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Cryptochloa stapfii (Poaceae: Bambusoideae: Olyreae), a new neotropical herbaceous bamboo from Panama

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Abstract

Cryptochloa stapfii, a new herbaceous bamboo species from Panama is described. This new bambusoid grass inhabits semi-shaded lowland forests in Bocas del Toro (Panama) and is related to *C. dressleri* Soderstr., an endemic species from Panama. This new taxon increases the number of species in *Cryptochloa* to eight, most of them present in Panama.

Key words: Taxonomy, Bocas del Toro, Central America, Flora of Panama, Poales

Introduction

Among the tribe Olyreae (Poaceae: Bambusoideae), *Cryptochloa* Swallen in Woodson & Schery (1942: 317) is one of the most well represented genera in the Republic of Panama with seven species (Judziewicz *et al.* 2000, TROPICOS 2014), including three endemics, i.e., *C. decumbens* Soderstrom & Zuloaga (1985: 29), *C. dressleri* Soderstrom in Soderstrom & Zuloaga (1982a: 25), and *C. soderstromii* Davidse in Davidse & Pohl (1992: 96).

The general distribution of the genus (Baldini & Ortiz 2014) shows a range from southern Mexico to northern South America (Colombia, Ecuador, Peru, Brazilian Amazonia) (Judziewicz *et al.* 1999). However, *C. capillata* (Trinius 1834: 114) Soderstrom (1982b: 202) from South America, extends its range up to Brazilian Atlantic Forest, but more investigations are required in order to establish its taxonomic status in *Cryptochloa* (Baldini & Ortiz 2013, 2014). Panama is a crucial centre of differentiation for *Cryptochloa* and other herbaceous bamboos, as there are several endemic taxa in the country (Calderón & Soderstrom 1973, Soderstrom & Calderón 1979, Soderstrom 1982a, 1982b, Soderstrom & Zuloaga 1985, Davidse & Pohl 1992, Judziewicz *et al.* 1999, Baldini & Ortiz 2014).

The grass flora of Panama, even though a relatively small region, is well represented by many forest endemics, a consequence of its paleogeographic history. It is therefore an important centre of conservation (Lewis 1971, Davidse 1985, Graham 2011, Bacon *et al.* 2012, Leigh *et al.* 2014, Bagley & Johnson 2014). According to the most recent floristic inventory, the grass family in Panama includes 417 taxa (Correa *et al.* 2004), and more taxa are expected to be described or reevaluated from taxonomical and nomenclatural points of views, according to our studies that are in progress.

In the present paper we describe a new species of *Cryptochloa* discovered in the Province of Bocas del Toro (Republic of Panama) during our field trips carried out from 2012–2014 with the aim to study the herbaceous bamboos of the Panamanian Flora and other Mesoamerican grasses.

Materials and methods

This study is based on the investigations of five living populations and herbarium collections of *Cryptochloa* taxa collected in Panama and housed at FT, MO, NY, PMA, SCZ and US. Field trips were carried out in the Republic of

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Panama in different periods of the year, either in dry or wet seasons. All of our new collections are deposited at FT, MO, PMA and SCZ herbaria. For SEM investigation, dried leaf fragments (5–10 mm), female florets and elaiosomes were taken from herbarium specimens (see figure captions for voucher details), mounted on standard stubs with double-sided adhesive tape, and examined with a Quanta 200 Esem (Fei) scanning microscope, at 1–30 kv. Original drawings were prepared by Mrs. Anne Maury (Florence, Italy).

