

**UNIVERSIDADE FEDERAL DO RIO GRANDE DO SUL
INSTITUTO DE BIOCÊNCIAS**

EDUARDO VALDUGA

***CROTON* (EUPHORBIACEAE) IN THE PAMPAS GRASSLANDS**

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CROTON (EUPHORBIACEAE) IN THE PAMPAS GRASSLANDS

EDUARDO VALDUGA

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Orientador: Prof. Dr. João Ricardo Vieira Iganci
Co-orientadora: Profa. Dra. Inês Sandoná Cordeiro

Comissão examinadora:

Dra. Letícia Ribes de Lima – UFAL

Dr. Sérgio Augusto de Loreto Bordignon – Universidade La Salle

Dra. Sílvia Teresinha Sfoggia Miotto – UFRGS

Suplentes:

Dr. Felipe Gonzatti – UCS

Dr. Gustavo Heiden – Embrapa Clima Temperado

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RESUMO

O gênero *Croton* L. está representado por 1.200 espécies, sendo o segundo maior gênero da família Euphorbiaceae. O Brasil possui a maior diversidade de *Croton*, com aproximadamente 350 espécies. O gênero é cosmopolita, porém, sua maior diversidade está nas regiões tropicais e subtropicais. *Croton* pode ser facilmente reconhecido por caracteres que incluem o indumento de tricomas estrelados ou lepidotos, látex colorido, folhas frequentemente com glândulas no ápice do pecíolo, junto à lâmina foliar e inflorescências terminais, geralmente com as flores estaminadas dispostas no ápice e as pistiladas na base. Devido ao elevado número de espécies, ampla distribuição geográfica e grande diversidade morfológica, o gênero é considerado um grupo de alta complexidade taxonômica. Apesar de o Brasil ser um dos centros de diversidade para *Croton*, poucos são os trabalhos com o gênero no Pampa. No sul da América do Sul, especialmente no bioma Pampa, os últimos estudos abrangentes são da década de 1990, restando ainda muitas lacunas de conhecimento sobre a diversidade e a distribuição das espécies. Desta forma, o objetivo da presente tese foi contribuir para o conhecimento da diversidade de *Croton* no sul da América do Sul, através do reconhecimento das espécies do gênero para possibilitar a sua identificação com uma chave dicotômica, propiciando que a comunidade científica e gestores ambientais possam ter acesso a este conhecimento de forma unificada. Na presente tese, estudamos as espécies de *Croton* ocorrentes no bioma Pampa, o qual inclui parte da Argentina, sul do Brasil e o Uruguai, através de um estudo florístico-taxonômico. Foram realizadas coletas de material botânico em campo, priorizando as áreas geográficas pouco amostradas. Ao mesmo tempo, foram realizadas revisões das coleções de herbários. Análises morfológicas foram realizadas para circunscrever as espécies. No primeiro artigo, apresentamos *C. allemii* como sinônimo de *C. triqueter*, *C. stenotrichus* como sinônimo de *C. hilarii* e um lectótipo para *C. stenotrichus*. *Croton lombardianus* é apresentado como um novo registro para o Brasil e *C. macrobothrys* como um novo registro para a Mata Atlântica no estado do Rio Grande do Sul. Também são fornecidas informações atualizadas sobre a distribuição geográfica dessas espécies. No segundo artigo, apresentamos *Croton bacupariensis*, uma nova espécie endêmica da planície costeira do Pampa. No terceiro artigo, foram confirmadas 31 espécies de *Croton* ocorrentes no Pampa, todas incluídas em uma chave de identificação, três espécies foram atribuídas como sinônimos e, em seguida, comentários sobre suas características diagnósticas são fornecidos. Das 31 espécies de *Croton* presentes no Pampa, 16 espécies foram designadas como endêmicas. Além disso, mapas de distribuição e fotografias são apresentados para a maioria das espécies.

Palavras-chave: América do Sul, espécies sul-americanas, nomenclatura, novos registros, taxonomia.

ABSTRACT

The genus *Croton* L. is represented by 1,200 species, being the second largest genus in the Euphorbiaceae family. Brazil presents the greatest *Croton* diversity, with approximately 350 species. The genus is cosmopolitan; however, its greatest diversity is in tropical and subtropical regions. *Croton* can be easily recognized by characters that include the indument of stellate or lepidote trichomes, colored latex, leaves often with glands at the apex of the petiole, along the leaf blade and terminal inflorescences, usually with staminate flowers arranged at the apex and pistillate at the base. Due to the high number of species, wide geographic distribution and great morphological diversity, the genus is considered a group of high taxonomic complexity. Despite Brazil being one of the centers of diversity for *Croton*, there are few works with the genus in the Pampas grasslands. In southern South America, especially in the Pampas grasslands, the latest comprehensive studies date back to the 1990s, with many gaps still remaining on the knowledge of diversity and distribution of species. Thus, the objective of this thesis was to contribute to the knowledge of *Croton* diversity in southern South America through the recognition of species of the genus to enable its identification with a dichotomous key, providing the scientific community and environmental managers with this knowledge in a unified way. In the present thesis, we study *Croton* species occurring in the Pampas grasslands, which includes part of Argentina, southern Brazil and Uruguay, through a floristic-taxonomic study. Collections of botanical material were carried out in the field, prioritizing geographical areas that were poorly sampled. At the same time, revisions of herbarium collections were carried out. Morphological analyzes were performed to circumscribe the species. In the first article, we present *C. allemii* as a synonym for *C. triqueter*, *C. stenorichus* as a synonym for *C. hilarii* and a lectotype for *C. stenorichus*. *Croton lombardianus* is presented as a new record for Brazil and *C. macrobotrys* as a new record for the Atlantic Forest in the state of Rio Grande do Sul. Updated information on the geographic distribution of these species is also provided. In the second article, we present *Croton bacupariensis*, a new species endemic to the coastal plain of the Pampas grasslands. In the third article, 31 species were compiled for the Pampas grasslands, all included in an identification key, three species were assigned as synonyms, and then comments on their diagnostic characteristics are provided. Of the 31 *Croton* species present in the Pampas, 16 species were designated as endemic. In addition, distribution maps and photographs are presented for most species.

Keywords: New records, nomenclature, South America, South American species, taxonomy.

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INTRODUCTION

The Euphorbiaceae Juss. family has approximately 6,300 species distributed in 246 genera (Wurdack & Davis, 2009). Since the first taxonomic studies on Euphorbiaceae, the family is divided into five subfamilies (Webster, 1975; 1994), based mainly on the number of seminal rudiments per loculus. Phyllanthoideae and Oldfieldioideae have two seminal rudiments per loculus, while Acalyphoideae, Crotonoideae and Euphorbioideae have only one seminal rudiment per loculus. Other characters used are the presence or absence of latex, type of laticiferous, type of indument and pollen grain morphology. Euphorbiaceae s.s. includes only subfamilies with one seminal rudiment per loculus, those with two seminal rudiments per loculus being segregated in the families Phyllanthaceae, Picrodendraceae and Putranjivaceae (Chase *et al.*, 2002; Wurdack *et al.*, 2005).

The genus *Croton* L. comprises approximately 1,200 species, being the second largest genus of Euphorbiaceae (Govaerts *et al.*, 2000; Berry *et al.*, 2005b), and the 11th largest genus of angiosperms (Frodin, 2004). The genus belongs to the subfamily Crotonoideae, which comprises about 2,400 species grouped into 67 genera and 12 tribes. The Neotropical Region is the richest in species for *Croton*, with the main centers of diversity in Brazil, Antilles, Mexico and Madagascar (Burger & Huft, 1995; Berry *et al.*, 2005b). Brazil has the greatest diversity for *Croton*, with approximately 350 species (Webster, 1994; Berry *et al.*, 2005b; Silva *et al.* 2020).

In phylogenetic analysis performed by Berry *et al.* (2005a), using molecular data from the ITS, from the nuclear ribosomal DNA, and from the trnL-F fragment from the plastid DNA, it was demonstrated that *Croton*, as circumscribed by Webster (1993), is not a monophyletic taxon. Studies based on molecular data (Berry *et al.*, 2005a, b; Wurdack *et al.*, 2005), showed different results on the affinities of *Croton* within the subfamily, which includes *Ophellantha* Standl. (Central America and the Caribbean), *Sandwithia* Lanj. (Guianas and Amazonia), *Sagotia* Baill. (Amazonia) and *Brasiliocroton* P.E.Berry & Cordeiro, the last genus described for eastern Brazil (Berry *et al.*, 2005a), in addition to *Astraea* Klotzch (Neotropical), a genus reestablished by Berry *et al.* (2005a) based on *Croton* sect. *Astraea* (Klotzsch) Baill. *Croton* differs from these genera

by presenting the folding of the fillets in the floral bud, associated with the thyrsoid inflorescences, and the reduced petals in the pistillate flowers (Berry *et al.*, 2005b; Wurdack *et al.*, 2005). The genus *Julocroton* Mart., recognized in earlier studies on Euphorbiaceae, such as Prodrômus de De Candolle (Müller 1866) and Flora Brasiliensis (Müller 1873), was synonymized by Webster (1992), and treated as a section of *Croton*. The studies by Berry *et al.* (2005a, b) and Wurdack *et al.* (2005), phylogenetically justified the synonymization of *Julocroton* into *Croton*, and also demonstrated the need to exclude *Croton* sect. *Astraea* (Klotzsch) Baill., in order to make *Croton* monophyletic. These phylogenetic analyses, in addition to the following recircumscriptions (Berry *et al.*, 2005a), showed the need for a reassessment of the infrageneric classification of *Croton*, as the sections presented by Webster (1993) were mostly not monophyletic. After Berry *et al.* (2005b), other phylogenetic studies have contributed to produce a more consistent infrageneric classification of *Croton* (Van Ee *et al.*, 2008; 2011; Riina *et al.*, 2009; 2010; Van Ee & Berry, 2009; 2010; 2011; Caruzo *et al.*, 2011).

Croton has a high morphological diversity, ranging from herbs, shrubs, trees to rarely lianas, and occupies a wide range of habitats. The species have a great variety of trichomes, for example, simple, stellate, dendritic and lepidote, glandular or not, which are the most important morphological characters for species delimitation (Lucena & Sales, 2005). The genus is found in almost all vegetation types, but many species grow in areas of dry and open vegetation and disturbed areas (Caruzo *et al.*, 2011). The species are easily recognized in the field due to a set of characters that include conspicuous, starry or lepidote trichomes, thyrsoid inflorescences, transparent or colored latex, petiolar glands, and orange senescent leaves (Riina *et al.*, 2009). Burger & Huft (1995) in the review for *Croton* in Costa Rica, noticed that some species are widely distributed while others have a specific geographic distribution, are endemic. This wide distribution of some species, in contrast with other endemic ones, is the norm for the genus in many areas of the Tropics.

The genus is rich in secondary metabolites such as alkaloids, terpenoids and cocarcinogens (Jones, 2003). *Croton* shares with other lineages of the Crotonoideae subfamily, unopened pollen grains, with exine ornamentation named the *Croton* pattern. This pattern was defined by Erdtman (1952) and designates pollen grains that present triangular or more or less circular outgrowths supported by a baculated, baculoid or spongy layer. This is an unusual feature amongst angiosperms and is present in most genera of the subfamily Crotonoideae (Nowicke, 1994). With a high number of species,

wide geographic distribution and considerable morphological diversity, the genus can be considered of high taxonomic complexity, challenging to be studied, even with molecular data (Riina *et al.*, 2009; Van Ee *et al.*, 2011).

According to Carneiro-Torres (2009), the greatest difficulty in the study of *Croton* is in the circumscription of its species, especially those with a wide geographic distribution, which in general are the most polymorphic. This combination of factors often led to the publication of several binomials for the same species, generating many nomenclatural and typification problems that are difficult to solve. There are many studies with Brazilian species of *Croton*, however, those from the states of Mato Grosso, Goiás, part of the Brazilian Amazon (Pará, Amazonas, Amapá and Roraima), Rio Grande do Sul and Paraná, especially those with herbaceous habits, need taxonomic review (Secco *et al.* 2012). For southern South America, studies with the genus are scarce, even more the works that include species from the Pampas grasslands. Klein (1977) presented descriptions and comments on the ecology of 27 species of the genus occurring in the state of Santa Catarina; Allem (1978) presented a preliminary study about the genus in the state of Rio Grande do Sul. Smith *et al.* (1988) for the Flora Ilustrada de Santa Catarina, and Allem (1979) proposed four new species and a new section (*Calycireduplicatae* Allem) of *Croton* for the state of Rio Grande do Sul. Ahumada (1991) revised and described southern cone species, and Berry *et al.* (2008), produced the “Catálogo de las plantas vasculares del Cono Sur” (including Argentina, southern Brazil, Chile, Paraguay and Uruguay). None of these studies included all the Pampas grasslands species of *Croton*, which makes their identification difficult.

AIMS

With collections and revisions of herbaria, an attempt was made to elucidate the taxonomy of *Croton* species occurring in the Pampas grasslands and boundary region.

FRAMEWORK OF THE THESIS

The thesis is composed by a general introduction, three chapters in the form of manuscripts, where one is already published as part of the thesis and the other two are unpublished, and a general conclusion. The chapters content is listed bellow:

- **Chapter 1.** This chapter presents a new record of *Croton* species reported for Brazil and a new record for the Atlantic Moist Forest in the state of Rio Grande do Sul. In addition, updated information on the geographic distributions of these species was also provided.
- **Chapter 2.** The second part of the thesis is the description of a new species, *C. bacupariensis*, discovered during a fieldwork in southern Rio Grande do Sul state, Brazil. The species is described, illustrated and its extinction risk is assessed.
- **Chapter 3.** The last part of the thesis presents a synopsis of *Croton* in the Pampas grasslands, including a nomenclatural revision based on herbarium material analyses and revision of protologues. This chapter provides updated taxonomic information, distribution maps and photos of the studied species. Main results include the designation of six lectotypes, five new synonyms and an identification key for the Pampas grasslands species.

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Novelties in *Croton* (Euphorbiaceae) from southern South America

EDUARDO VALDUGA^{1*}, MARTIN MOLZ², INÊS CORDEIRO³ & JOÃO IGANCI^{1,4}

¹*Universidade Federal do Rio Grande do Sul, Instituto de Biociências, Programa de Pós-Graduação em Botânica, 9500, Agronomia, Porto Alegre—RS, Brazil.*

²*Museu de Ciências Naturais, Rua Doutor Salvador França Jardim Botânico 90690000, Porto Alegre—RS, Brazil.*

³*Instituto de Botânica, Av. Miguel Stéfano, 3687, São Paulo, 04301902, SP, Brazil.*

⁴*Universidade Federal de Pelotas, Departamento de Botânica, Campus Capão do Leão, 354, 96010900, Pelotas—RS, Brazil.*

*Author for correspondence, email: valduedu10@yahoo.com.br

Abstract

During a taxonomic revision of the genus *Croton* from the Pampas grasslands, some necessary taxonomic adjustments were identified and are here presented. The study was based on new collections, field work and analyses of protologues and type specimens. We treat *C. allemii* as a synonym of *C. triqueter*, *C. stenotrichus* as a synonym of *C. hilarii*, and we designate a lectotype for *C. stenotrichus*. *Croton lombardianus* is newly reported for Brazil and *C. macrobothrys* as a new record for the Atlantic Rainforest in the state of Rio Grande do Sul. Updated information on the geographic distributions of these species is also provided.

Resumo

Durante o estudo taxonômico do gênero *Croton* para o Pampa, alguns ajustes taxonômicos necessários foram identificados e são apresentados aqui. O estudo foi baseado em novas coleções, trabalhos de campo e análises de protólogos e espécimes tipo. Apresentamos *C. allemii* como sinônimo de *C. triqueter*, *C. stenotrichus* como sinônimo de *C. hilarii* e os lectótipos para *C. stenotrichus* e *C. macrobothrys*. *Croton lombardianus* é apresentado como um novo registro para o Brasil e *C. macrobothrys* como um novo registro para a Mata Atlântica no estado do Rio Grande do Sul. Também são fornecidas informações atualizadas sobre a distribuição geográfica dessas espécies.

Key words: Argentina, grasslands, Pampas, Rio Grande do Sul, Uruguay

Introduction

Croton Linnaeus (1753: 1004) comprises about 1,200 species, being the second largest genus of Euphorbiaceae (Govaerts *et al.* 2000, Berry *et al.* 2005), and the eleventh largest genus of angiosperms (Frodin 2004). It occurs in almost all tropical and subtropical areas worldwide (Van Ee *et al.* 2011). The species of *Croton* are trees, shrubs, subshrubs, herbs or scandent shrubs, usually monoecious, rarely dioecious. The indumentum is mostly composed of stellate or lepidote trichomes. The thyrsoid inflorescences have pistillate flowers in proximal cymules and staminate ones in distal ones. The filaments are inflexed in bud and the petals of the pistillate flowers are reduced, obsolete or absent (Secco & Berry 2013).

Recent taxonomic studies in *Croton* from southern South America are mostly composed of regional floras, including Smith *et al.* (1988), for the state of Santa Catarina, Allem (1978) for the state of Rio Grande do Sul, the “Flora Ilustrada Catarinense” (Smith *et al.* 1988), Allem (1979), Ahumada (1991), and the “Catálogo de las plantas vasculares del Cono Sur” (including Argentina, southern Brazil, Chile, Paraguay and Uruguay) (Berry *et al.* 2008).

