A New Awned Species of *Paspalum* (Poaceae, Panicoideae, Paniceae) from Brazil

Author(s): Desirée M. Ramos, José F. M. Valls, Regina Célia de Oliveira, and Dalva Graciano-Ribeiro
Source: Novon: A Journal for Botanical Nomenclature, 21(3):368-372.
Published By: Missouri Botanical Garden
https://doi.org/10.3417/2010033
URL: http://www.bioone.org/doi/full/10.3417/2010033

A New Awned Species of *Paspalum* (Poaceae, Panicoideae, Paniceae) from Brazil

Desirée M. Ramos,[1] *José F. M. Valls,*[1,2] *Regina Célia de Oliveira,*[1]* *and Dalva Graciano-Ribeiro*[1]

[1]Programa de Pós-Graduação em Botânica, Instituto de Biologia, Universidade de Brasília, Caixa Postal 04457, 70910-970, Brasília, Distrito Federal, Brazil

[2]Embrapa Recursos Genéticos e Biotecnologia, Caixa Postal 02372, 70770–900, Brasília, Distrito Federal, Brazil

*Author for correspondence: reginacelia@unb.br

Abstract. A new species of *Paspalum* L. (Poaceae, Panicoideae, Paniceae), *P. rostratum* D. Ramos, Valls & R. C. Oliveira, from the Distrito Federal in central Brazil, is described and illustrated. The new species is awned and is related to *P. biaristatum* Filg. & Davidse and *P. longiaristatum* Davidse & Filg., to which it is compared. Distinguishing features of *P. rostratum* include shorter awns and a rostrate upper lemma, as well as the free branching and flowering from the upper nodes, with the successive branches forming cymose branching systems.

Resumo. Uma nova espécie de *Paspalum* L. (Poaceae, Panicoideae, Paniceae), *P. rostratum* D. Ramos, Valls & R. C. Oliveira, do Distrito Federal, Brasil, é descrita e ilustrada. Essa nova espécie é aristada e é relacionada a *P. biaristatum* Filg. & Davidse e *P. longiaristatum* Davidse & Filg. e a elas é comparada. As características que distinguem *P. rostratum* incluem aristas mais curtas e lema superior rostrado, além dos colmos muito ramificados nos nós superiores, formando um sistema de ramificação cimoso.

Key words: Brazil, IUCN Red List, Paniceae, Panicoideae, *Paspalum*, Poaceae.

During a study on the phenology of grass species in the Distrito Federal, Brazil, an unusual 2-awned *Paspalum* L. (Poaceae) species was collected.

Other 2-awned *Paspalum* species include *P. biaristatum* Filg. & Davidse and *P. longiaristatum* Davidse & Filg., both from areas of serpentine soils in central Brazil. These awned species were accommodated within *Paspalum* sect. *Biaristata* Filg. & Davidse, within subgenus *Ceresia* (Pers.) Rchb. (Filgueiras & Davidse, 1994). More recently, Denham et al. (2002) merged *Paspalum* sect. *Biaristata* with section *Ceresia* (Pers.) Nees (1829), so as to render section *Ceresia* monophyletic, with this latter name having priority.

Samples for leaf anatomy were sectioned from the middle portion of the blade. Culm sections were from the second or third stem internode from the top. Roots were sectioned at 3 cm from the shoot. Cross sections were made with a Ranvier microtome, clarified and stained with Alcian blue and safranin 1%, and mounted using a synthetic resin (Paiva et al., 2006). Photomicrographs were made using the Olympus CX31 optical microscope with an Olympus C-7070 digital camera (Olympus Corp., Shinjuku-ku, Tokyo, Japan).

Paspalum rostratum D. Ramos, Valls & R. C. Oliveira, sp. nov. TYPE: Brazil. Distrito Federal: Sobradinho, Reserva Ecol. Perm. do Centro Nac. de Pesquisa do Cerrado (Embrapa CPAC), 15°39′33.57″S, 47°43′29.46″W, 1100 m.s.m., área com declividade de 45°, ecótono campo sujo—mata de galeria, 20 Apr. 2009, *D. M. Ramos & P. D. Alves 16* (holotype, UB; isotypes, BAA, CEN, MO). Figures 1, 2.