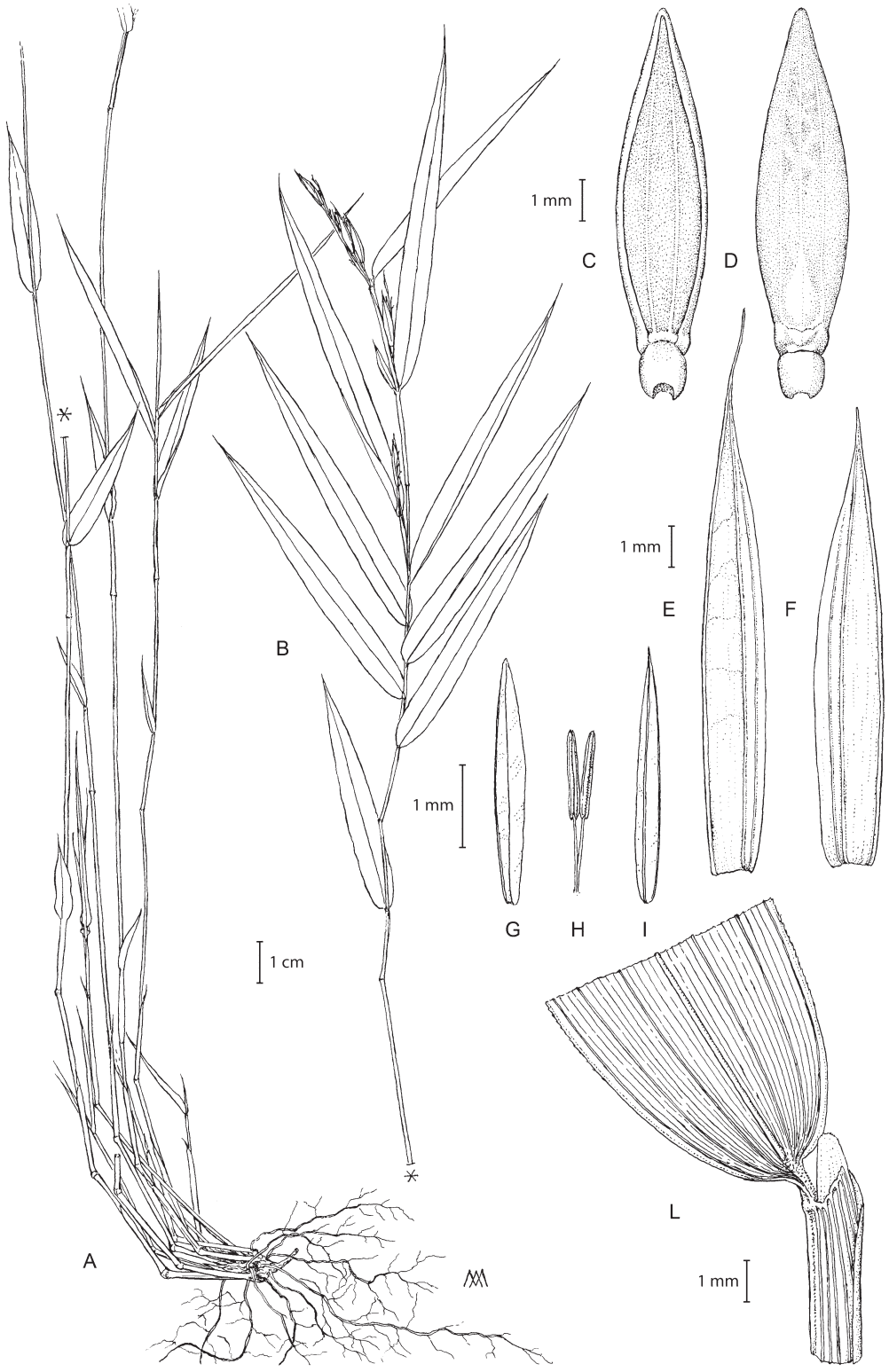

FIGURE 1. *Cryptochloa stapfii* Baldini & Ortiz: Panama, Bocas del Toro, *M.S. Stapf 865, R.M. Baldini R. & O.O. Ortiz* (from holotype, PMA). A. Habit, basal part. B. Habit, upper part with slender inflorescences. C. Female floret (ventral view). D. Female floret (dorsal view). E. Lower glume of female floret. F. Upper glume of female floret. G. Lemma of male floret. H. Stamens. I. Palea of male floret. L. Basal leaf blade with ligule. Illustration by Anne Maury.