According to Carneiro-Torres (2009), in addition to the large number of species, the greatest challenge in *Croton* is the circumscription of widely distributed species, which are often polymorphic. Thus, taxonomic confusion related to the morphological variability has led to the publication of superfluous names for a number of species in the genus. As part of a taxonomic revision of *Croton* from the Pampas grasslands that is currently underway, we present nomenclatural and taxonomic novelties for *Croton* species from southern South America.

Material and Methods

The Pampas is one of the largest continuous grasslands area in the Americas, and they occupy around 750,000 km² (28°–38°S, 50°–61°W) (Soriano 1992). This biome covers the plains of central-eastern Argentina, the entire territory of Uruguay and part of southern Brazil. In Argentina, also called Rio de La Plata Grasslands, it includes a

region near the capital Buenos Aires, Córdoba, Corrientes, Entre Ríos, La Pampa, Misiones, Santa Fé and San Luis provinces (Andrade *et al.* 2018). The Brazilian area of the Pampas is found mostly in the southern half of the Rio Grande do Sul state (Iganci *et al.* 2011). Besides grasslands that are dominant in Pampa, forest formations are also present mainly along riverbanks (Oliveira-Filho *et al.* 2013).

A list of *Croton* species recorded from the Pampas grasslands was compiled based on taxonomic and floristic publications and study of over 200 collections from the herbaria CORD, CTES, CTESN, FURB, HAS, HUCS, ICN, LP, MPUC, MVFA, MVJB, MVM, PACA, SI, SP and UNR, and digital images of A, B, F, G, K, MPU, P and US (acronyms according to Thiers 2019, continuously updated). All protologues and images of type collections were checked in online databases: JSTOR Plants (<http://plants.jstor.org>), Reflora Herbário Virtual (2020), speciesLink (2020); the International Code of Nomenclature for algae, fungi, and plants (Turland *et al.* 2018) was followed to solve the nomenclatural and taxonomic problems, in particular the recommendation 9A for lectotypifications. Type localities are cited as indicated in the specimens' labels.

Results

Croton hilarii Baillon (1864: 322). Type:—URUGUAY. Rocha: Cerro Aspero, 1816, A. St. Hilaire Catal. C2 #2069ter (holotype P 00623552 [digital image!]).

Croton stenotrichus Müller Argoviensis (1865: 105), **syn. nov.** Type:—BRAZIL. “In Brasilia meridional”, F. Sellow 2571 (lectotype B 100127733!, designated here; isolectotype A 00277230! [digital image!]).

Notes:—Although Müller (1865) did not mention the number of Sellow's collection in his protologue of *C. stenotrichus*, it is likely that he observed *Sellow 2571*. The analysis of the types and many collections showed that it is not possible to distinguish *C. stenotrichus* from *C. hilarii*. Both species occur in southern South America, have 12–20 stamens and 2-fid styles, hirsute leaves with stellate trichomes on both sides, more tomentose on the abaxial face and two glands at the base. The presence of glands is not mentioned in the protologues, and they may be inconspicuous in some collections, but they can be clearly seen in the type collections of *C. hilarii* and *C. stenotrichus*. Thus, *C. stenotrichus* is considered here to be a synonym of *C. hilarii* due their

overlapping characteristics. *Croton hilarii* [sect. *Adenophylli* Grisebach (1859: 40)] is an infrequent subshrub in grasslands interspersed with forest on moist soils. This is a new report of the species for Brazil.

Selected specimens seen:—ARGENTINA. Salta: Dpto. Santa Victoria. Los Toldos, camino al Arazay, Tabaquillo, 01 July 1999, *N. Nilgert 2431* (SI). BOLIVIA: Tarija. Aniceto Arce, Comunidad Guayavillas, 23.6 km S of Podcaya on road to Bermejo, Isolated pocket of moist forest dominated by Myrtaceae on W side Serranias de Cerrillos, 27 April 1983, *J. C. Solomon 10184* (SI). BRAZIL. Rio Grande do Sul: São Francisco de Paula, Tainhas, 05 January 2018, *E. Valduga 834* (ICN). URUGUAY. Cerro Largo: Paso de Tia Lucia a Fraile Muerto, 11 November 1965, *B. R. Arrilaga et al. 2439* (MVFA).

Croton lombardianus Croizat (1942: 1).

Type:—URUGUAY. “Montevideo: Malvin en arenales”, November 1925, *A. Lombardo 228* (holotype A 00047334 [digital image!]). Fig. 1.

Notes:—*Croton lombardianus* [sect. *Barhamia* Klotzsch (1853: 104)] was described from Uruguay in sandy soils of the Rio de La Plata coast. However, it was recently found in Rio Grande do Sul state, Brazil, in the municipalities of Mostardas (*E. Pasini 227a*, HUUCS), and Palmares do Sul, around Lagoa da Porteira (*F. Gonzatti 261*, HUUCS). It was also found in the state of Santa Catarina, based in the collection *Reitz 880* (PACA, MO), previously treated as *C. serratus* Müller Argoviensis (1866: 647) by Smith *et al.* (1988). The collection from Santa Catarina has the leaves always serrate, unlike the collections from Rio Grande do Sul and Uruguay where leaves are rarely serrate. Since 1944, *C. lombardianus* has not been collected in Santa Catarina. All collections have flowers with ten stamens and multifid styles. The species grows in sandy soils from the coast of southern Brazil to Uruguay, around coastal lagoons, forming large populations in the open areas of coastal scrub. The branches are predominantly prostrate and their inflorescences ascending. This is a new species record for the states of Rio Grande do Sul and Santa Catarina.

Selected specimens seen:—BRAZIL. Santa Catarina: São João do Sul, Currealinhos, 07 December 1944, *R. Reitz 880* (PACA, RB). Rio Grande do Sul: Palmares do Sul,

Lagoa da Porteira, 27 November 2011, *F. Gonzatti 261* (HUCS); Mostardas, 17 November 2007, *E. Pasini 227a* (HUCS). URUGUAY. Canelones: Carrasco, 06 November 1960, *B. Rosengurt 7781* (MVM). Maldonado: Las Delicias, 07 October 1965, *O. Del Puerto & E. Marchesi 5307* (MFVA). Montevideo: Arenas de Carrasco, 18 December 1934, *C. D. Legrand 220* (MVM); Carrasco; without further locality, 5 December 1915, *M. B. Berro 8386* (MVFA).

Croton macrobothrys Baillon (1864: 332). Type:—BRAZIL. Rio de Janeiro: without further locality, 1833, *A.-C. Vauthier 92* (lectotype P 00633413 [digital image!], designated by Caruzo *et al* (2016); isolectotype: P00633414!, P00633415! [digital images]., F barcode 0056158F!, MPU014844 [digital image]). Fig. 2.

Notes:—*Croton macrobothrys* [sect. *Cyclostigma* Grisebach (1859: 42)] is known from the Atlantic rain forest in the States of Alagoas to Santa Catarina (BFG 2015, Silva *et al.* 2020). During our fieldwork, a new population was found in the municipality of Itati, Rio Grande do Sul state (*E. Valduga 914*, ICN), which extends its range further south in Brazil. This species is a tree up to 20 m and shows reddish latex when the bark is damaged. In addition, it is easily identified by the reddish senescent leaves that fall off the tree, covering the soil (Fig. 2).

Selected specimens seen:—BRAZIL: Paraná: Adrianópolis, Parque Estadual das Lauráceas, 17 November 1999, *E. Barboza & L. M. Abe 400* (MBM). Cerro Azul, cabeceiras do Ribeirão do Tigre, 16 December 1992, *G. Hatschbach & O. S. Ribas 58455* (MBM). Rio Grande do Sul: Itati, Reserva Biológica Mata Paludosa, 06 January 2020, *E. Valduga 914* (ICN). Santa Catarina: Siderópolis, São Bento, 05 November 2009, *M. Verdi et al. 3045* (FURB).

Croton triqueter Lamarck (1786: 214).—*Julocroton triqueter* (Lam.) Didrichsen (1857: 134). Type:—BRAZIL. Rio de Janeiro: without further locality, without date, *P. Commerson s.n.* (holotype P00382045 [digital image!]; isotypes P00634801, P00634800, P00674036 [digital images!]).

Julocroton ramboi Smith & Downs (1959: 163), **syn. nov.**—*Croton allemii* Webster (1992: 271). Type:—BRAZIL. Santa Catarina: Itapiranga, 06 February 1951, *B. Rambo s.n.* (holotype PACA 49824!, isotype US 00109806 [digital image!]).

Notes:—*Croton allemii* [sect. *Julocroton* (Martius (1837: 119) Webster (196: 354)] is a new name for *Julocroton ramboi* published by Webster (1992). This was necessary once Webster (1967) reduced *Julocroton* to a section of *Croton*, and the epithet “ramboi” was already occupied by *Croton ramboi* Allem (1979: 3). According to Smith & Downs (1959), the differences between *C. allemii* and *C. triqueter* are the leaf base and stipule margin, respectively cordate and laciniate in the former and rounded and entire in the latter. The analysis of collections from the States of Paraná, Santa Catarina, Rio Grande do Sul, the type collection of *J. ramboi* and collections from Argentina revealed that leaf base is actually rounded and the stipule margin varies from entire to laciniate. Considering the wide distribution of *C. triqueter* in eastern Brazil (Silva *et al.* 2020) and the inconspicuous differences pointed out by Smith and Down (1959) between *C. triqueter* and *C. allemii* (*J. ramboi*), we now treat *Julocroton ramboi* and *Croton allemii* as synonyms of *C. triqueter*.

Selected specimens seen:—ARGENTINA. Misiones: Dept. 25 de Mayo, Ruta Prov. 2, entre el Saltito y Pto. Aurora, 26 February 1995, *F. O. Zuloaga et al.* 4984 (SI). BRAZIL. Rio Grande do Sul: Derrubadas, Parque Estadual do Turvo, estrada para o antigo Porto Garcia, 14 December 2017, *E. Valduga* 832 (ICN); Dom Pedro, de Alcântara, 13 January 2014, *F. Gonzatti* 1007 (HUCS). Paraná: Medianeira, Rio Ocuí, 09 February 1969, *G. Hatschbach* 21084 (MBM). Santa Catarina: Blumenau, Vila Nova, 27 July 2017, *L. A. Funez* 5443 (FURB).

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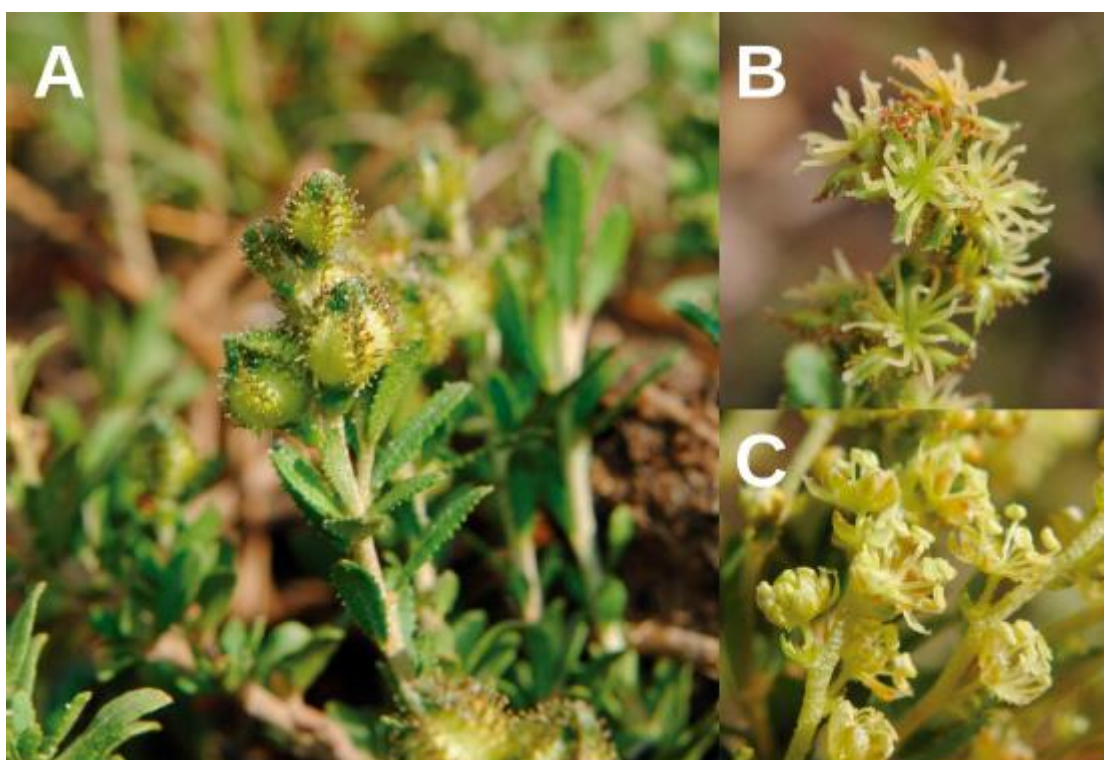


FIGURE 1. *Croton lombardianus*. A) Habit and pistillate flowers. B) Pistillate flowers showing the stigma. C) Staminate flowers. *F. Gonzatti 261*. Images by Andrés González.



FIGURE 2. *Croton macrobothrys*. A) Fruits. B) Deciduous leaves on the ground. C) Habit. E. Valduga 914. Images by Martin Molz.

CHAPTER II - *Croton bacupariensis* (Euphorbiaceae), a new species from the Coastal Plain of Rio Grande do Sul, Brazil.

Manuscript submitted in *Phytotaxa*

***Croton bacupariensis* (Euphorbiaceae), a new species from the Coastal Plain of Rio Grande do Sul, Brazil**

EDUARDO VALDUGA^{1,*}, INÊS CORDEIRO³ & JOÃO RICARDO VIEIRA IGANCI^{1,2}

¹*Universidade Federal do Rio Grande do Sul, Programa de Pós-Graduação em Botânica, Av. Bento Gonçalves, 9500, Agronomia, Porto Alegre—RS, Brazil.*

²*Universidade Federal de Pelotas, Instituto de Biologia, Campus Universitário Capão do Leão, Capão do Leão, Rio Grande do Sul, Brazil.*

³*Instituto de Botânica, Av. Miguel Stéfano, 3687, São Paulo, 04301902, SP, Brazil.*

**Author for correspondence, e-mail: valduedu10@yahoo.com.br*

Abstract

Croton bacupariensis, an endemic species from the coastal plain of the State of Rio Grande do Sul, southern Brazil, is described and illustrated. The new species shares morphological features with *Croton gnaphalii*, but differs mainly by the habit, indumentum of leaves and morphology of pistillate flowers. Besides *C. gnaphalii* occurs all over the Pampa's grasslands of Argentina, Uruguay and Rio Grande do Sul.

Keywords: Endemism, Morphology, southern Brazil, Taxonomy

Resumo

Croton bacupariensis, espécie endêmica da planície costeira do Rio Grande do Sul, é descrita e ilustrada. A nova espécie compartilha características morfológicas com *Croton gnaphalii*, mas difere principalmente pelo hábito, indumento das folhas e morfologia das flores pistiladas. Além disso *C. gnaphalii* ocorre por todo o Pampa nos campos da Argentina, Uruguai e Rio Grande do Sul.

Palavras-chave: Endemismo, Morfologia, sul do Brasil, Taxonomia

Introduction

Croton Linnaeus 1753: 1004. comprises approximately 1,200 species, being the second largest genus of the family Euphorbiaceae with a broad tropical to subtropical worldwide distribution in various habitats (Govaerts *et al.*, 2000; Berry *et al.*, 2005b; van Ee *et al.*, 2011, 2015), and the 11th largest genus of angiosperms (Frodin, 2004). Its high morphological variation and wide distribution create great difficulties for taxonomic studies (van Ee *et al.*, 2011). The main centers of diversity of *Croton* are located in the Neotropics: Brazil, Antilles and Mexico. (Burger & Huft, 1995; Berry *et al.*, 2005b). Brazil has the greatest diversity of *Croton*, with approximately 300 species and 37 of them have been recorded so far for the State of Rio Grande do Sul (Flora do Brasil 2020 in prep.). The new species, belongs to *Croton* sect. *Lamprocroton* (Müller Argoviensis 1873:243) Pax [1890: 40], based on morphological characters, a South American group with high diversity in Brazil (Lima & Pirani 2008; Van Ee *et al.* 2011). In the current circumscription of *Croton* sect. *Lamprocroton*, 37 south American species are recorded, characterized by its shrubby habit, indument of lepidote or stellate trichomes, eglandular leaves, male flowers up 16 stamens, and pistillate ones with bifid or twice bifid styles (Lima & Pirani 2008; Van Ee and Berry 2011; Van Ee *et al.* 2011; Vitarelli *et al.* 2015). Here we describe *Croton bacupariensis* Valduga & Iganci, as a new species known so far only from the coastal plain of the State of Rio Grande do Sul in southern Brazil. The description is complemented by photos and line drawings, as well as informations on distribution, habitat and conservation. The present region is located on the coastal plain, 10 m above sea level, with lagoons and near the sea. *C. bacupariensis* occurs in established dunes and the flora is called Pioneer Vegetation (Leite & Klein 1990; Veloso 1992) or simply Restinga (Rizzini 1992; Falkenberg 1999; Silva 1999), as it occurs in stressful environments, subjected to the action of physicochemical environmental variations and successional gradients (Rambo 1954; Klein 1984; Seeliger 1998). Phytogeographically, the coastal plain of Rio Grande do Sul is influenced to the north, by the domain of the Atlantic Forest biome, while the southernmost portion, from the 30° parallel, is influenced by the Pampas grasslands (Fiaschi & Pirani 2009).