Species *Paspalo longiaristato* Davidse & Filg. et *P. biaristato* Filg. & Davidse prae gluma superiore aristata et lemmate inferiore aristato similis, sed a hoc racemo uno, aristis brevioris et lemmate superiore apice rostrato ab omnibus congeneris culmis in nodis superioribus profuse ramosis differt.

Caespitose perennial; base of tillers forming very short, curved rhizomes with numerous cataphylls; culms 60–82 cm tall, ca. 2 mm diam., erect, freely branching and flowering from nodes in the upper 1/3; successive branches arising from the axils of the upper leaf sheaths and forming cymose branching systems; internodes and nodes glabrous. Leaf sheaths longer than the internodes, glabrous, the dead ones remaining and bladeless, obscuring culm bases, with evident auricles; ligules ca. 0.3 mm, membranous, rounded to obtuse, erose, hyaline, with dorsal trichomes ca. 1.5 mm, erose; blades 2.5–8.5 × 0.05–0.1(–0.2) cm, linear-lanceolate or lanceolate,

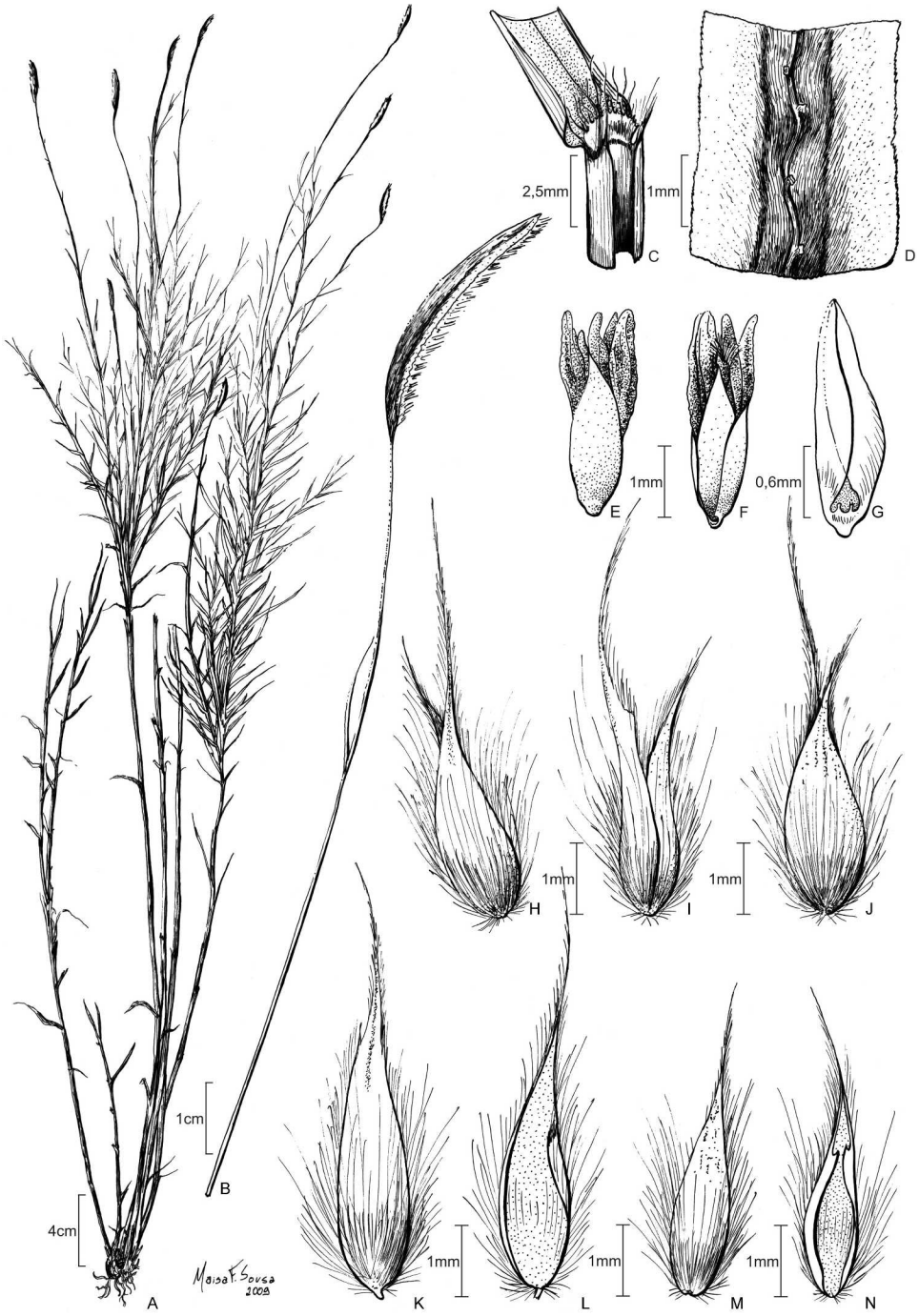

Figure 1. *Paspalum rostratum* D. Ramos, Valls & R. C. Oliveira, based on the holotype *Ramos & Alves 16* (UB). —A. Habit. —B. Detail of flowering culm. —C. Ligular region with auricles. —D. Segment of winged rachis, with the pedicels. —E. Upper anthecium, dorsal view. —F. Upper anthecium, ventral view. —G. Upper palea, ventral view, with the gynoecium evident. —H. Spikelet, dorsal view, showing upper glume. —I. Spikelet, lateral view, with detail of the lateral extension of the upper glume. —J. Spikelet, ventral view, showing lower lemma. —K. Upper glume, dorsal view. —L. Upper glume, ventral view, detail of asymmetric lateral extension. —M. Lower lemma, dorsal view. —N. Lower lemma, ventral view, with detail of symmetric lateral extensions.

