complemented with molecular analyses, making use of the large *Stylosanthes* germplasm collections held in the major tropical forage genebanks at CIAT (International Center for Tropical Agriculture) in Cali, Colombia, the Australian Pastures Genebank in Adelaide, Australia, and ILRI (International Livestock Research Institute) in Addis Ababa, Ethiopia.

Table 2. Invalid *Stylosanthes* names found in recent literature (period 1982–2014).

Name	Reference examples	Comments
S. grandiflora M.B. Ferreira & Sousa Costa nom. nud.	Kazan et al. 1993 Vander Stappen et al. 1999 Fortuna-Perez et al. 2011	There is no description of a *Stylosanthes* species under this name. Thus the name has not been validly published and consequently is a nomen nudum. We assume this is a mis-spelling of *S. grandifolia* M.B. Ferreira and Sousa Costa.
S. guianensis var. *vulgaris* M.B. Ferreira & Sousa Costa	Gillies and Abbott 1996 Vieira et al. 1997	The naming of this variety (Ferreira and Costa 1979) did not follow international nomenclatural rules (McNeill et al. 2012; Arts. 24.3 and 26.1). Consequently, the name was not validly published and should not be used. The correct name for this taxon is *S. guianensis* var. *guianensis* (see Table 1).
S. hemihamata nom. nud.	Maass and Sawkins 2004 Gama-López et al. 2007	Following an earlier suggestion of H. Stace (pers. comm. 1984), Maass and Sawkins (2004) proposed the name *S. hemihamata* for tetraploid *S. hamata* such as the cultivars Verano and Amiga. However, the species has never been described and consequently the name is a nomen nudum.
S. pseudohumilis Gama & Dávila nom. nud.	Gama-López et al. 2007	Gama-López et al. (2007) referred to *S. pseudohumilis* as a new species described in an MSc thesis (Gama López 2006). However, names published in independent non-serial work (e.g. post-graduate theses) are not effectively published (McNeill et al. 2012; Art. 30.8). Consequently the name is a nomen nudum.
S. tehuacanensis Gama & Dávila nom. nud.	Gama-López et al. 2007	Gama-López et al. (2007) referred to *S. tehuacanensis* as a new species described in an MSc thesis (Gama López 2006). However, names published in independent non-serial work (e.g. post-graduate theses) are not effectively published (McNeill et al. 2012; Art. 30.8). Consequently the name is a nomen nudum.
S. guianensis var. *occidentalis* Gama & Dávila nom. nud.	Gama-López et al. 2007	Gama-López et al. (2007) referred to *S. guianensis* var. *occidentalis* as a new botanical variety described in an MSc thesis (Gama López 2006). However, names published in independent non-serial work (e.g. post-graduate theses) are not effectively published (McNeill et al. 2012; Art. 30.8). Consequently the name is a nomen nudum.

Table 3. Regional studies on *Stylosanthes* taxonomy, period 1982–2014.

Country	State	Reference	Comments
Brazil	Ceará	Sousa et al. 2003	Seven species are reported, none being endemic to this state.
	Mato Grosso do Sul	Costa et al. 2008	Seventeen species are reported, including *S. maracajuensis*, which is endemic to this state.
	Roraima	Medeiros and Flores 2014	Seven species are reported, none being endemic to this state.
	São Paulo	Fortuna-Perez et al. 2011	Nine species are reported, none being endemic to this state.
Mexico	Countrywide	Gama-López et al. 2007	This Bioversity International booklet contains a taxonomic synopsis of Mexican *Stylosanthes* and includes 11 species and 2 varieties of *S. guianensis*. *Stylosanthes macrocarpa*, *S. mexicana* and *S. subsericea* are reported as endemic to Mexico. Three taxa mentioned in this booklet are not validly published (see Table 2).
Venezuela	Countrywide	Calles and Schultze-Kraft 2010c	Eleven species are reported, including *S. falconensis*, *S. sericeiceps* and *S. venezuelensis*, which are endemic to Venezuela.

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