Taxonomy

Cryptochloa stapfii Baldini & O. Ortiz, *sp. nov*. (Figs. 1–2)

A C. dressleri foliis intense viridis, raro purpureis, linearis angustatis, et maturitatem dispositione lemmatatum florum femineorum ad basim nunquam mutue supraimposita, filamentibus antherarum longioribus.

Type:—PANAMA. Bocas de Toro, Camino Rambala-Platanarito, E de Rambala, área semi-sombreada, 8°55'28"N 82°09'53"W, 85 m, 21 January 2012, *M.S. Stapf, R.M. Baldini R. & O.O. Ortiz 865* (holotype PMA!, isotypes FT!, MO!, SCZ!).

FIGURE 2. *Cryptochloa stapfii* Baldini & O. Ortiz, in its habitat at the type locality (Panama: Bocas del Toro, Camino Rambala-Platanarito, E de Rambala) Photo: Riccardo M. Baldini.

Perennial, short-rhizomatous, delicate, 5–15(–20) culms, 20–40 cm tall. Leaves narrowly lanceolate, green, rarely purplish, 3–7 cm long, 0.3–0.6 cm wide, ligule truncate, glabrous, prominent, 5.5–6 mm long. Monoecious. Inflorescences paniculiform, 2–3 at the upper nodes of each terminal leaf, simply exserted, generally sticking along the axis, with 1 terminal female spikelet and few lateral spikelets with 1 branch of 3–5 male spikelets, borne in the lower part of the rachis, or at the end of the inflorescence. Female spikelet: glumes green, glabrous, scabrous at the margin, lower glume glabrous, 9–11(–11.5) mm long, aristate, awns up to 2.5 mm long, upper glume acuminate, 8–10 mm long. Lemma 8–9 mm long; palea narrowly ovate, 2-nerved, acute at the apex, margins not folding toward at the base at maturity; lodiculae 3, sometimes reduced to 2, glabrous, slightly coriaceous. Male spikelets: deciduous after anthesis, glumes lacking, lemma glabrous, elliptic, linear not curved at the apex, palea glabrous; lodiculae 3, fleshy; stamens 2, anthers basifixed**,** 2 mm long, filaments 0.8–2 mm long. Fruit: caryopsis, elliptic.

Etymology:—This species is dedicated to Maria Stapf, expert botanist of the Flora of Panama.

Distribution:—*Cryptochloa stapfii* is known only from the type locality on Bocas del Toro (Panama), around Chiriquí Grande and its surroundings (Fig. 3).

Habitat and Ecology:—This species is present in moist forest remnants on steep slopes, in semi-shaded areas (Fig.

4). *Cryptochloa stapfii* grows in an area of very wet tropical forest according to the classification of zones proposed by Holdridge *et al.* (1971), in association with *Miconia ampla* Triana (1871: 10, Melastomataceae), *Neonicholsonia watsonii* Dammer (1901: 179, Arecaceae), *Calyptrogyne pubescens* de Nevers (1995: 336, Arecaceae), *Ichnanthus pallens* (Swartz 1788: 23) Munro ex Bentham (1861: 414, Poaceae) and *Arberella lancifolia* Soderstrom & Zuloaga (1985: 25, Poaceae) and others species of the Arecaceae family.

FIGURE 3. Distribution of *Cryptochloa stapfii* Baldini & Ortiz in Panama. Star: type locality (holotype). Square: Paratype, *B. Hammel, G. McPherson & L. Sanders 14746* (MO, PMA).