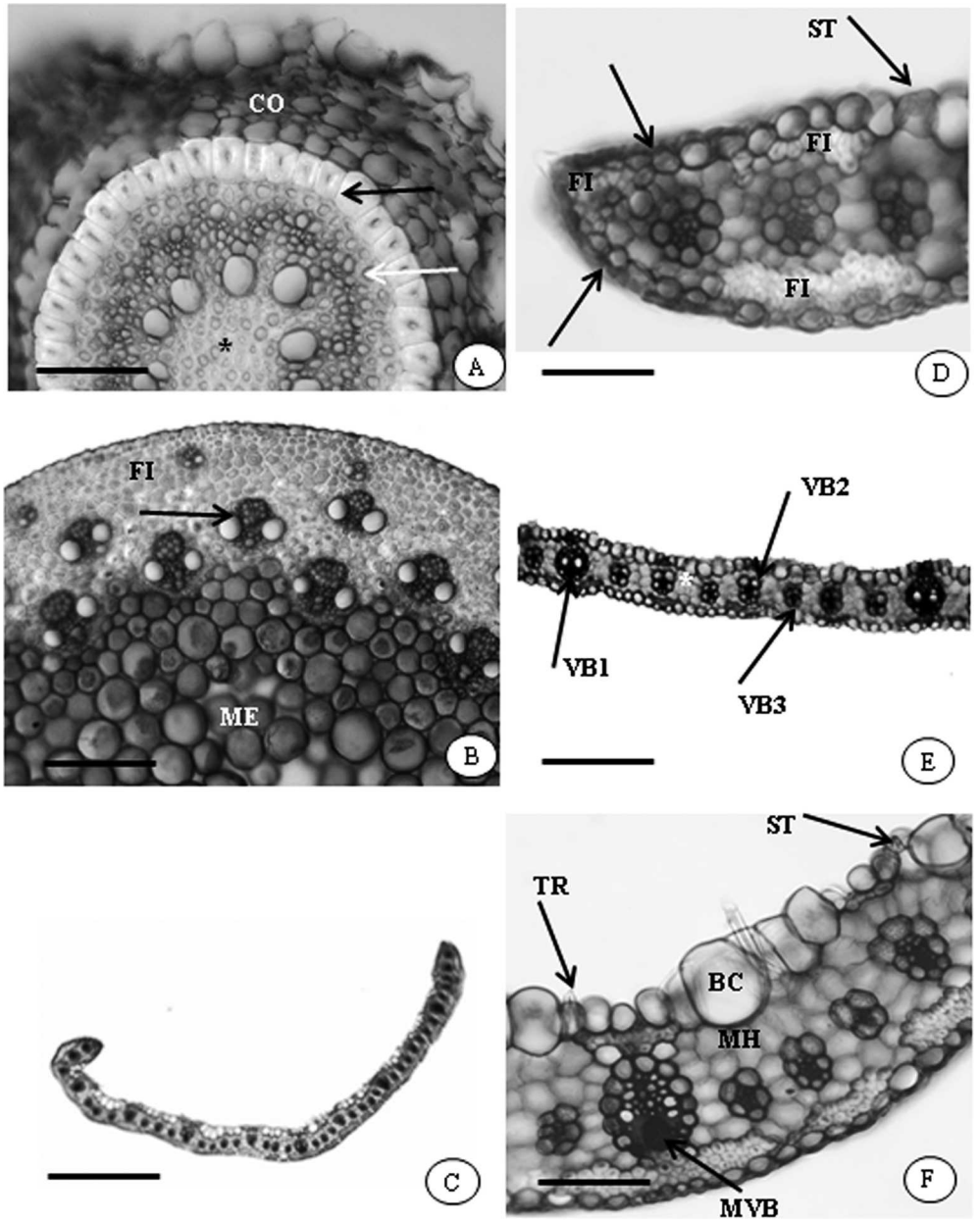

Figure 2. *Paspalum rostratum* D. Ramos, Valls & R. C. Oliveira, taken from *Oliveira & Ramos 2482* (UB). —A. General view of the root section: short cortical region (CO), endodermis (black arrow), pericycle (white arrow), and densely thickened medulla (*). —B. General view of the culm section: lignified epidermis, cortical region with fibers (FI), vascular bundles (black arrow), and parenchymatic medulla (ME). —C. General view of the leaf blade section. —D. Detail of leaf margin: thickened cuticle (black arrows), stomata (ST), and fibers (FI) in the mesophyll. —E. Detail of mesophyll: vascular bundles (VB1, VB2, VB3) and one to two parenchyma cells between bundles (white *). —F. Detail of median bundles: first-order vascular bundle with single-layered sheath (MVB) and homogeneous mesophyll (MH), bulliform cells (BC), trichome (TR), and stomata (ST) in the adaxial face. Scale bars: A, B, E = 200 μm; C = 500 μm; D, F = 50 μm.

patent, flat to folded (when dry) and apparently subulate, glabrous on both surfaces but hirsute adaxially when young; blade base slightly broader than the sheath, apex acuminate, margins finely scabrous; lower