Material & Methods

The new species was found during the ongoing revision of *Croton* in the Pampa grasslands. Exsiccates from the following herbaria were examined: CORD, CTES, CTESN, FURB, HAS, HUCS, ICN, UNILASALLE (non indexed), LP, MBM, MPUC, MVFA, MVM, PACA, SI and UNR (acronyms according to Thiers, continuously updated). Additionally, we conducted three field expeditions in order to observe natural populations from May 2017 to May 2018. Morphological terms follow Radford *et al.* (1974), Webster *et al.* (1996), and Lima and Pirani (2008). ArcGis 10.1 was used for the construction of the distribution map, each point corresponding to a single locality. The conservation status was provisionally evaluated according to the criteria proposed by the IUCN Red List, (IUCN 2017) criteria, using GeoCAT (Bachman *et al.* 2011) for geospatial analysis.

Taxonomy

Croton bacupariensis Valduga & Iganci *sp.nov.* (Figures 1 and 2)

Type:—BRAZIL. Rio Grande do Sul: Mostardas, Lagoa do Bacopari, 30°32'19.98"S 50°25'21.93"W May 29, 2017, *Valduga, E. 795* (holotype: ICN! isotypes: HUCS! ICN!)

Diagnosis:—Densely branched shrub up to 60 cm, dioecious. *Croton bacupariensis* is very similar to *C. gnaphalli* Baillon (1864: 359), but differs mainly by its densely branched shrubby habit (vs. sparsely branched in *C. gnaphalli*); stellate-lepidote trichomes on the abaxial face of leaves (vs. stellate trichomes on both faces in *C. gnaphalli*); pistillate sepals 2.3 mm long (vs. 4.2 mm long in *C. gnaphalli*). Table 1.

Monoecious shrubs, 30–60 cm, densely branched; branches cylindrical to flattened in the apex, covered by cream to silver indument of stellate-lepidote trichomes; latex translucent. **Leaves** elliptic slightly discolours, without petiolar colleters; lamina 4–12 × 2–5 mm, apex acute, base acute to obtuse, margin entire, abaxial surface pubescent with silver stellate-lepidote trichomes with ferruginous to brownish spots, adaxial surface with silver stellate trichomes, hiphodromous, central vein immersed on the adaxial surface and prominent abaxially, secondary veins inconspicuous; petioles 0.8–

1 mm long, covered by subentire lepidote trichomes. **Staminate inflorescences** 0.7–1.5 cm long, terminal, lax, axis covered by stellate-lepidote trichomes; bracts ca. 3.6 mm long, linear lanceolate, glabrate on the adaxial surface, covered by stellate-lepidote trichomes on the abaxial one. **Staminate flowers:** pedicel 1.5–3.5 mm long; sepals 5, valvate, entire, ca. 3 × 1.5 mm, narrowly ovate, apex slightly cucullate, entire, adaxial surface glabrate, abaxial one with stellate trichomes; petals linear, narrowly elliptic, ca. 3 × 1 mm, ciliate; adaxial surface glabrate and abaxial one with stellate trichomes; receptacle covered by simple and hyaline trichomes; nectary disk segmented; stamens ca. 15; filaments hirsute. **Pistillate inflorescences:** 5–10 mm long, terminal, lax, axis covered by stellate-lepidote trichomes; pedicels ca. 3 mm long. **Pistillate flowers:** sepals 5, valvate, ca. 2.3 × 1.2 mm, narrowly ovate, entire, adaxial surface glabrescent with sparse stellate-lepidote trichomes, abaxial with stellate-lepidote trichomes; reduced petals linear, ca. 0.5 mm long; ovary ca. 1.6 × 1.4 mm, trigonous, covered by stellate-lepidote trichomes; styles bifid (with 12 terminal tips), covered by stellate-lepidote trichomes; nectary disk deeply 5-lobed. Capsules ca. 5 × 4.2 mm, ellipsoid. Seeds 3.3 × 2.1 mm, narrowly ellipsoid, brownish; caruncle tiny, ca. 1.5 × 0.4 mm, reniform, yellowish. Figure 2.

Distribution and Habitat—*Croton bacupariensis* has been collected so far in the Brazilian State of Rio Grande do Sul (Fig. 3), in open vegetation on sandy soils of dunes near the sea level, around lagoons.

Phenology—Flowers and fruits found in January, May and October.

Paratypes—BRAZIL. Rio Grande do Sul: Mostardas, Lagoa do Fundo, 15 January 2008 (stam. fl) L. Scur 1191 (HUCS!, MBM!); Mostardas, Lagoa do Bacupari, 30°32'32"S 50°25'02"W 05 October 2018 (stam. fl.) C. Rabuske-Silva, C.C.Alff 379 (ICN!).

Etymology—The specific epithet refers to the type-locality, Lagoa do Bacupari, in the Municipality of Mostardas, Rio Grande do Sul, Brazil.

Suggested Conservation Status—*Croton bacupariensis* could be considered Critically endangered (CR) according to IUCN (2017) criteria B1 b(i,ii,iii,iv,v)C1. Its area of occupation (AOO) is 8.000 km² and only two populations of the species were

found on sandy soil in the municipality of Mostardas, around salt lagoons, an area that is rapidly being occupied by real estate development.

Comments—While *Croton bacupariensis* is restricted to the sandy soils of the dunes, near lagoons in the municipality of Mostardas, Rio Grande do Sul state, *C. gnaphalli* is widely distributed in the Pampa's grasslands, in Argentina, Uruguay and Rio Grande do Sul, in southern Brazil, growing mostly in rocky soils. *Croton bacupariensis* is here positioned in *Croton* sect. *Lamprocroton* due to the presence of lepidote indumentum, leaves without petiolar glands, and bifid styles with four terminal tips. The following species also occur in the same environment. *Croton lombardianus* Croizat (1942:1), which is distinct by having branches predominantly prostrate, serrate leaves and stellate trichomes (vs. ascending branches, entire leaves and stellate-lepidote trichomes in *C. bacupariensis*). *Croton lombardianus* was recently recorded to Brazil by Valduga *et al.* (2021). *Croton glandulosus* Linnaeus (1759: 1275) is distinguished by the serrate leaves and stipitate glands at the base of the leaf blade, or at the apex of the petiole (vs. entire leaves without glands in *C. bacupariensis*). *Croton helichrysum* Baillon (1864: 358) is recognized by the spatulated leaves (vs. elliptic leaves in *C. bacupariensis*) and *Croton lanatus* Lamarck (1876: 211) presents sessile glands at the base of the leaf (vs. leaf glands absent in *C. bacupariensis*).

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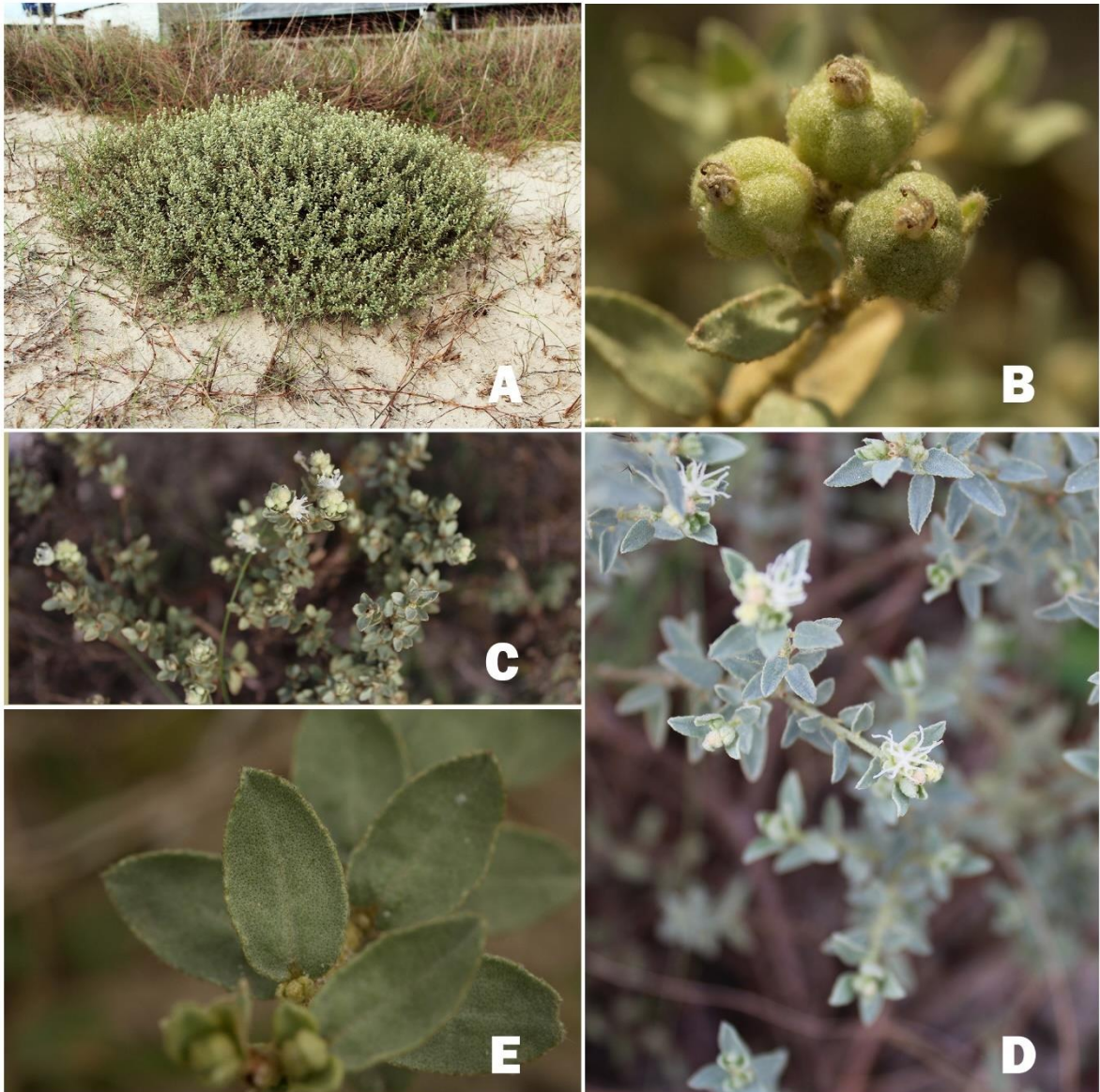


FIGURE 1. *Croton bacupariensis*. A. Habitat; B. Imature fruit; C. Staminate flower; D. Pistillate flower; E. Leaves. Photos (A, C, D) Eduardo Valduga, (B, E) Martin Grings.

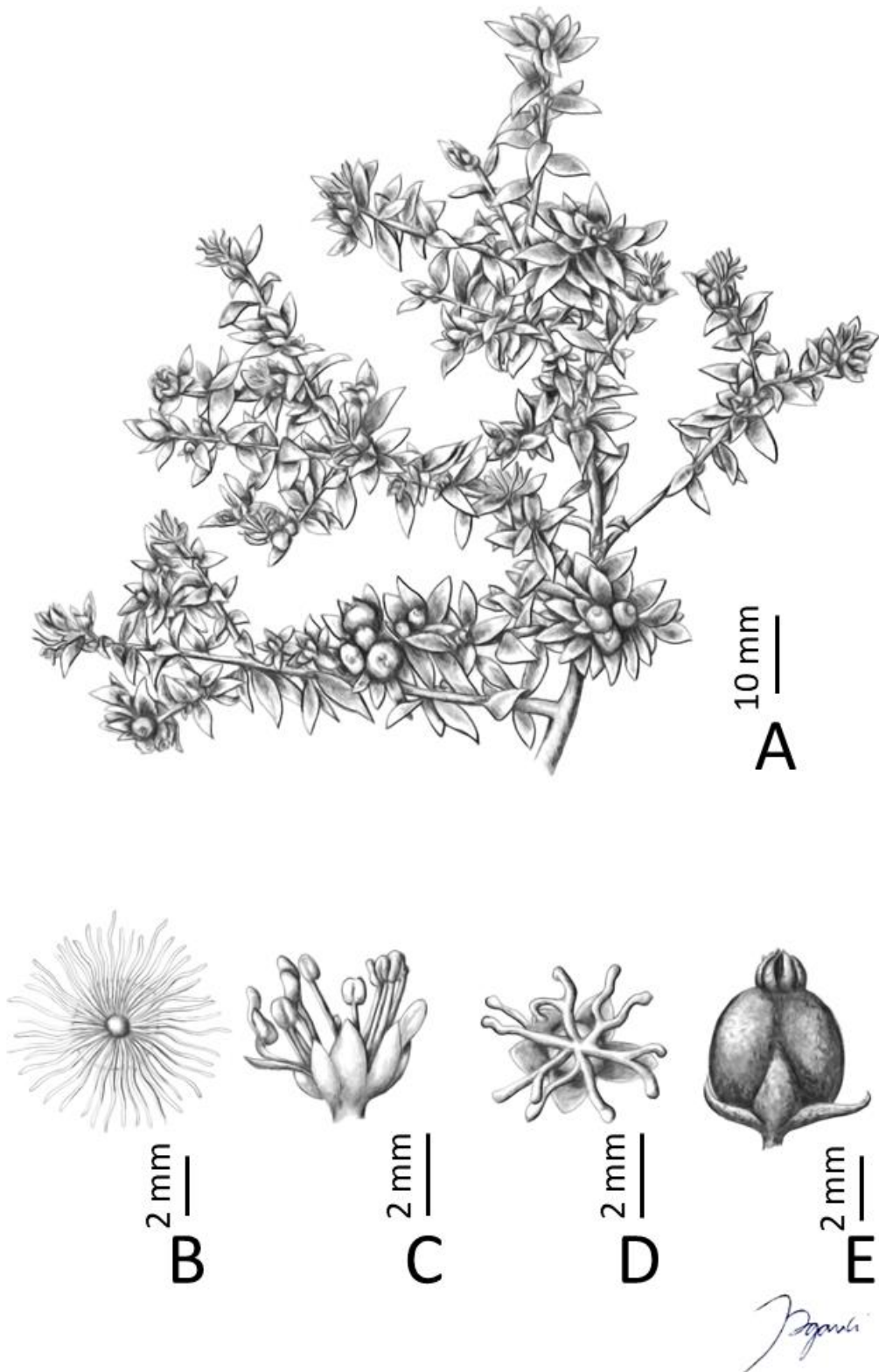


FIGURE 2. *Croton bacupariensis*. A, Habit; E. Stellate-lepidote trichomes from abaxial leaves side; C. Staminate flower; D. Pistillate flower; B. Fruit. (Valduga, E 795).

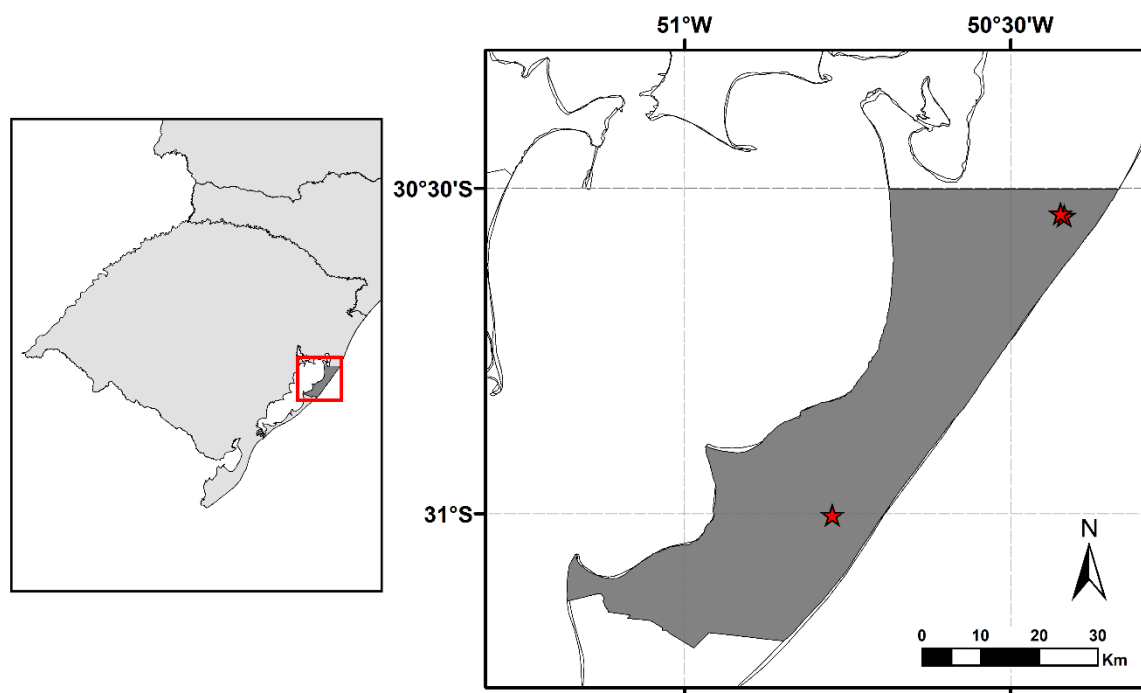


FIGURE 3. Distribution map of *Croton bacupariensis*, showing the only two localities where the species was collected until now in the Rio Grande do Sul state, Brazil.