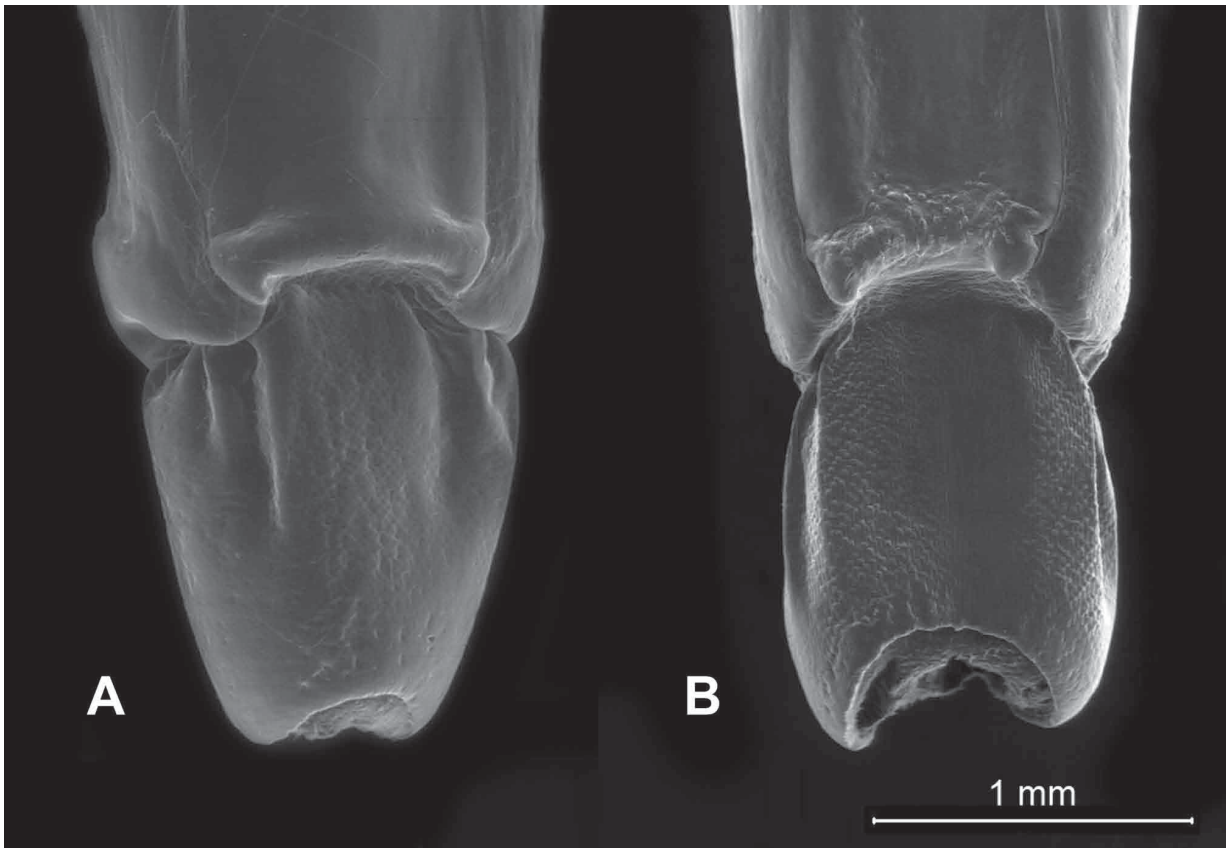

FIGURE 4. Rachillas of the internode of the anthecium (elaiosomes). A. *Cryptochloa dressleri* B. *C. stapfii.*

Phenology:—Flowering and fruiting throughout the year, with a peak in the dry season (January–March).

Conservation status:—This species is notable for its reduced geographical range and small population size. It is endangered, being not yet protected and subjected to habitat degradation as a result of the forest cutting and agricultural activities in its area of distribution. We suggest it be considered in the CR B2ab(iii) category according to the IUCN Red List Criteria (IUCN 2001).