blades deciduous. Peduncles 3–9 cm, terete, glabrous; inflorescences mostly exserted; racemes single, ascending, 1.5–4 cm; raceme rachis 3–4 mm wide, glabrous, greenish to purplish at the

middle, conspicuously winged (wings hyaline), with longitudinal veins at the wings, ending in a naked point; pedicels minute, glabrous. Spikelets solitary, 3–3.2 × 0.8–1 mm, biseriate, compactly imbricate, dorsiventrally compressed; lower glume absent; upper glume 3–3.2 × 0.8–1 mm, membranous, densely silky-pilose at the base (trichomes ca. 2 mm) and minutely pilose on the distal margins, glabrous elsewhere, with 1 asymmetric lateral extension, 3-nerved, lateral nerves submarginal; apex attenuate with an awn 1–1.8 mm. Lower lemma ca. 2.8 × 1 mm, membranous, with symmetric lateral extensions, 3-nerved; apex attenuate to an awn 0.8–1.4 mm; indument as in the upper glume; upper anthecium 2–2.1 × 0.5–0.6 mm, membranous, narrowly ellipsoid, dorsiventrally compressed, whitish, deciduous at maturity; lemma with rostrum and minute apical trichomes; palea rostrate, glabrous; lodicules minute; stamens 3, anthers ca. 2 mm, orange. Caryopsis 0.9–1.1 × 0.5–0.7 mm, oblong, hilum elliptical.