TABLE 1. Morphological differences between *Croton gnaphalii* and *C. bacupariensis*.

Diagnostic characters	<i>C. gnaphalii</i>	<i>C. bacupariensis</i>
Sepals of pistillate flowers	8 x 4 mm	3 x 1.5 mm
Leaves	0.5–2.1 x 0.2–0.6 cm	0.4–1.2 cm x 0.2–0.5 cm
Indument on the abaxial face of leaves	silver with stellate trichomes	silver with stellate - lepidote trichomes with ferruginous to brownish spots.
Habitat	rocky slopes and clayey soils	sandy soils on the dunes

CHAPTER III – A synopsis of *Croton* (Euphorbiaceae) in the Pampas grasslands

Manuscript to be submitted in *Phytotaxa*

A Synopsis of *Croton* (Euphorbiaceae) in the Pampas grasslands

EDUARDO VALDUGA^{1,*} INÊS CORDEIRO² & JOÃO RICARDO VIEIRA IGANCI^{1,3}

¹*Universidade Federal do Rio Grande do Sul, Programa de Pós-Graduação em Botânica, Av. Bento Gonçalves, 9500, Agronomia, Porto Alegre—RS, Brazil.*

²*Instituto de Botânica, Av. Miguel Stéfano, 3687, São Paulo, 04301902, SP, Brazil.*

³*Universidade Federal de Pelotas, Instituto de Biologia, Campus Universitário Capão do Leão, Capão do Leão, Rio Grande do Sul, Brazil.*

*Author for correspondence, e-mail: valduedu10@yahoo.com.br

Resumo

Croton é o segundo maior gênero de Euphorbiaceae com aproximadamente 1200 espécies concentradas nas regiões tropicais de todo o globo. Destas, mais de 750 espécies são nativas das Américas e representam 31 seções do gênero nesse continente. O objetivo deste estudo foi analisar a vegetação do Pampa com base no estudo das espécies de *Croton* em virtude de sua ampla ocorrência nesse domínio vegetacional. Das 31 espécies encontradas, uma foi recentemente descrita, 16 são endêmicas do Pampa, seis têm ampla distribuição na região neotropical e oito concentram-se no cone sul da América. Além de uma chave de identificação, são apresentados mapas de ocorrência, fotos das espécies no campo e quatro novos sinônimos são propostos.

Palavras-chave: América do Sul, Brasil, endemismo, subtropical, taxonomia, tipificação

Abstract

Croton is the second largest genus of Euphorbiaceae with about 1200 species concentrated in tropical regions across the globe. Of these, over 750 species are native to the Americas and represent 31 sections of the genus in this continent. The aim of this study was to analyze the Pampas grasslands vegetation based on the study of *Croton* species due to their wide occurrence in this vegetation domain. Of the 31 species found, one was recently described, 16 are endemic to the Pampas grasslands, six are widely distributed in the neotropical region and eight are concentrated in the southern cone of

America. In addition to an identification key, occurrence maps are presented, photos of species in the field and four new synonyms were proposed.

Key words: Brazil, endemism, South America, subtropical, taxonomy, typification

Introduction

Croton L. has a pantropical distribution and encompasses 1,200 to 1,300 species, of which 750 occur in the Americas (Berry et al. 2005; Van Ee et al. 2011). Around 300 are found in Brazil (BFG 2015, Caruzo et al. 2020, Silva et al. 2020). *Croton* is amongst the 15 largest genera of angiosperms (Frodin, 2004). The genus displays a diversity of habit, indumentum, trichomes, and foliar secretory structures. Most of *Croton* species are easily recognized by their conspicuous stellate or scale-like trichomes, spiciform inflorescences with staminate flowers in the distal nodes and pistillate in the proximal ones unisexual flowers, watery to colored sap, often petiolar glands, and senescent leaves that turn orange before dehiscing (Berry et al. 2005; Riina et al. 2009). The genus occurs mainly in tropical regions worldwide, with some representatives in subtropical and temperate areas (Caruzo & Cordeiro 2013) The following works dealing with *Croton* to southern South America: Smith et al. (1988), the first modern taxonomic treatment of Euphorbiaceae in Brazil, referred ca. 31 species of *Croton* from the State of Santa Catarina, Lima & Pirani (2008) revised *Croton* sect. Lamprocroton, with several species restricted to southern South America, Allem (1978, 1979) presented the list of *Croton* species to the State of Rio Grande do Sul as well described new species, Ahumada (1991) described new species. Considering the good representation of *Croton* species in open vegetations from southern South America, we aimed to study their distribution in the Pampas grasslands, following the mapping presented by Soriano (1992) of this vegetation, which extends through southern State of Rio Grande do Sul in Brazil, all over Uruguay and eastern Argentina.

Materials and Methods

The list of *Croton* species recorded from the Pampas grasslands was compiled based on field collections, taxonomic and floristic publications and the study of over 200 collections from the herbaria CORD, CTES, CTESN, FURB, HAS, HUCS, ICN, , LP,

MPUC, MVFA, MVJB, MVM, PACA, SI, SP, UNILASALLE and UNR, and digital images of A, B, F, G, K, MPU, P and US (acronyms according to Thiers 2021, continuously updated). Besides thirty field trips to preserved areas through the Pampas grasslands and boundary areas were conducted between January 2017 and October 2020. All protologues and images of type collections were checked in online databases: JSTOR Plants (<http://plants.jstor.org>), Re flora Herbário Virtual (2020) and speciesLink (2020). The International Code of Nomenclature for algae, fungi, and plants (Turland *et al.* 2018) was followed to solve the nomenclatural and taxonomic problems, in particular the recommendation 9A for lectotypifications. Synonymizations proposed here are based on the analysis of the protologues, type collections, and consideration of the variation found in populations in their respective areas of occurrence. None of the varieties or forms described for the species are recognized here, since we consider the characteristics that differentiate them to be continuous among populations of their respective species. Leaf characters such as petiole length, shape, margin and venation, presence, number and shape of glands and floral characters such as number and density of flowers along the axis of the inflorescence, number of stamens, morphology of bracts and sepals of pistillate flowers and number of divisions of the styles were the main characters analyzed to distinguish the species. Type localities are cited as indicated in the specimens' labels. Morphological characters were observed using a stereomicroscope and the morphological terms are following Hickey (1973), Lima & Pirani (2008), Stearn (1992), Webster (1993), and Webster *et al.* (1996).

Croton Linnaeus (1753: 1004)

Croton includes subshrubs to trees, monoecious; hyaline or colored sap; covered by simple, stellate, stellate-porrect, dendritic, dendritic-porrect or lepidote trichomes. Usually alternate leaves with simple, entire, margin entire to serrate, usually with 1(2) pair(s) of acropetiole or basilar glands, sessile to stipitate, stipules persistent or deciduous. Tyrses terminal; pistillate flowers in proximal cymules, staminate flowers more often in distal ones or rarely in every cymule of the inflorescence. Staminate flowers dichlamydeous, with 7–120 stamens, inflexed in bud. The pistillate flowers generally have petals reduced to glands, but sometimes they are fully developed; ovary with 3 carpels, 3-locular, locules 1-ovulate; stigmas are 2-fid to multifid, free from the

base or united into a short column. (Webster 1993; Burger & Huft 1995; Radcliffe-Smith 2001; Caruzo & Cordeiro 2007; Lima & Pirani 2008; van Ee et al. 2011).

Identification Key to *Croton* species occurring in the Pampas grasslands

1. Calyx of pistillate flowers with 3 well developed and laciniate sepals and 2 entire and vestigial ones*C. didrichsenii*
- 1'. Calyx of pistillate flowers with 5 well developed entire sepals
2. Procumbent subshrub, branches totally or partially horizontal
3. Leaf blade with serrated margin
4. Suborbicular to reniform leaves, long petiolate, petioles up to 2 cm long, stellate trichomes with porrect rays..... *C. glechomifolius*
- 4'. Elliptical leaves, sessile to short petiolate (1 mm), stellate trichomes without porrect rays.....*C. lombardianus*
- 3'. Leaf blade with entire margin
5. Sepals of pistillate flowers with entire margin.....*C. quintasii*
- 5'. Sepals of pistillate flowers with glandular-toothed margins*C. calyciglandulosus*
- 2'. Never procumbent, erect subshrubs; branches never procumbent
6. Glands distributed on the adaxial face of sepals of pistillate flowers..... *C. ramboi*
- 6'. Glands absent or restricted to the margins of sepals of pistillate flowers
7. Glandular dissected stipules
8. Leaf blade more than 3 cm long, serrated margins, sepals of pistillate flowers with glandular margins*C. serratifolius*
- 8'. Leaf blade up to 1.5 cm long, entire margins, sepals of pistillate flowers without glands*C. helichrysum*
- 7'. Non-glandular entire stipules
9. Margins of pistillate sepals serrate *C. parvifolius*
10. Underground system apparently xylopodiferous
11. Globose and congested inflorescences *C. aberrans*
- 9'. Margins of pistillate sepals entire
- 11'. Cylindric and lax inflorescences

12. Indumentum of stems with stellate trichomes, blackened glands at the base of the leaf blade *C. lanatus*
- 12'. Indumentum of stems with porrect stellate trichomes, without glands at the base of the leaf blade *C. fulvus*
- 10'. Underground system not xylopodiferous
13. Leaves with glands at the base of blade or apex of the petiole
14. Staminate cimulae separate from the pistillate ones in the raquis *C. lundianus*
- 14'. Staminate cimulae contiguous to the pistillate ones in the raquis
15. Bracts with sessile lageniform glands *C. glandulosus*
- 15'. Bracts without glands
16. Shrubs, concolor leaf blades, puberulous, with stipitate glands at the base of leaf blade; digested, slender inflorescences, longer than wide, 6 x 1 cm
C. bonplandianus
- 16'. Subshrubs, discolor leaf blades, densely pubescent, glands at the base of the leaf blade, when present, sessiles; congested inflorescences, wider than long, 4 x 5 cm
..... *C. hilarii*
- 13'. Leaves without glands at the base of blade or petiole
17. Adaxial face of leaf blade glabrous; distal half of adaxial face of pistillate sepals tomentose *C. uruguayensis*
- 17'. Adaxial face of leaf blade indumented; adaxial face of pistillate sepals glabrous or completely tomentose
18. Trichomes of the adaxial face of the leaf blade stellate with rays totally free
19. Abaxial face of leaf blades with secondary veins evident and indumentum sublepidote trichomes *C. ceanothifolius*
- 19'. Abaxial face of leaf blade with secondary veins barely or not evident and indument with lepidote or stellate trichomes
20. Sepals of pistillate flowers conspicuously reduplicated
21. Margin of sepals of pistillate flowers serrate, externally glabrous or glabrescent
..... *C. calycireduplicatus*
- 21'. Margin of the sepals of pistillate flowers entire, externally indumented *C. montevidensis*
- 20'. Sepals of pistillate flowers flat
22. Abaxial face of leaf blade with lepidote trichomes *C. pygmaeus*
- 22'. Abaxial face of leaf blade glabrous or with stellate trichomes

23. Linear-lanceolate leaf blades; sepals of pistillate flowers plicate*C. cuchillae-nigrae*
- 23'. Elliptical leaf blades, oval to lanceolate; sepals of pistillate flowers flat
24. Obovate-lanceolate leaf blades; calyx of pistillate flowers with stellate trichomes, more concentrated in the basal half of adaxial face of sepals *C. nitrariifolius*
- 24'. Lanceolate, elliptical, oblong, or oval leaf blades; calyx of pistillate flowers with stellate trichomes equally dispersed through the adaxial face of sepals
25. Calyx of pistillate flowers not globose, with sessile trichomes
26. Shrubs to subshrubs with pale white to silvery leaves, indument of stellate trichomes with united rays ranging from 10 to 30%.
27. Stellate-lepidote trichomes in the abaxial leaf blade with ferruginous to brownish spot *C. bacupariensis*
- 27'. Stellate trichomes in the abaxial leaf blade without ferruginous to brownish spot *C. gnaphalii*
- 26'. Shrubs to subshrubs with greenish to yellowish leaves, indument of stellate trichomes with union of the rays higher than 30%
- 18'. Trichomes of the adaxial face of the leaf blade lepidote with rays almost completely united
28. Subshrubs with up 1 m high; leaves up 1.5 mm wide, hyphodromous venation, *C. ericoides*
- 28'. Shrubs to subshrubs up to 2 m high; leaves over 2 mm wide, brochidodromous venation *C. myrianthus*
- 25'. Calyx of pistillate flowers globose (inflated), with pedunculate trichomes
29. Trichomes of the calyx, fasciculate, nigrescent pinkish with a wider base of the stipe, thinning to the apex *C. echinulatus*
- 29'. Trichomes of the calyx pale grayish, golden to brown, of the same width by extension.
30. Leaf blade 0.4 – 1.5 x 0.2 - 1.4 cm wide *C. chamaepitis*
- 30'. Leaf blade 2.0 x 0.5 cm
31. Leaf blade oval, abaxial face actinodromous *C. lachnostephanus*
- 31'. Leaf blade elliptic, abaxial face not markedly trinervated at the base *C. pycnocephalus*

Taxonomic treatment

Croton aberrans Müller Argoviensis (1873: 232).—*Oxydectes aberrans* (Müll. Arg.) Kuntze (1891: 613). Type:—BRAZIL. Mato Grosso do Sul: “in campis arenosis secus Rio Pardo”, September 1826, L. Riedel 546 (lectotype: LE 00003045! [digital images] designated by Sodré *et al* (2019); isolectotype: G 00434413).

Croton guaraniticus Chodat & Hassler (1905: 496). Type:—PARAGUAY. Cordillera: “Cordillerae centralis; in region collium: Cerros de Tobaty”, September 1900, E. Hassler 6314 (lectotype: G 00307062!, designated by Sodré *et al* (2019); isolectotypes: A 00047309!, B† [photo at F 0BN005109!], F 0056134F, G, K 000574182!, MPU 014831!, NY 00246548!, P 00623669!, P 00623670!, S 07-12802, W [digital images]); remaining syntype:—PARAGUAY. “pr. Tacuaral” September 1885, E. Hassler 1083 (not located).

Selected material: ARGENTINA. Corrientes: Paso de La Patria. 16 November 1967, U. Eskuche 3249 (SI). BRAZIL. Rio Grande do Sul: Cruz Alta. 26 November 2018, E. Valduga 903 (ICN). Jari-Tupanciretã. 26 January 1942, B. Rambo s/n° (PACA).

Distribution:—Native species from Argentina, Bolivia, Brazil and Paraguay. In Brazil, this species is found in Goiás, Mato Grosso do Sul, Minas Gerais, Paraná, Rio Grande do Sul and Santa Catarina. The species is most common in the Pampas grasslands of the Northwest of Rio Grande do Sul, Brazil. Figures 1 and 9 (A).

Notes: *Croton* sect. *Geiseleria* (Gray 1856: 391) Baillon [1858:359]. *Croton aberrans* is easily confused with *C. hirtus* and was synonymized in that species by Caruzo & Cordeiro (2007). However, *C. aberrans* has densely congested inflorescences 0.9–1.4 cm long vs. more elongate inflorescences in *C. hirtus* 2–6 cm long.

Croton bacupariensis Valduga & Iganci sp. nov. ined. Type:—BRAZIL. Rio Grande do Sul: Mostardas, Lagoa do Bacupari, 30°32'19.98"S 50°25'21.93"W May 29, 2017, Valduga, E. 795 (holotype: ICN!)

Selected material: BRAZIL. Rio Grande do Sul: Mostardas. Lagoa do Bacopari. 05 October 2018. Rabuske, E. C. 379, Alff, C.C. (ICN). Mostardas. Lagoa do Fundo. 15 January 2008. Scur. L. 1191. (HUCS).

Distribution:—Endemic species to the Pampas grasslands in Mostardas municipality, Rio Grande do Sul state, Brazil. The species occurs on sandy soils around lakes. Figures 1 and 9 (B).

Notes: The species belongs to *Croton* sect. *Lamprocroton* (Müller Argoviensis 1873:243) Pax [1890: 40]. based on morphological characters, a South American group with high diversity in Brazil (Lima & Pirani 2008, Van Ee *et al.* 2011). This species differs from the morphologically closest species; *C. gnaphalli* Baillon (1864: 359), mainly by its densely branched shrubby habit (vs. sparsely branched in *C. gnaphalli*); stellate-lepidote trichomes on the abaxial face of leaves (vs. stellate trichomes on both faces); pistillate sepals 2,3 mm long (vs. 4.2 mm long). While *C. bacupariensis* is restricted to open vegetation on the dunes in Mostardas municipality, *C. gnaphalli* is widely distributed,

mostly in rocky soils, in the Pampas grasslands, Argentina, Uruguay and southern South of Rio Grande do Sul state in Brazil.

Croton bonplandianus Baillon (1864: 339). Type:—ARGENTINA. Corrientes: without further locality. Type: *H.A Weddel 3207*, April - May 1845, (Holotype P 00623062 [digital image!], isotype: A 00047235 [digital image!]; Isotypes: P 0062362 P 00623063 [digital images!]).

Croton nivifer Moore (1895: 456). Type:—BRAZIL. Mato Grosso do Sul: Corumbá *T. Moore 1096* (Holotype BM 000947393 [digital image!]).