Additional specimens examined (paratypes):—PANAMA. Bocas del Toro, hill just S of Chiriquí Grande, at end of pipeline access road 2 mi N of 2nd large bridge N (10 mi) of continental divide, in forest along ridge & draws, 350–500 m asl, 8°54'N 82°10'W, 10 March 1986, *Hammel, McPherson & Sanders 14746* (MO, PMA) [this specimen bears a comment by G. Davidse (MO) about its unusual leaf morphology]; Carretera hacia Chiriquí Grande, Rambala, Platanarito, 8°55'28"N, 82°90'53"W, 2 February 2014, *Ortiz, Baldini & Galdames 1995* (BM, FT, K, PMA).

Discussion:—*Cryptochloa stapfii* is an endemic species closely related to *C. dressleri*, with which it shares the presence of two rather than three stamens as in the rest of the species in the genus (Soderstrom 1982a). *Cryptochloa stapfii* differs from *C. dressleri* in its narrow green leaves, not deeply purplish as in *C. dressleri*. Soderstrom (1982a) discussed the role of the purplish color of leaves in tropical plants, especially in herbaceous bamboos, in enhancing the capture of light in shaded habitats (Lee *et al.* 1979). While *Cryptochloa dressleri* has this feature, in accordance with its typical shaded habitat, *C. stapfii*, with green leaves, seems to have evolved a different adaptation to the semi-shaded habitats to which it is restricted along the edge of the mist forest, where it receives more intense sunlight. During three years of field observations in Bocas del Toro area of five different populations at different times of the year, *C. stapfii* always showed the same green coloration. The main morphological distinguishing features in *C. stapfii* and *C. dressleri* are given in the Table 1.

During our field trips in Panama, we have observed that small dipteran insects visit some herbaceous bamboos (i.e., *Arberella lancifolia, Pariana argentea* Hollowell & Davidse in Davidse & Pohl 1992: 98) and presumably also species of *Cryptochloa*, confirming the role of insect pollination in the herbaceous bamboos (Soderstrom & Calderón 1979). However, the role of insect pollination in *Cryptochloa* needs more evidence to be accepted. The presence of elaiosomes confirms and enforces the role of ants in fruit dispersal in the new species (Davidse 1987, Bronstein *et al.* 2006, Lengyel *et al.* 2010). Dispersal of diaspores via elaiosomes has also been suggested for some panicoid genera (Davidse 1987), including genera occupying the same habitat as *Cryptochloa*, including *C. stapfii*, such as *Ichnanthus* Palisot de Beauvois (1812: 56). Species in the bamboo tribe Olyreae are monoecious with very reduced male spikelets, while the female spikelets are frequently and clearly modified, with an elongated and solid internode present between the glumes and the floret. This internode is made of a tissue that produces oils at fruit maturity, and has a function similar to an elaiosome (Davidse 1987, Judziewicz 1990). The elaiosomes of *C. stapfii* and *C. dressleri* (Fig. 4, cf. Table 1) differ (papillate vs. not papillate), and this feature may be worth investigating more carefully throughout the genus as a source of taxonomic characters.

TABLE 1. Characters distinguishing *Cryptochloa dressleri* from *C. stapfii.*

	Cryptochloa dressleri	***Cryptochloa stapfii***
Leaves		
Color	Purplish to burgundy	Green, rarely purplish
Blade size	8–14 × 0.8–2.0 cm	3–7 × 0.3–0.6 cm
Ligule length	3–5 mm	5.5–6 mm
Prickles on abaxial surface	Present	Absent
Papillae on abaxial surface	Reticulate	Linear
Siliceous bodies on adaxial surface	Thin and continuous	Thick and alternate
Female spikelet		
Lower glume awn length	Up to 1–2 mm	Up to 2.5 mm
Lower glume length	8–9(–10) mm	9–11(–11.5) mm
Upper glume length	6–9 mm	8–10 mm
Lemma length	6–8 mm	8–9 mm
Palea shape	Ovate	Narrowly ovate
Male spikelet		
Lemma shape	Elliptic, curved at the apex	Elliptic to linear, not curved at the apex
Stamens		
Anther length	1.3 mm	2 mm
Filament length	0.4–0.5 mm	0.8–2 mm
Rachilla internode (*elaiosome*) of the anthecium	Not papillate	Papillate