The above measurements were taken from fertile, intensively branched herbarium specimens. Experimentally cultivated, well-irrigated plants produced thicker younger stems, up to 2.95 mm diam. Young basal blades on not-yet-proliferated culms on cultivated plants averaged 7–15 cm in length, eventually reaching 16.5 cm long and 0.5–0.75 cm wide.

Distribution and habitat. The species has been found in savanna-forest ecotones, at the edge of gallery forests, and is known so far only in Distrito Federal, Brazil. Plants of *Paspalum rostratum* persist in the natural vegetation, totally dry and erect, throughout the dry season.

IUCN Red List category. So far, *Paspalum rostratum* is only known from two sites 36.6 km apart, both in legally conserved areas. Although the documented occurrence is restricted and no further searching has yet been conducted, there is no evidence of population decline or of a possible threat of extinction. Because insufficient information is available, we assess *P. rostratum* as Data Deficient (DD) according to IUCN Red List criteria (IUCN, 2001).

Etymology. The epithet of the new species refers to the rostrate lemma and palea of the upper anthecium.

Anatomy. Root (Fig. 2A) epidermal cells are large, presenting thin walls. The exodermis is uniseriate, slightly thickened, followed by up to four layers of parenchyma cells. In the endodermis, cells are squared, large, densely lignified, with reduced lumen. The pericycle is unistratified and lignified; the phloem is external to the xylem, which is disposed in an interrupted cylinder; the metaxylem is in five or more arches; and the medullar cells are lignified. The culm (Fig. 2B) epidermis is densely sclerified. The cortical region is composed only of irregularly sized fibers and has a reduced lumen. In this region, small leaf traces are immersed. First-order vascular bundles are distributed in two arches and surrounded by fibers; medullar cells are parenchymatic, rounded, with thin walls, and large intercellular spaces. Leaf blades are U-shaped in cross section, with the midrib not developed (Fig. 2C); the adaxial epidermis (Fig. 2D) has papillose epidermal cells, fan-shaped or rounded bulliform cells, protuberant stomata, silicified cells, cushion macrohairs, prickle hairs, and bicellular microhairs; the abaxial epidermis has a thick cuticle and papillose cells, silicified cells, level stomata, and microhairs; the mesophyll is homogeneous, consisting of radial parenchyma cells around the vascular bundles; three orders of vascular bundles are present (Fig. 2E), all with a single-layered sheath; first-order vascular bundles have an adaxial sclerenchyma cap; the abaxial surface has two or three layers of small-diameter sclerenchyma adjacent to the stomata; the adaxial surface has only one discontinuous layer of sclerenchyma, close to the second-order vascular bundles, these separated by one or two parenchyma cells (Fig. 2F).

Discussion. Plants of *Paspalum rostratum* are distinguished from its congeners by the free branching and flowering from the upper nodes and the successive branches arising from the axils of the leaf sheaths, forming cymose branching systems. The dead sheaths remain, although without blades, and obscure the culm bases.

In Denham et al. (2002), *Paspalum* subg. *Ceresia* was supported by the characters of the membranous upper anthecium and the upper palea gaping at the apex, based on exomorphological characters. In other most-parsimonious trees based on the same characters, the lower lemma with pilose margins and the upper lemma with unicellular macrohairs also support this clade. According to these criteria, the new species taxonomically assigns within subgenus *Ceresia*. Within this subgenus, Denham et al. (2002) recognized two sections, section *Ceresia* and section *Pectinata* Chase ex Rodr.-Rodr. *Paspalum rostratum* is related to those species assigned to section *Ceresia*, which includes 18 other species, based on the following synapomorphies: the upper glume with pilose margins, the upper glume pilose on the lower half, and the margins of the upper glume folded along the marginal nerves. Two subgroups were found in this clade by Denham et al. (2002) as clades A and B.