Croton pauperulus Müller Argoviensis (1864: 485). Type:—ARGENTINA. “In territorio Tucumanensi inter Chili et Buenos Aires, prope San Jago” *J. Tweedie 1215* (Holotype K 000574044 [digital image!]).

Croton sparsiflorus Morong (1893: 221). Type:—PARAGUAY. Asuncion: without further locality *T. Morong 940* (Lectotype NDG 2929 [digital image!]) designated here.

Selected material: ARGENTINA. Corrientes. 11 November 1934. *A. Burkart 6886* (MO). Corrientes. Ituzaingó: Rápidos del Apipé. October 1977. *A. Cabrera 28985* (SI). BRAZIL. Rio Grande do Sul. São Borja. 28 April 1991. *E. Trindade s.n* (ICN). URUGUAY. Artigas. Bella Unión. 01 November 1928. *W. Herter s.n* (SI).

Distribution:—Native species from Argentina, Bolivia, Brazil, Paraguay and Uruguay. In Brazil, the species is found in Mato Grosso, Mato Grosso do Sul, Paraná and Rio Grande do Sul states. This species is mostly found in open vegetation areas. Figures 1 and 9 (C).

Notes: *Croton* sect. *Geiseleria* (Gray 1856: 391) Baillon [1858:359]. Subshrub found predominantly around rivers and lakes. Similar to *C. glandulosus*, it differs mainly in the sessile glands at the base of the leaf blade and having the adaxial face of the leaves glabrescent, vs. stipitate glands at the base of the leaf blade and tomentose leaves in *C. glandulosus*. In *C. sparsiflorus*, the author mentioned paratypes, and for the lectotype, the most complete material was selected here.

Croton calyciglandulosus Allem (1979: 73). Type:—BRAZIL. Rio Grande do Sul: Encruzilhada do Sul. 10 October 1972, *J.C. Lindeman, B. Irgang e J.F.M. Valls s.n.* (Holotype ICN 20580 Isotypes: ICN 20579, CEN 00003836 [digital image!]).

Selected material: BRAZIL. Rio Grande do Sul: estrada Pantano Grande a Encruzilhada do Sul. 29 September 1978, *M. Fleig 1055* (ICN).

Distribution:—Endemic species to Pampas grasslands. This species is only found in two municipalities of Rio Grande do Sul, Pantano Grande and Encruzilhada do Sul. Figure 1.

Notes: *Croton* sect. *Barhamia* (Klotsch 1853: 104) Baillon [1858:367]. Subshrub close related to *C. ramboi*, by presenting the edge of the sepals of the pistillated flowers, glandulous - toothed. In *C. calyciglandulosus* the abaxial face of the pistillate flower sepals is covered by glands vs. the glands are restricted to the edge in *C. ramboi*. In staminate flowers, *C. calyciglandulosus* has a toothed glandular edge and in *C. ramboi*

it is whole and without glands. In addition, *C. calyciglandulosus* has a prostrate to semi-erect habit, while in *C. ramboi* it is always erect.

Croton calycireduplicatus Allem (1979: 67). Type:—BRAZIL. Rio Grande do Sul: Vacaria, Passo do Socorro. 27 December 1951. *B. Rambo* s.n. (Holotype PACA 51528!).

Selected material: BRAZIL. Rio Grande do Sul: Taquari. 15 October 2003. *A Knob & S. Bordignon 7494* (ICN, UNILASALLE). URUGUAY. Rocha: Palmares de Castillos. 22 January 1944. *H. H. Bartlet 213* (US).

Distribution:— This species is found in Brazil and Uruguay. In Brazil it occurs in Rio Grande do Sul and Santa Catarina states. Figure 2 and 9 (D).

Notes: *Croton* sect. *Barhamia* (Klotsch 1853: 104) Baillon [1858:367]. This species differs from the morphologically closest species; *C. montevidensis* mainly by the sepals of the pistillate flowers with cutted edge, vs. entire edge sepals of the pistillate flowers. *C. calycireduplicatus* can present hirsute forms as in Knobb & Bordignon 0909 (herbário??).

Croton ceanothifolius Baillon (1864: 295). Type:—BRAZIL. Minas Gerais: without further locality *A.S. Hilaire. 558* (Lectotype A barcode 00277244 [digital image!]) designated by Webster (1993).

Selected material: BRAZIL. Rio Grande do Sul: Torres, Parque Estadual do Itapeva. 15 January 2017. *E. Valduga 753* (ICN).

Distribution:—Endemic species to Brazil, occurs in Minas Gerais, Paraná, Rio Grande do Sul, Santa Catarina and São Paulo states. Figures 2 and 9 (E).

Notes: *Croton* sect. *Lamprocroton* (Müller Argoviensis 1873: 243) Pax [1890: 40]. Species treated in the work of Lima & Pirani (2008) for Pastizales de La Plata as *C. pallidulus* Baillon (1864: 2), we consider here for the Pastizales de La Plata as *C. ceanothifolius*. This species differs from the morphologically closest species; *C. myrianthus*, by the secondary veins that emerge from the abaxial leaf blade and the adaxial surface of the leaves, glabrous to glabrescent vs. hiphodromous veins and hirsute adaxial leaf blade in *C. myrianthus*.

Croton chamaepitis Baillon (1864: 356). Type:—URUGUAY. Maldonado: Cerro Pan de Azucar *A.S. Hilaire, cat. C², 2117* (Lectotype P barcode 00634655 [digital image!]) designated here.

Selected material: URUGUAY. Maldonado: Abra del Perdomo. 31 October 1965. *E. Marchesi 1416* (MVFA).

Distribution:—Endemic species to the Uruguayan Pampas grasslands, occurs only in Maldonado and Lavalleja departments. Figures 2 and 9 (H).

Notes: *Croton* sect. *Lamprocroton* (Müller Argoviensis 1873: 243) Pax [1890: 40]. Species very similar to the habit of *C. pycnocephalus* and *C. lachnostephanus*, it has a smaller size, leaves and smaller inflorescences. Leaves 0.4-1.2 x 0.2 – 0.4 cm , vs. 1.5

– 3.5 x 0.2 – 0.5 cm in *C. pycnocephalus* and 1.0 – 2.5 x 0.4 – 1.0 cm in *C. lachnostephanus*. Compact subshrub, sympatric with *C. lachnostephanus*.

Croton cuchillae-nigrae Croizat (1942: 2). Type:—Uruguay. Tacuarembó: Cuchilla Negra. January 1941 *J. Chebataroff* 9124 (holotype AAH barcode 00047278 [digital image!]).

Selected material: BRAZIL. Rio Grande do Sul: Santiago. 02 November 2017. *E. Valduga* 822 (ICN). URUGUAY. Tacuarembó: Cuchilla de Laureles. 16 November 2003. *M. Bonifacino* 960 (MVFA).

Distribution:—Endemic species to Pampas grasslands, occurs in Brazil and Uruguay. Figures 2 and 9 (F).

Notes: *Croton* sect. *Barhamia* (Klotsch 1853: 104) Baillon [1858: 367]. This species differs from the morphologically closest *C. parvifolius* by its pistillate flowers fused at the base as a cup, vs., free sepals in *C. parvifolius*.

Croton didrichsenii Webster (1992: 271) *Julocroton humilis* Didrichsen (1857: 132) Type:—BRAZIL. São Paulo: Mogi das Cruzes. November 1833. *P.W. Lund* s.n. (Holotype C barcode 10011298!) [digital image].

Croton lanceolaris Webster (1992: 272) *Julocroton lanceolatus* Klotzsch ex Müller Argoviensis (1866: 702). Type:—BRAZIL. São Paulo: Alegres. *L. Riedel* 2806 (Holotype B destroyed, lectotype P barcode 00441700! [digital image]) designated by Caruzo & Cordeiro (2007).

Croton solanaceus Müller Argoviensis (1873: 701) Webster (1992: 272) *Julocroton humilis* var. *solanaceus* Müller Argoviensis (1866: 701). *Julocroton solanaceus* (Müller Argoviensis) Müller Argoviensis (1873: 279). Type:—BRAZIL. *F. Sellow* s.n. (Holotype B destroyed, lectotype G barcode 00441756 [digital image!], designated by Caruzo & Cordeiro (2007).

Croton subpannosus Müller Argoviensis ex Grisebach. (1874: 96), **syn. nov.** *Julocroton subpannosus* (Müller Argoviensis ex Grisebach) Müller Argoviensis (1874: 203). Type:—ARGENTINA. Cordoba: Ascochinga *P.G. Lorentz* n. 291. (Lectotype B destroyed, Isolectotype G barcode 00441916 [digital image!]) designated here.)

Selected material: ARGENTINA. Corrientes: Santo Tomé. 13 December 2007, *F. O. Zuloaga* 9802 (SI). BRAZIL. Rio Grande do Sul: São Francisco de Assis. 02 November 2017. *E. Valduga* 828 (ICN). URUGUAY. Artigas. 1927, *G. Herter* 82765 (MVM).

Distribution:—This species is found in Argentina, Brazil, Uruguay and Paraguay. In Brazil the species occurs in Bahia, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Paraná, Rio Grande do Sul, Santa Catarina, São Paulo and Tocantins states. Figures 3 and 10 (A).

Notes: *Croton* sect. *Julocroton* (Martius 1837: 119) Webster [1967: 354]. Subshrub with apparently xylopodiferous underground structure, tomentose. Leaves ranging from narrow lanceolate to wider, cordiform and obovate. Here we propose the synonymization of *C. subpannosus* into *C. didrichsenii* because there are morphological

continuums between species. The differences between the two species are in the vegetative characters, and even so, they have a high morphological variability. The type was destroyed, but an isotype from herbarium G was complete, for this reason it was elected as a isolectotype.

Croton echinulatus (Grisebach) Croizat [1941: 445]. *Croton pycnocephalus* var. *echinulatus* Grisebach (1879: 55). Type:—ARGENTINA. Entre Ríos: Concordia. P.G. Lorentz 621, 15 February 1876. (Holotype GOET 006454 [digital image!] designated by Ahumada (1991).

Selected material: ARGENTINA. Entre Ríos: Concordia, Parque Rivadavia. 22 October 1961. A. Burkart s/n. (SI). BRAZIL. Rio Grande do Sul: Tupanciretã. 29 January 1942. B. Rambo s/n. (PACA). URUGUAY. Rivera: Cerro del Indio. 02 December 2018. C. Vogel & A. Gonzalez s/n. (ICN).

Distribution:—Endemic species to Pampas grasslands, occurs in Argentina, Uruguay and Brazil. Figures 3 and 9 (G).

Notes: *Croton* sect. *Lamprocroton* (Müller Argoviensis 1873: 243) Pax [1890: 40]. Species similar to *C. pycnocephalus*, differs mainly by the nigrescent trichomes on the inflorescences and wider distribution, reaching Uruguay and Argentina, vs. silvery white to goldish trichomes.

Croton ericoides Baillon (1864: 293). Type:—BRAZIL. Rio Grande do Sul: without further locality A.S. Hilaire C2-1812. 1816-1821. (Holotype P barcode 00623150 [digital image!]).

Selected material: BRAZIL. Rio Grande do Sul: Palmares do Sul. Lagoa Manuel Nunes. 23 October 2011. E. Valduga 139 (HUCS).

Distribution:— Endemic species to Brazilian Pampas grasslands. Figures 3 and 10 (B).

Notes: *Croton* sect. *Lamprocroton* (Müller Argoviensis 1873: 243) Pax [1890: 40]. Occurs predominantly in seashore plains. It is similar to *C. pygmaeus*, which occurs in rocky outcrops and has stellate trichomes with free lateral rays, vs. lepidote trichomes with rays almost entirely united in *C. ericoides*.

Croton fulvus Martius in Spix & Martius (1823: 282).—*Croton vepretorum* Müller Argoviensis (1873: 165), *nom. illeg.* Type:—BRAZIL. Minas Gerais: “prope Barreira, inter frutices, ad camporum margines et in vepretis”, s.d., C.F.P. von Martius 1407 (lectotype: M 0089129! designated by Sodré & Silva (2020); isolectotype: G 00434720!).

Croton agrarius Baillon (1864: 319). Type:—BRAZIL. Minas Gerais: without further locality, 1838, P. Claussen 764 (lectotype: P 00623663!, designated by Sodré *et al.* 2017); remaining syntypes:—BRAZIL. Minas Gerais: 1816–1821, A.F.C.P. Saint-Hilaire *cat. C1, 210bis* (P 00623661, P 00623662, [digital images!]).

Croton alnoideus Baillon (1864: 319). Type:—BRAZIL. Without locality, s.d., Collector unknown (holotype: P 00623649 [digital image!]).

Croton cordobensis Ahumada (1999: 170). Type:—ARGENTINA. Córdoba: Sobremonte, Ruta Nacional No 9, Sierra de Ambargasta, 15 February 1982, *U.G. Eskuche 4995* (holotype: CTES, isotype: SI).

Croton medians Müller Argoviensis (1873: 169). Type:—BRAZIL. Minas Gerais: Lagoa Santa, 24 November 1863, *E. Warming s.n.* (lectotype: G 00434618, designated by Sodré & Silva (2020); isolectotypes: A 00047342 [digital images!]).

Croton missionum Croizat (1944: 446). Type:—ARGENTINA. Misiones: Santa Ana, 18 November 1909, *F.M. Rodriguez 45* (lectotype: A 00047348!, designated by Sodré & Silva (2020); isolectotypes: A 00047349, A 00303793, A 00303794, LIL 000789, LIL 000790, SI 001372, SI 001373, U 1271422 [digital images!]).

Croton peraffinis Müller Argoviensis (1873: 166). Type:—BRAZIL. Tocantins: between the municipalities of Porto Nacional and Natividade, s.d., *W.J. Burchell 8306* (lectotype: K 000186137, designated by Sodré & Silva (2020); isolectotype: BR 0000008760180); remaining syntypes:—BRAZIL. Minas Gerais: “in campis prope Lagoa Santa”, s.d. *E. Warming 1645/5* (A 00257976, C 10011189, G 00434652, P 00634598 [digital images!]).

Croton pohlianus Müller Argoviensis (1865: 92) Type:—BRAZIL. Goiás: Serra de Christaës, s.d., *J.B.E. Pohl 1610* (lectotype: G 00434639! [photo at F 24520], designated by Caruzo & Cordeiro 2007; isolectotypes: A 00257979, BR 0000008761521, M 0089114, W 0051229, W 0051230 [digital images!]); remaining syntype:—BRAZIL. Without locality, s.d., *F. Sellow s.n.* (B not found, probably destroyed).

Croton regnellianus Müller Argoviensis (1865: 122). Type:—BRAZIL. Minas Gerais: “ad Caldas”, 1867, *A.F. Regnell I 399* (holotype: S S-R-1056!, isotypes: A 00047393, BR 0000008552747, BR 0000008553072, F 0056189F, NY 01281033, P 00634653, P 00634654, US 00109669, US 01014156 [digital images!]).

Croton subagrarius Müller Argoviensis (1873: 174). Type:—BRAZIL. São Paulo: Itu, 1839, *P.W. Lund s.n.* (lectotype: G n.v. [photo at F 24530], designated by Caruzo & Cordeiro 2007); remaining syntypes:—BRAZIL. “Brazilia occidentalis”, s.d., Tamberlik s.n. (G 00434680, W 0051220 [only the branch on the right], [digital images!]).

Croton turnerifolius Moore (1895: 458). Type:—BRAZIL. Mato Grosso: Santa Cruz, 1891–1892, *S.L. Moore 575* (lectotype: BM 000947404, designated by Sodré & Silva (2020); isolectotypes: E 00326417, K 000254411, P 00634805 [digital images!])

Croton ypanemensis Müller Argoviensis (1873: 165). Type:—BRAZIL. São Paulo: “in campis graminosis siccis prope Ypanema”, s.d., *G.H. Langsdorff s.n.* (holotype: G 00434712 [digital image!]).

Selected material: ARGENTINA. Córdoba: Tulumba. 20 March 2007. *B. W. Van Ee; P. E. Berry & H. Illaraga Van Ee 652* (MO). BRAZIL. Rio Grande do Sul: Giruá. October 1963. *K. Hagelund 2021* (ICN).

Distribution:— This species is native from Argentina and Brazil. In Brazil occurs in the states of Bahia, Goiás, Maranhão, Mato Grosso do Sul, Minas Gerais, Pará, Paraná, Rio Grande do Sul, Santa Catarina and Tocantins. Figures 3 and 10 (C).

Notes: *Croton* [sect. *Adenophylli* Grisebach (1859-1864)]. Species similar to *C. lanatus*, due to their habit and underground system. *C. fulvus* may not have glands at the base of the blade vs. glands always present in *C. lanatus*.

Croton glandulosus Linnaeus (1759: 1275). Type:—JAMAICA. *P. Browne s.n.* (Lectotype Herb. LINN 1140.7! Designated by Fawcett & Rendle (1920).

Selected material: ARGENTINA. Corrientes: San Martin. 28 October 2012. *W. Medina et al.* 247 (CTES). BRASIL. Rio Grande do Sul: Torres. Parque Estadual de Itapeva. 15 January 2017. *E. Valduga* 754 (ICN). URUGUAY. Rivera. 22 February 1966. *E. Marchesi* 1493 (MVFA).

Distribution:—North, Central and South America. In Brazil, the species is found in all Brazilian states. Figures 4 and 10 (D).