Comparative leaf morphology between *C. dressleri* and *C. stapfii* clearly shows some differences (Fig. 5), such as the absence of prickles on the abaxial leaf surface in *C. stapfii*, and their presence in *C. dressleri* (Jaén *et al.* 2013, Jaén 2014). The siliceous bodies in the adaxial leaf surface are reticulately arranged in *C. dressleri* and linear in *C. stapfii*. Discovery of *C. stapfii* brings the number of species of *Cryptochloa* in the Flora of Panama to eight (Table 2), considering the present unresolved taxonomical status of *C. granulifera* Swallen in Woodson & Schery (1942: 321). The exact number of the species in the entire genus will only be known upon completion of an on-going taxonomical revision of the genus by us.

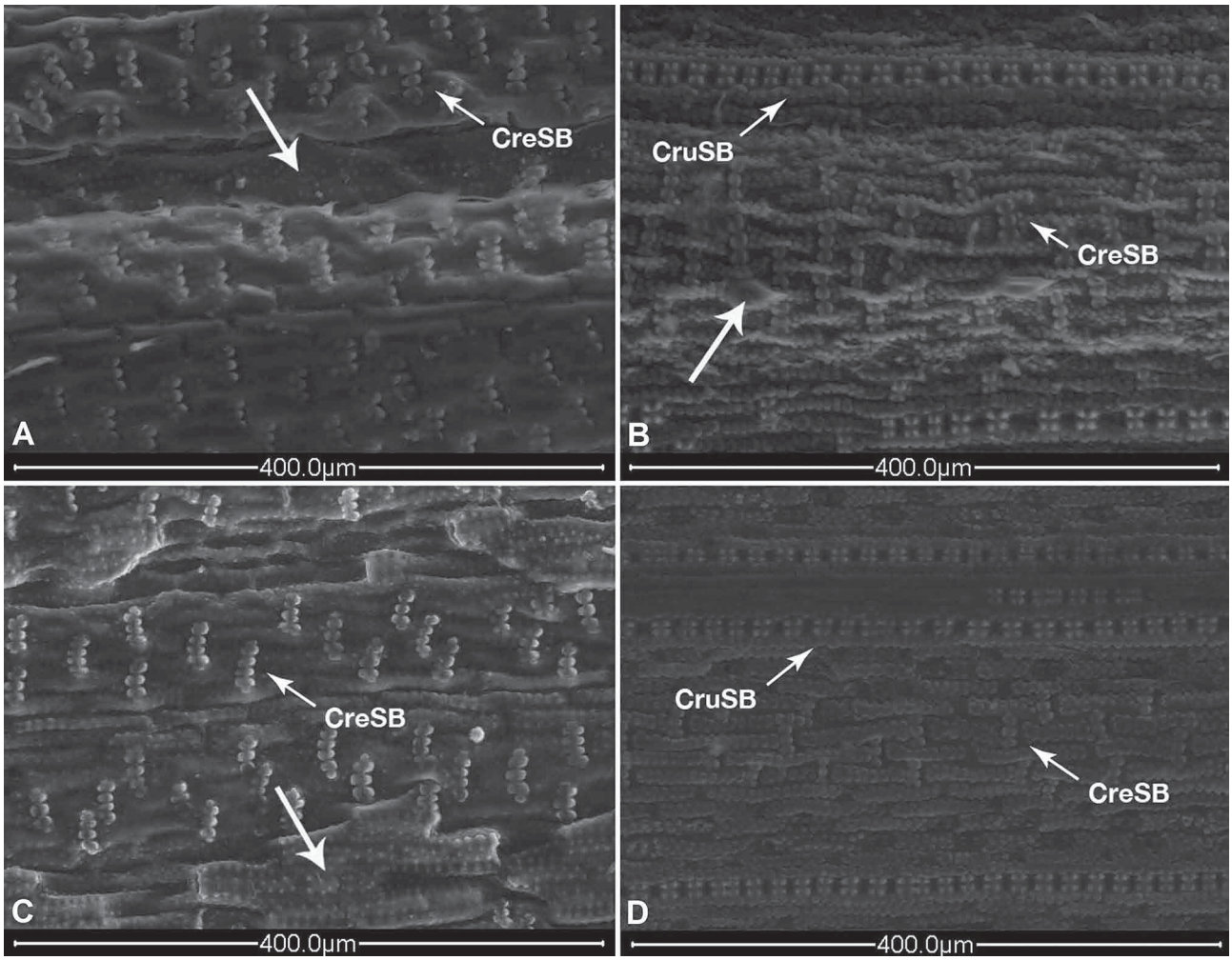

FIGURE 5. Comparison of leaf morphology between *Cryptochloa dressleri* and *C. stapfii*. A. *C. dressleri*, adaxial leaf surface, with linear rows of bulliform cells (large arrow), and crenate (olyroid) silica bodies (CreSB). B. *C. dressleri*, abaxial leaf surface, with prickles (large arrow), crenate (olyroid) silica bodies (CreSB), and cruciform silica bodies (CruSB). C. *C. stapfii*, adaxial leaf surface with irregular rows of bulliform cells (large arrow) and crenate (olyroid) silica bodies (CreSB). D. *C. stapfii*, abaxial leaf surface without prickles, crenate (olyroid) silica bodies (CreSB), and cruciform silica bodies (CruSB). Specimens: *C. dressleri* (*Stapf et al. 785*, FT, PMA, SCZ), *C. stapfii* (*Stapf et al. 865*, FT, PMA, SCZ).