In all most-parsimonious trees, *P. longiaristatum* and *P. biaristatum*, both species that have an awned upper glume and lower lemma, constitute a well-supported terminal group in clade A (also with *P. goyasense* Davidse, Morrone & Zuloaga, *P. carinatum* Humb. & Bonpl. ex Flüggé, *P. eucomum* Nees ex Trin., *P. malmeanum* Ekman, *P. ceresia* (Kuntze) Chase, and *P. stellatum* Humb. & Bonpl. ex Flüggé). Two equally parsimonious topologies were found in clade A: the first where *P. stellatum* is the sister species of *P. longiaristatum* and *P. biaristatum*, supported by the presence of marginal nerves on the lower lemma lacking marginal extension. In the second resolution, *P. ceresia* was sister to *P. longiaristatum* and *P. biaristatum*, due to the absence of lodicules. Almost all the characters above are homoplasic, because *P. rostratum* has the lower lemma without marginal nerves and with extension of the margins, and lodicules are present, which is therefore inconsistent with the topologies of Denham's trees.

The leaf blade anatomy of *Paspalum rostratum* is typical for the Panicoideae: bicellular microhairs, fan-shaped bulliform cells, radial parenchyma around the vascular bundles, Kranz anatomy subtype MS (XyMS-; Hattersley & Watson, 1976), and two cells between vascular bundles. Other blade characters are typical in *Paspalum*: the presence of stomata and papillae on both epidermal surfaces as well as cushion macrohairs. The culm is peculiar to the species, with a densely sclerified epidermis and the cortical region consisting only of fibers, an aspect not mentioned in the literature for other species. Sclerification was also observed for cells of the root endodermis and medulla.

Key to Two-awned *Paspalum* Species from West-Central Brazil

1a. Annual plants dwarf, only to 40 cm tall; spikelets 1.8–2.2 mm long . . . *P. longiaristatum*
1b. Perennial plants > 60 cm tall; spikelets 3–4.5 mm long.
2a. Inflorescence with a single raceme; spikelets 3–3.2 mm long; awn ca. 1–1.8 mm long; anthecium rostrate . . . *P. rostratum*
2b. Inflorescence with (1)2 to 4(to 7) racemes; spikelets 3.8–4.5 mm long; awn 4–7.1 mm long; anthecium acute . . . *P. biaristatum*

Paratypes. BRAZIL. **Distrito Federal:** Sobradinho, Reserva Ecol. Perm. do Centro Nac. de Pesquisa do Cerrado (Embrapa/CPAC), 15°39′33.57″S, 47°43′29.46″W, 1100 m.s.m., 20 Apr. 2009, *J. E. Q. Faria Júnior 488* (K, RB, UB); 15°39′33.57″S, 47°43′29.46″W, 27 July 2009, *R. C. Oliveira & D. M. Ramos 2482* (UB); Lago Oeste, APA da Cafuringa, Poço Azul, 15°34′54.42″S, 48°02′50.22″W, 11 Sep. 2009, *D. M. Ramos & R. C. Oliveira 42* (UB).

Acknowledgments. We thank Odaci Fernandes de Oliveira for the Latin diagnosis and comments, and Maisa Ferreira for the line drawings. J. Valls thanks Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), Brazil, for a research fellowship.

Literature Cited

Denham, S. S., F. O. Zuloaga & O. Morrone. 2002. Systematic revision and phylogeny of *Paspalum* subgenus *Ceresia* (Poaceae: Panicoideae: Paniceae). Ann. Missouri Bot. Gard. 89: 337–399.

Filgueiras, T. S. & G. Davidse. 1994. *Paspalum biaristatum* (Poaceae: Paniceae), a new serpentine endemic from Goiás, Brazil, and the second awned species in the genus. Novon 4: 18–22.

Hattersley, P. W. & L. Watson. 1976. C_4 grasses: An anatomical criterion for distinguishing between NADP-Malic enzyme species and PCK or NAD-Malic enzyme species. Austral. J. Bot. 24: 297–308.

IUCN. 2001. IUCN Red List Categories and Criteria, Version 3.1. Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland, and Cambridge, United Kingdom.

Nees ab Esenbeck, C. G. D. 1829. Agrostologia Brasiliensis. J. G. Cottae, Stuttgart.

Paiva, J. G. A., S. M. Fank-de-Carvalho, M. P. Magalhães & D. Graciano-Ribeiro. 2006. Verniz vitral incolor 500: Uma alternativa de meio de montagem economicamente viável. Acta Bot. Bras. 20: 257–264.