Notes: *Croton* sect. *Geiseleria* (Gray 1856: 391) Baillon [1858: 359]. Similar to *C. lundianus* by its habit and leaves morphology, but differs by the inflorescence without flowers uniformly distributed along the axis, vs. the inflorescence free of flowers between the pistillate and staminate flowers in *C. lundianus*.

Croton glechomifolius Müller Argoviensis (1865: 126). Type:—BRAZIL. Paraná: Central East Mesoregion, 15 November 1828, F. Sellow s.n. (holotype: B†, photo at F 249290!); Neotype:—BRAZIL. São Paulo: “in campis graminosis ad furnas”, March 1826, L. Riedel 263 (LE 00018218!, designated by Sodré *et al* (2019)).

Croton tragifolius Baillon (1865: 16). Type:—BRAZIL. São Paulo. “bord du chemin, près le rio Verde”, A.S. *Hilaire cat.* C2 1387 (P barcode 00493389! [digital image]).

Distribution:—This species is found in Argentina and Brazil. In Brazil occurs in the states of Paraná, Rio Grande do Sul, Santa Catarina and São Paulo. Figures 4 and 10 (E).

Selected material: ARGENTINA. Misiones: Manuel Belgrano. 21 October 2006. *H. A. Keller* 3722 (CTES). BRAZIL. Rio Grande do Sul: Tapes. Saco de Tapes. Lagoa dos Patos. December 1980. *J. Goergen s/n.* (ICN).

Notes: *Croton* sect. *Geiseleria* (Gray 1856: 391) Baillon [1858: 359]. Similar *C. lundianus*. It differs mainly by its smaller, reniform leaves, vs. elliptic leaves in *C. lundianus*.

Croton gnaphalii Baillon (1864: 359). *Adansonia* 4: 359. 1864. Type:—Brazil, Rio Grande do Sul. *C. Gaudichaud* 1673 s.d. Lectotype P barcode 06773115 [digital image!], here designated.

Croton argentinus Müller Argoviensis (1874: 2004). **syn. nov.** Type:—ARGENTINA. Cordoba: Las Penãs *P.G. Lorentz* 426 (Lectotype G barcode 00434468 [digital image!]). Designated by Lima & Pirani (2008). Remnant of original syntype: “Argentina, prov. Cordoba, Las Penãs, *habitat in collibus saxosis*”, *P.G. Lorentz* 288 jan. 1871, G barcode 00434467 [digital image!], K barcode 000574051! [digital image!]).

Selected material: ARGENTINA. Corrientes: Isla Toledo. Río Paraná. 27 July 1944. T. S. Ibarrola s/n. (SI). Entre Ríos: Santa Ana. 12 December 1966. E. R. Guaglianone, N. E. Mulgura & N. Bacigalupo 452 (SI). BRASIL. Rio Grande do Sul: Porto Alegre. Morro da Extrema. August 2004. C. Mansan 593 (ICN). URUGUAY. San José: Autodromo Nacional. 11 November 1964. O. Del Puerto 3695 (MVFA). Colonia: Riachuelo. 10 February 1934. A. L. Cabrera 2832 (LP).

Distribution:—This species is endemic to Pampas grasslands, occurs in Argentina, Uruguay and Brazil. Figures 4 and 10 (F).

Notes: *Croton* sect. *Lamprocroton* (Müller Argoviensis) Pax [1890: 40]. *Croton argentinus* had been recorded to Brazil by Lima & Pirani (2008) to one single locality in Rio Grande do Sul, in the Municipality of São Borja, been the remaining collections from Argentina. The remaining collections of this species and its distribution was found in the herbariums visited, predominantly in Argentina. Both species have wide morphological variability. The vegetative and reproductive characters overlap. Due to this wide morphological variation and having intermediate individuals among the various morphotypes, it is considered here *C. argentinus* as a synonym for *C. gnaphalii*.

Croton helichrysum Baillon (1864: 358). Type:—BRAZIL. Rio Grande do Sul: Tramandaí A. S. Hilaire. *cat. C², 1830.*” (Holotype P00623564 [digital image!]; Isotypes: A 00047312, R 000129479, K 000186154, P 00623565, P 00623566, SI 001364, US 00109578 [digital images!]).

Selected material: BRASIL. Rio Grande do Sul: Palmares do Sul. Lagoa da Porteira. 24 September 2011. E. Valduga 99 (HUCS).

Distribution:—This species is endemic to Brazilian Pampas grasslands. Figures 4 and 10 (G).

Notes: *Croton* sect. *Barhamia* (Klotsch 1853: 104) Baillon [1858: 367]. Shrub coastal species, grows on psamphilic soil, on the edge of restinga forests and around lakes and rivers. Easily recognizable by its spatulated leaves. It is endemic to Rio Grande do Sul, Brazil.

Croton hilarii Baillon (1864: 322). Type:—URUGUAY. Rocha: Cerro Aspero, 1816, A. St. Hilaire *Catal. C2 #2069ter* (holotype P 00623552 [digital image!]).

Croton emporiorum Croizat (1940: 97). **syn. nov.** Type:—BOLIVIA. “Toldos near Bermejo, 1900 m”, K. Fiebrig 2243 (Holotype A 00246510 [digital image!]).

Croton pomaderris Baillon (1864: 311). **syn. nov.** Type:—BRAZIL. “In Prov. De Saint-Paul”, A.S. Hilaire *cat. C², n. 1426.* (Holotype P 00634615 [digital image!]).

Croton stenotrichus Müller Argoviensis (1865: 105). Type:—BRAZIL. “In Brasilia meridional”, F. Sellow 2571 (Lectotype B 100127733; Isolectotype A 00277230 [digital images!]). Designated by Valduga *et al.* (2021).

Selected material: BRAZIL. Rio Grande do Sul: Passa Sete. 14 October 2018, *C. Rabuske Silva, C. C. Alff* 363 (ICN). URUGUAY. Cerro Largo: Paso de Tia Lucia a Fraile Muerto, 11 November 1965, *B. R. Arrilaga et al.* 2439 (MVFA).

Distribution:—This species is found in Argentina, Bolivia, Brazil, Paraguay and Uruguay. In Brazil occurs in the states of Paraná, Rio Grande do Sul and Santa Catarina. Figures 5 and 11 (A).

Notes: *Croton* sect. *Barhamia* (Klotsch 1853: 104) Baillon [1858: 367]. Shrub similar to *C. lanatus*, but differs by its more developed size and globose and congested inflorescences vs. smaller size and long inflorescences of *C. hilarii*. *Croton emporiorum* and *C. pomaderris* were synonymized since their characters overlap with *C. hilarii*.

Croton lachnostephanus Baillon (1864: 357). Type:—URUGUAY. Maldonado: Pan de Azúcar 1816-21. *A.S. Hilaire, cat. C², 2139*, (Holotype P 00634659 [digital image!]).

Selected material: URUGUAY. Maldonado: Cerro Pan de Azúcar. 12 November 1970. *O. Del Puerto, P. Izaguirre & E. Marchesi* 9664 (MVFA).

Distribution:—Endemic species to Uruguayan Pampas grasslands, is found only in Maldonado department. Figures 3 and 11 (B).

Notes: *Croton* sect. *Lamprocroton* (Müller Argoviensis 1873:243) Pax [1890: 40]. Sympatric species with *C. chamaepitis*, endemic to Uruguay, occurs only in the Department of Maldonado (Pan de Azúcar and Sierra de las Animas). *C. chamaepitis* has leaves up to 0.6 cm wide, vs. exceeding 1.0 cm in *C. lacnostephanus*.

Croton lanatus Lamarck (1876: 211). Type:—URUGUAY. Montevideo: without further locality *P. Comerson s.n.* (Holotype P barcode 00674054 [digital image!]).

Selected material: ARGENTINA. Corrientes: San Miguel. 24 September 2012. *W. A. Medina, R. Cajade, B. Fandibo* 167 (CTES). BRAZIL. Rio Grande do Sul: Piratini. Chácara Gomes. 09 January 2018. *E. Valduga* 840 (ICN). URUGUAY. Rocha: Parque San Miguel. 6 October 1965. *O. Del Puerto & E. Marchesi* 5240 (MVFA).

Distribution:—This species is endemic to Pampas grasslands, found in Argentina, Brazil and Uruguay. Figures 5 and 11 (C).

Notes: *Croton* sect. *Adenophylli* Grisebach (1859-1864). Subshrub, with well developed underground system which survives the dry season and fire allowing shoot regrowth. It can be more easily confused with *C. hilarii* due to the presence of glands at the base of the leaf blade, however *C. lanatus* has a smaller habit and long inflorescences vs. bigger habit and congested inflorescences of *C. hilarii*.

Croton lombardianus Croizat (1942: 1) Type:—URUGUAY. “Montevideo: Malvin em arenas,” nov. 1925. *A. Lombardo* 228, A barcode 00047334 [digital image!].

Selected material: BRAZIL. Rio Grande do Sul: Palmares do Sul, Lagoa da Porteira, 27 November 2011, *F. Gonzatti* 261 (HUCS). URUGUAY. Canelones: Carrasco, 06 November 1960, *B. Rosengurt* 7781 (MVM).

Distribution:—This species is found in Uruguay and Brazil. In Brazil occurs in the states of Rio Grande do Sul and Santa Catarina. Figures 5 and 11 (D).

Notes: *Croton* sect. *Barhamia* (Klotsch 1853: 104) Baillon [1858: 367]. Prostrate subshrub from sandy plains of Uruguay, Rio Grande do Sul and southern Santa Catarina. The sepals have stipitate glands on its serrate margins.

Croton lundianus (Didrichsen) Müller Argoviensis (1866: 662) *Podostachys lundiana* Didrichsen (1857: 137). Type:—BRAZIL. São Paulo: Taubaté, XI-1833, P.W. Lund s.n. (holotype C barcode 10011178 [digital image!]).

Selected material: ARGENTINA. Corrientes: Ituzaingó. 21 January 1987. S. Ginzabrg, M. Urbani & J. Daviña 366 (SPF). BRAZIL. Rio Grande do Sul: Torres. 17 January 1966. K. Hagelund 3970 (ICN).

Distribution:—This species is found in Argentina and Brazil. In Brazil it occurs in all states. Figures 6 and 11 (E).

Notes: *Croton* sect. *Geiseleria* (Gray 1856: 391) Baillon [1858: 359]. Most similar to *C. glandulosus*, but differs by the axis of inflorescence without flowers between the staminate and pistillate cymulae, vs. contiguous in *C. glandulosus*.

Croton montevidensis Sprengel (1826: 873). Type:—URUGUAY. Montevideo: F. Sellow s.n. (Holotype BR barcode 00000855292 G barcode 00311734 K barcode 000186156 K barcode 000186153 P barcode 00634510 L barcode 0234914 [digital images!]).

Selected material: BRAZIL. Rio Grande do Sul: Cristal. Rio Camacuã. 08 January 2018. E. Valduga 835 (ICN). URUGUAY. Maldonado: Cerro Bertete. Sierra de las Animas. 27 October 1996. M. Bonifacino & E. Mendez s/n. (MVFA).

Distribution:—This species is endemic to Pampas grasslands in Brazil and Uruguay. Figures 7 and 11 (H).

Notes: *Croton* sect. *Barhamia* (Klotsch 1853: 104) Baillon [1858: 367]. Shrub similar to *C. cuchillae-nigrae* and *C. parvifolius* but differs by the calyx of the pistillate flowers bigger than the staminate one. Besides, the calyx margin is reduplicated and overlaps the fruit, vs. not reduplicate in *C. cuchilla-nigrae* and *C. parvifolius*.

Croton myrianthus Müller Argoviensis (1865: 138) *Croton pallidulus* var. *myrianthus* Müller Argoviensis (1865: 249) Smith & Smith (1988: 127). Type:—BRAZIL. “In Brasilia Meridionali”, F. Sellow s.n. (Holotype, B destroyed; Lectotype SP 18550!). Designated by Lima & Pirani (2008).

Selected material: ARGENTINA. Misiones: General Belgrano. 06 December 2007. M Dematteis 2701. (CTES). BRAZIL. Rio Grande do Sul: Canoas. Quinta do Valdemar. 07 December 1939. Imão Augusto s/n. (ICN).

Distribution:—This species is found in Argentina and Brazil. In Brazil occurs in the states of Paraná, Rio Grande do Sul and Santa Catarina. Figures 7 and 11 (F).

Notes: *Croton* sect. *Lamprocroton* (Müller Argoviensis 1873: 243) Pax [1890: 40]. Subshrubs to shrubs with porrect-lepidote trichomes. Similar to *C. uruguayensis*, however, it presents lepidote trichomes on the adaxial surface of the leaves, vs. stellate trichomes in *C. uruguayensis*.

Croton nitrariifolius Baillon (1864: 351) Type:—BRAZIL. Without further locality. *F. Sellow* s.n (Lectotype B barcode 100086870 Isolectotype: K barcode 000254375 designated here [digital images!]).

Selected material: BRAZIL. Rio Grande do Sul: Barão do Triunfo. Morrinhos. 04 May 2013. *A. Knob & S. Bordignon*. 2989 (ICN). URUGUAY. Maldonado: Cerro de la Salamanca. 26 March 1939. *B. Rosengurt B-2892* (MVFA).

Distribution:—This species is endemic to Pampas grasslands in Brazil and Uruguay. Figures 6 and 11 (G).

Notes: Shrub similar to *C. montevidensis*, sect. *Barhamia* (Klotsch 1853: 104) Baillon [1858: 367] but its sepals of the pistillate flowers are connate as a cup vs. free and reduplicated in *C. montevidensis*.

Croton parvifolius Müller Argoviensis (1864: 537) Type:—BRAZIL. “In Brasilia meridional ad flumem Parana” may 1858. *B. D. Gilbert* 26, 81. (Lectotype K barcode 000574046! [digital image]; Isolectotype K barcode 000574045 [digital image!] designated here).

Selected material: ARGENTINA. Buenos Aires: Partido de Coronel Suárez. Estancia El Lolén. 16 December 1979. *L. Pertusi* 192 (LP). BRAZIL. Rio Grande do Sul: Piratini. Cerro da Chácara Gomes. 09 January 2018. *E. Valduga* 841 (ICN). URUGUAY. Treinta y Tres: Quebrada de los Cuervos. 03 March 1972. *O. Del Puerto & E. Marchesi* s/n. (MFVA).

Distribution:—This species is endemic to Pampas grasslands in Argentina, Uruguay and Brazil. Figures 7 and 12 (A).

Notes: Subshrub sect. *Barhamia* (Klotsch 1853: 104) Baillon [1858: 367], similar to *C. montevidensis* and *C. nitrariifolius*. It differs because it is a smaller subshrub, with spatulate leaves and free sepals while in *C. montevidensis* the sepals of the pistillate flowers are reduplicated and cup-shaped in *C. nitrariifolius*, vs. oblong to ovate sepals of the pistillate flowers in *C. parvifolius*. The lectotype of *C. parvifolius* was chosen because there is an annotation on the exsiccate indicating it is the original material.

Croton pycnocephalus Baillon (1864: 356) Type:—BRAZIL. Rio Grande do Sul: without further locality *C. Gaudichaud* 1668 (*alpha*). (Lectotype A barcode 00047390 Isolectotype A 00047391 [digital images!]), designated by Ahumada (1991).

Croton isabellei Baillon (1864: 318), **syn. nov.** Type:—BRAZIL. Rio Grande do Sul: without further locality, *Isabelle* 1835 (Lectotype, P 00623534! [digital image]; Isolectotypes, F V0092876F P 00623534 [digital images!]). Remaining syntypes 1816-1821, P 00623532 P 00623533 F V0093319F [digital images!]). designated by Lima & Pirani (2008).

Croton julopsidium Baillon (1864: 318) Type:—BRAZIL. Rio Grande do Sul: without further locality 1833, *C. Gaudichaud* 1675, P 00623525 [digital image!].

Selected material: BRAZIL. Rio Grande do Sul: São Sepé. 30 September 1982. A. Nilson 127 (HAS).

Distribution:—This species is endemic to Brazil, in the states of Paraná, Rio Grande do Sul and Santa Catarina. Figures 7 and 12 (B).

Notes: *Croton* sect. *Lamprocroton* (Müller Argoviensis 1873: 243) Pax [1890: 40]. *Croton pycnicephalus* is a subshrub very similar to *C. echinulatus*. It differs mainly by the most robust inflorescences and never nigrescent, the trichomes of the pistillate flowers have a stipite of equal width, from the base to the apex in *C. pycnocephalus*, vs. tiny nigrescent inflorescences and the trichomes of the pistillate flowers have a stipite of unequal width. Larger in the base, thinning at the apex in *C. echinulatus*. *C. isabellei* has characteristics that overlap with *C. pycnocephalus*, such as the same number of stamens and type of indument.

Croton pygmaeus Lima (2008: 126) Type: —Brazil, Rio Grande do Sul, Caçapava do Sul. 21 January 1994. D.B. Falkenberg, J.R. Stehmann & A.O. Vieira 6483 (Holotype MBM barcode 0202813 [digital image!]).

Selected material: BRAZIL. Rio Grande do Sul. Quevedos. 10 April 2002. A. Knob & S. Bordignon 7160 (ICN, UNILASALLE).

Distribution:—This species is endemic to Brazilian Pampas grasslands. Figure 7.