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TABLE 2. Synopsis of the geographic distribution of species of *Cryptochloa*. Data according to Judziewicz *et al.* (2000), Correa *et al.* (2004), TROPICOS (2014), herbarium data (MO, US) and unpubl. data. (*) means a taxon of uncertain taxonomic status, but according to Davidse (1994) this species must be considered a synonym of *Cryptochloa strictiflora* (Fournier 1876: 465) Swallen in Woodson & Schery (1942: 321).

Taxon	Distribution
Cryptochloa capillata	Brazil, French Guiana
=*Olyra capillata*	
Cryptochloa concinna (Hooker f. 1896: t. 7469) Swallen in Woodson & Schery (1942: 320)	Belize, Colombia, Costa Rica, Ecuador, Guatemala, Honduras, Mexico, Nicaragua, **Panama** and Peru
=*Olyra concinna*	
=*Raddia concinna* (Hooker f.) Chase (1908: 185)	
Cryptochloa decumbens	**Panama (**endemic)
Cryptochloa dressleri	**Panama** (endemic)
* ***Cryptochloa granulifera***	Costa Rica, Ecuador, Guatemala, Honduras, Mexico, **Panama**
Cryptochloa soderstromi	**Panama** (endemic)
Cryptochloa strictiflora	Belize, Honduras, Mexico, Nicaragua Honduras, Costa Rica, **Panama**,
=*Strephium strictiflorum*	Ecuador
Cryptochloa stapfii	**Panama** (endemic)
Cryptochloa unispiculata Soderstrom (1982b: 200)	Brazil, Colombia, Bolivia, Ecuador, **Panama** (*unpubl. data*), Peru
Cryptochloa variana Swallen in Woodson & Schery (1942: 318)	Caribbean, Colombia, Honduras, **Panama**

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