Notes: *Croton* sect. *Lamprocroton* (Müller Argoviensis 1873: 243) Pax [1890: 40]. *C. pygmaeus* is similar to *C. ericoides* but differs mainly by the indument of lepidote trichomes of the adaxial surface of leaves vs. stellate trichomes in *C. pygmaeus*. While *C. ericoides* grows in sand plains near lakes, *C. pygmaeus* is found in rocky outcrops.

Croton quintasii Allem (1979: 70) Type:—BRAZIL. Rio Grande do Sul: Encruzilhada do Sul. Lindemam, Irgang e Valls s.n. 09 September 1972. (Holotype ICN 20552!).

Selected material: BRAZIL. Rio Grande do Sul. Alegrete. 07 July 2018. E. Valduga 855 (ICN). URUGUAY. Cerro Largo: Punta del Tacuarí. 26 October 2017. A. Gonzalez (ICN).

Distribution:—This species is endemic to Pampas grasslands in Brazil and Uruguay. Figures 7 and 12 (C).

Notes: Subshrub similar to other species from *Croton* sect. *Barhamia* (Klotsch 1853: 104) Baillon [1858: 367], mainly to *C. ramboi*, from which it differs by its prostrate habit and sepals with entire margins vs. erect habit and sepals with serrate margins in *C. ramboi*.

Croton ramboi Allem (1979: 64) Type:—BRAZIL. Rio Grande do Sul: São Leopoldo: Morro de Steinkopf B. Rambo S.J. s.n. 20 December 1948. (Holotype PACA 39052!).

Selected material: BRAZIL. Rio Grande do Sul: Sapucaia do Sul, Morro das Cabras. 11 October 2018. E. Valduga 864 (ICN).

Distribution:—This species is endemic to Brazilian Pampas grasslands. Figures 8 and 12 (E).

Notes: *Croton* sect. *Barhamia* (Klotsch 1853: 104) Baillon [1858: 367]. Shrub to subshrub endemic of sandstone hills in the region of the Municipality of São Leopoldo, in the State of Rio Grande do Sul, Brazil. Similar in habit and leaves to *C. quintasii*, from which it differs by the serrate glandulous pistillate sepals and erect habit, vs. prostrate habit and entire pistillate sepal in *C. quintasii*.

Croton serratifolius Baillon (1864: 312) Type:—BRAZIL. Rio Grande do Sul: without further locality A.S. *Hilaire* cat. C2 2704 (Holotype P barcode 00493376 [digital image!]) Isotype A barcode 0047422 [digital image!]).

Croton garckeanus Baillon (1864: 308) Type:—BRAZIL. Rio Grande do Sul: *Gaudichaud-Beaupré* 1656 (Holotype P barcode 00222704 [digital image!]).

Croton pimeleus Baillon (1864: 307) Type:—BRAZIL. Rio Grande do Sul: *Saint-Hilaire* cat. C2 1391 (Holotype P barcode 00634586 [digital image!]; Isotype A barcode 00047380 [digital image!]).

Selected material: ARGENTINA. Misiones: San Ignacio. 3 June 1946. G. J. Scwartz 2753 (LIL). BRAZIL. Rio Grande do Sul: Arroio dos Ratos, Granja Faxinal. 01 October 1977. K. Hagelund 11713 (ICN). URUGUAY. Rivera. 12 December 1997. E. Marchesi & I. Grela s/n. (MVFA).

Distribution:—This species is found in Argentina, Brazil and Uruguay. In Brazil occurs in the states of Mato Grosso do Sul, Paraná, Rio Grande do Sul, Santa Catarina and São Paulo. Figures 8 and 12 (D)

Notes: *Croton* sect. *Barhamia* (Klotsch 1853: 104) Baillon [1858: 367]. Similar to *C. hilarii* by the leaves but differs mainly by glandular stipules, bracts and calyx, vs. not glandular in *C. hilarii*.

Croton uruguayensis Baillon (1864: 292) Type:—URUGUAY. 1816 – 1821. A.S. *Hilaire* cat. C², n. 2449 o. (Lectotype P 00634814 [digital image!]; Isolectotype P 00634813 [digital image!]). Designated by Lima & Pirani (2008).

Croton gaudichaudii Baillon (1864: 293) Type:—BRAZIL. Rio Grande do Sul: 1833. *Gaudichaud* 1672 (Lectotype P 00634807 [digital image!]; Isolectotype P 00634806 [digital image!]; Remaining syntypes: P 00634806; P 00634809; P 00634808 [digital images!]). Designated by Lima & Pirani (2008).

Selected material: ARGENTINA. Entre Ríos: Federación. 12 January 1990. N. M. Bacigalupo et al 1258 (MBM). BRAZIL. Rio Grande do Sul: São Borja, Estância das Bonitas. 27 March 2003. R. A. Záchia 5564 (ICN). URUGUAY. Salto: Salto Grande. 12 September 1961. O. Del Puerto 33 (MVFA).

Distribution:—This species is found in Argentina, Brazil and Uruguay. In Brazil occurs in the States of Paraná, Rio Grande do Sul and Santa Catarina. Figures 8 and 12 (F).

Notes: *Croton* sect. *Lamprocroton* (Müller Argoviensis 1873: 243) Pax [1890: 40]. Shrubs to subshrubs easily confused with *C. myrianthus*. Differing mainly by the leaves strongly discolor with glabrous adaxial face, rarely with sparse trichomes and densely tomentose abaxial face in *C. uruguayensis*, vs. mostly concolor leaves with densely lepidote trichomes on the adaxial face in *C. myrianthus*.

Figures

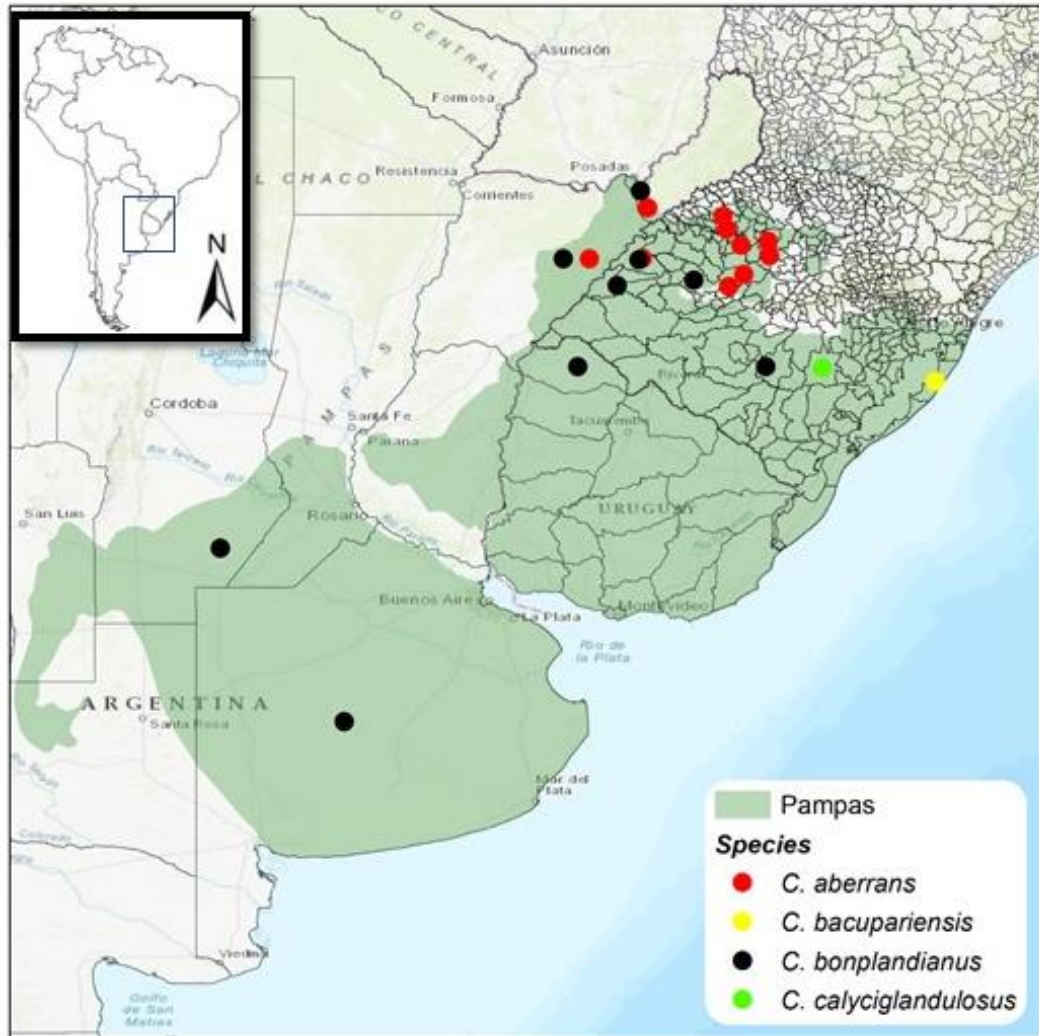


Figure 1. Distribution of *Croton* species (Euphorbiaceae) in the Pampas grasslands. Red dot: *Croton aberrans*, Yellow dot: *Croton bacupariensis*, Black dot: *Croton bonplandianus*, Green dot: *Croton calycglandulosus*. The study area is highlighted in green.

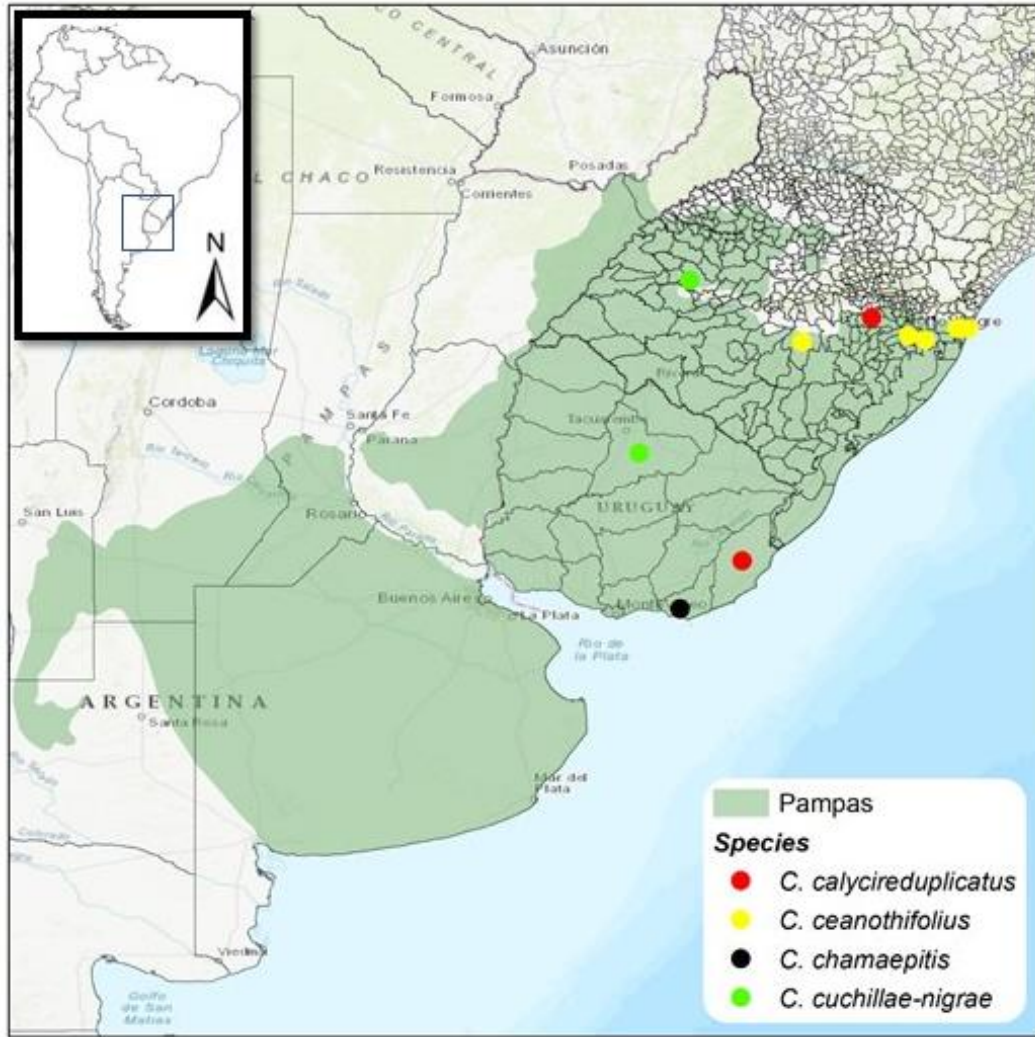


Figure 2. Distribution of *Croton* species (Euphorbiaceae) in the Pampas grasslands. Red dot: *C. calycireduplicatus*. Yellow dot: *Croton ceanothifolius*. Black dot: *Croton chamaepitis*. Green dot: *Croton cuchillae-nigrae*. The study area is highlighted in green.

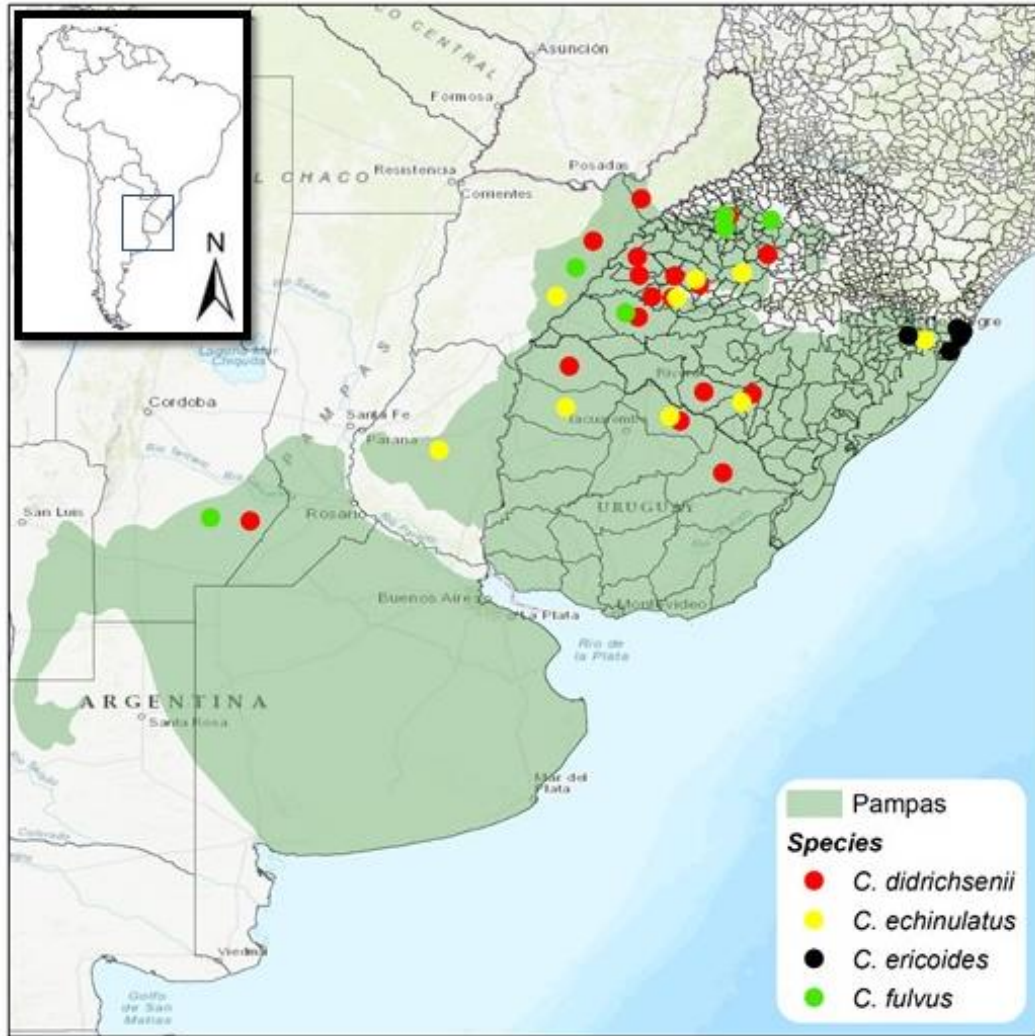


Figure 3. Distribution of *Croton* species (Euphorbiaceae) in the Pampas grasslands. Red dot: *Croton didrichsenii*. Yellow dot: *Croton echinulatus*. Black dot: *Croton ericoides*. Green dot: *Croton fulvus*. The study area is highlighted in green.

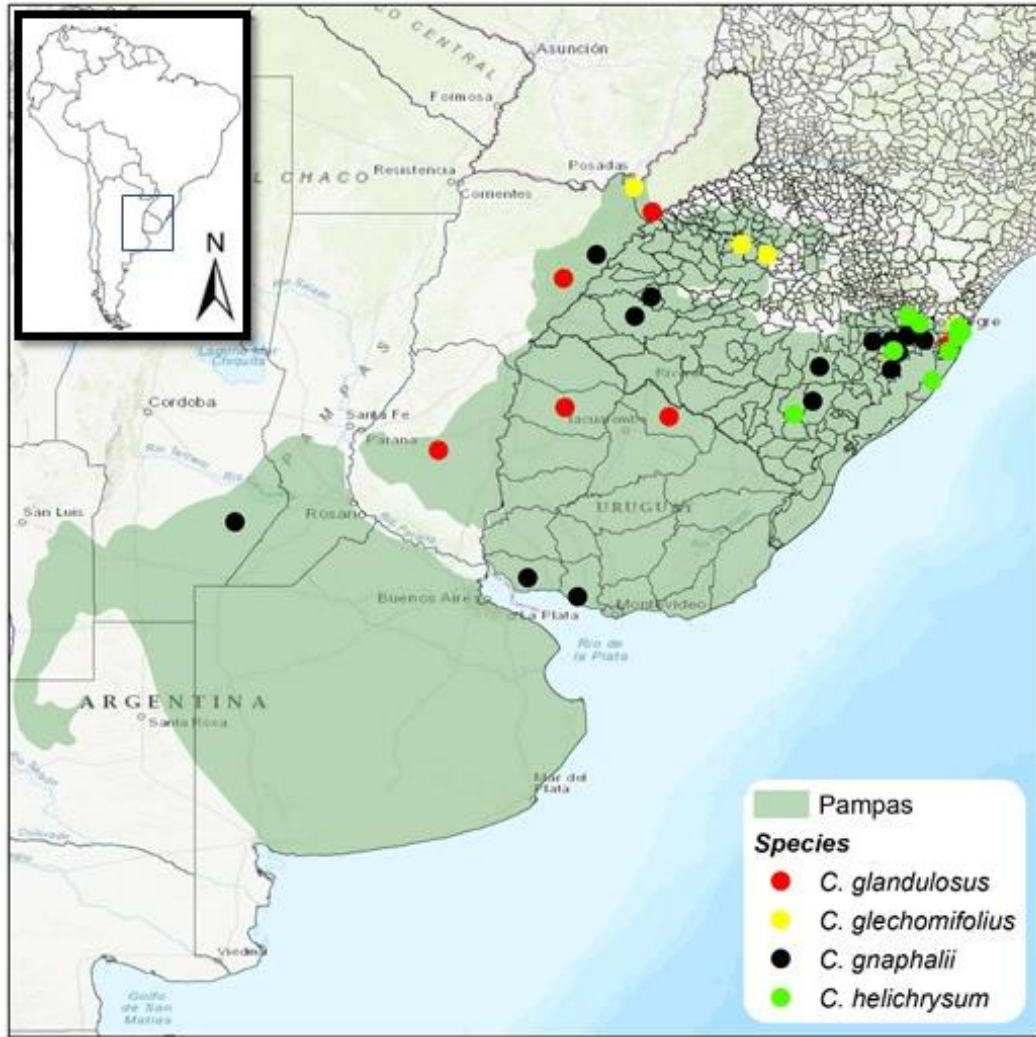


Figure 4. Distribution of *Croton* species (Euphorbiaceae) in the Pampas grasslands. Red dot: *Croton glandulosus*. Yellow dot: *Croton glechomifolius*. Black dot: *Croton gnaphalii*. Green dot: *Croton helichrysum*. The study area is highlighted in green.

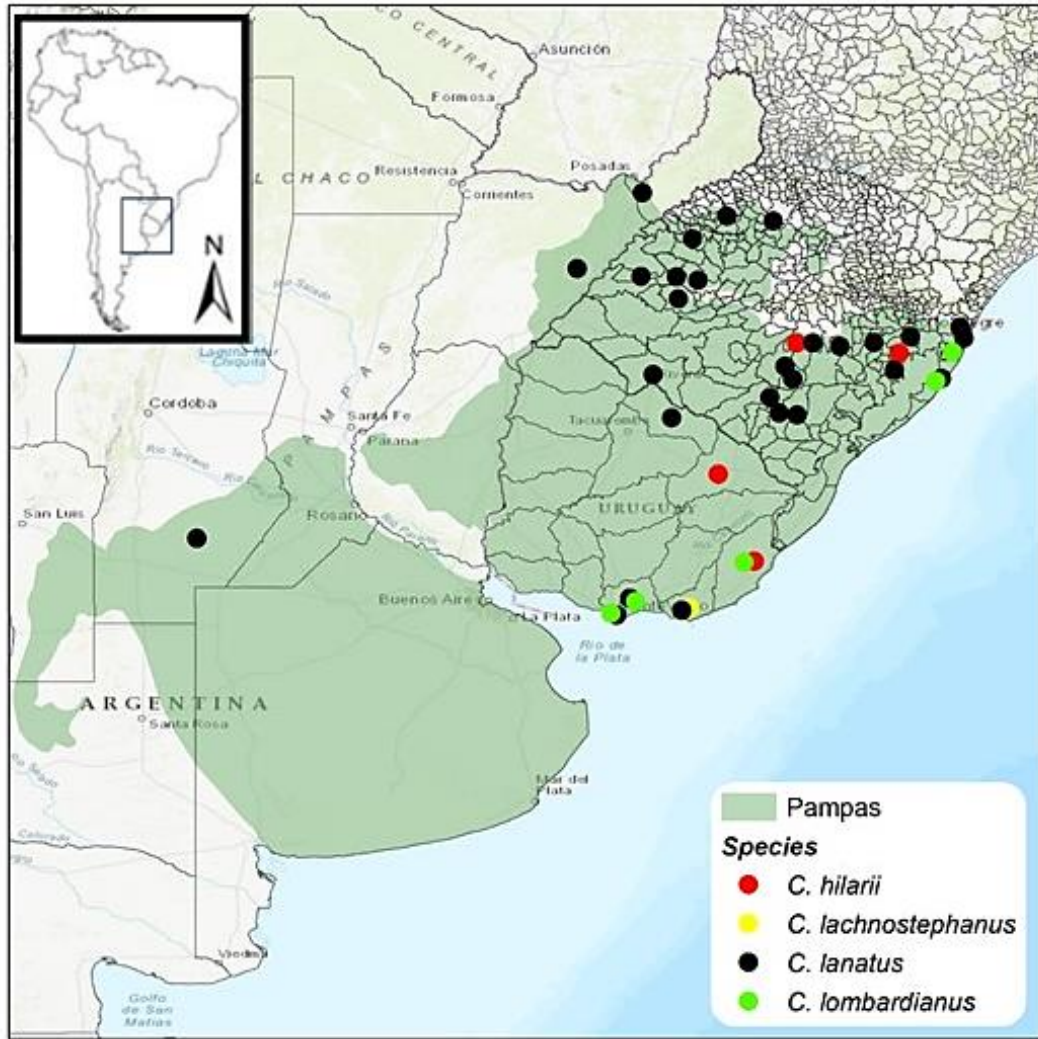


Figure 5. Distribution of *Croton* species (Euphorbiaceae) in the Pampas grasslands. Red dot: *Croton hilarii*. Yellow dot: *Croton lachnostephanus*. Black dot: *Croton lanatus*. Green dot: *Croton lombardianus*. The study area is highlighted in green.

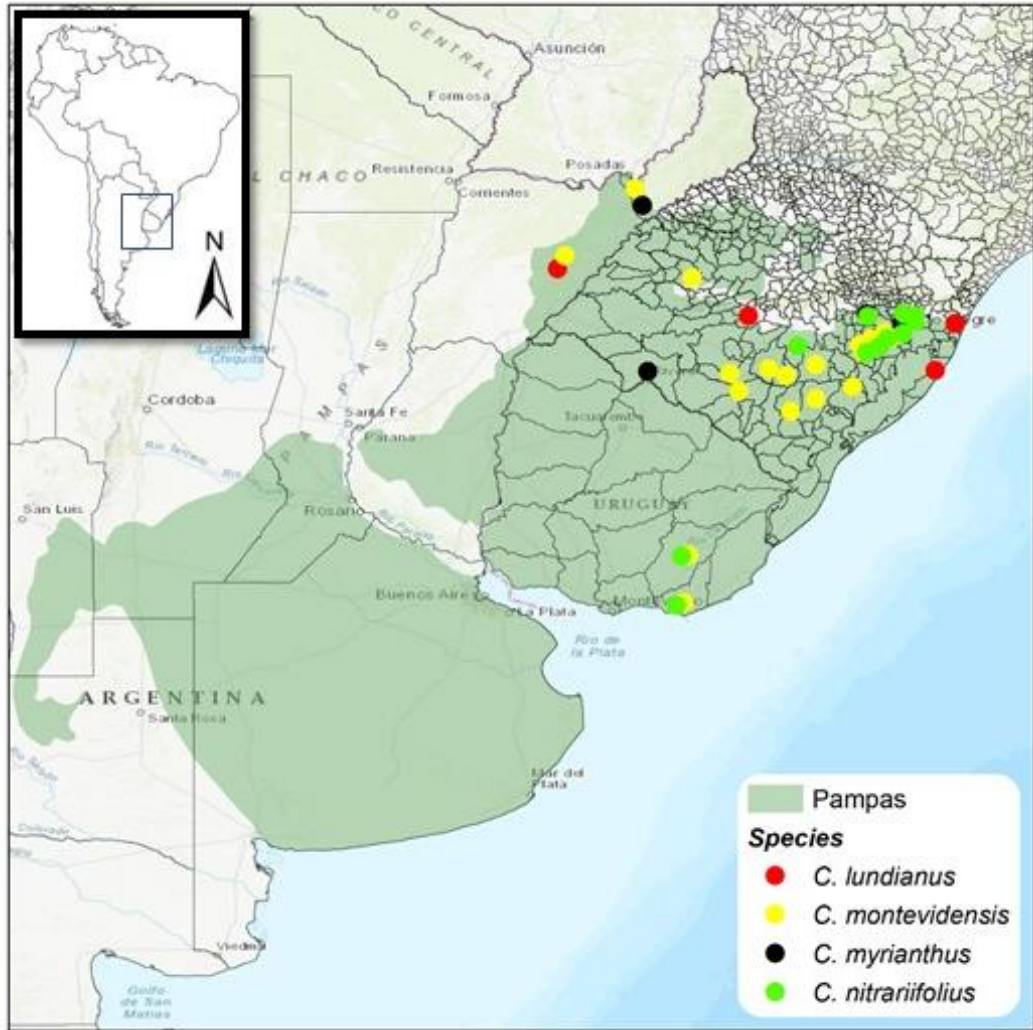


Figure 6. Distribution of *Croton* species (Euphorbiaceae) in the Pampas grasslands. Red dot: *Croton lundianus*. Yellow dot: *Croton montevidensis*. Black dot: *Croton myrianthus*. Green dot: *Croton nitrariifolius*. The study area is highlighted in green.

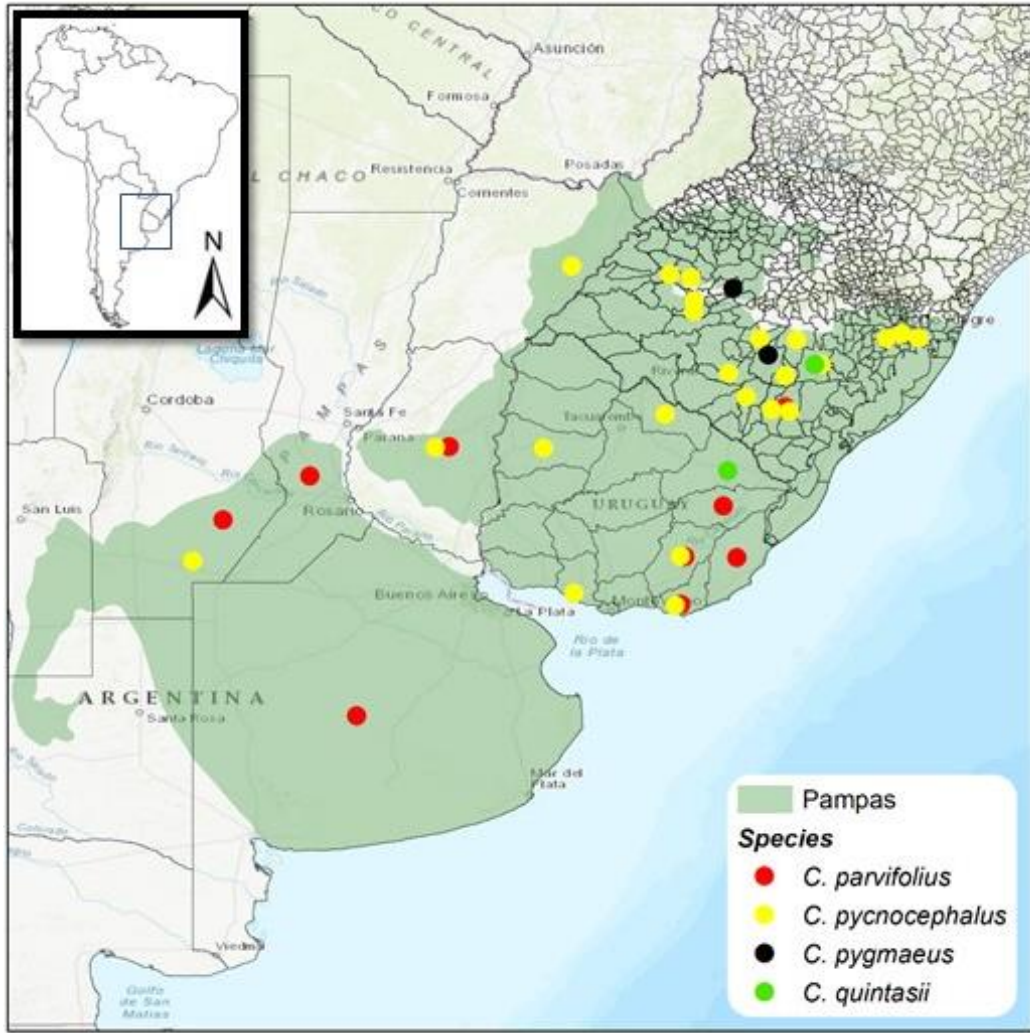


Figure 7. Distribution of *Croton* species (Euphorbiaceae) in the Pampas grasslands. Red dot: *Croton parvifolius*. Yellow dot: *Croton pycnocephalus*. Black dot: *Croton pygmaeus*. Green dot. *Croton quintasii*. The study area is highlighted in green.

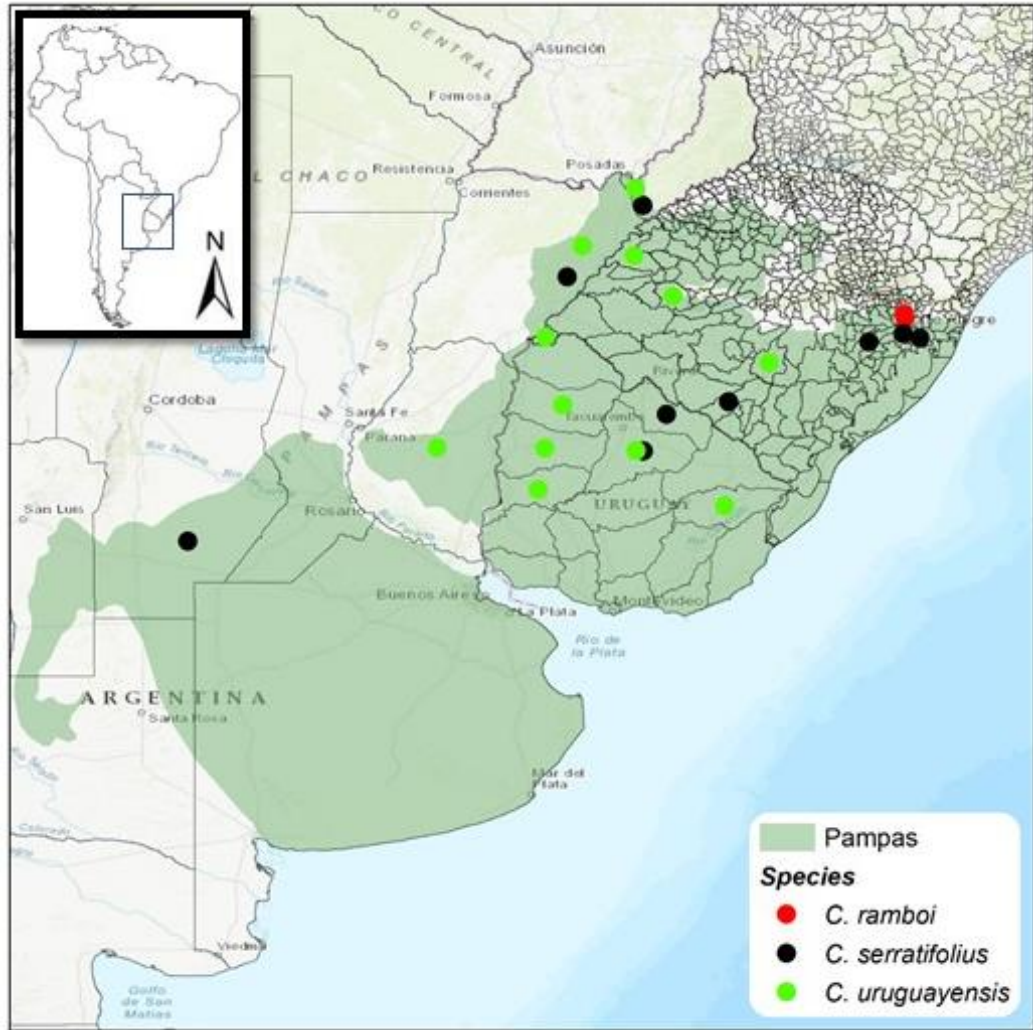


Figure 8. Distribution of *Croton* species (Euphorbiaceae) in the Pampas grasslands. Red dot: *Croton ramboi*. Black dot: *Croton serratifolius*. Green dot: *Croton uruguayensis*. The study area is highlighted in green.

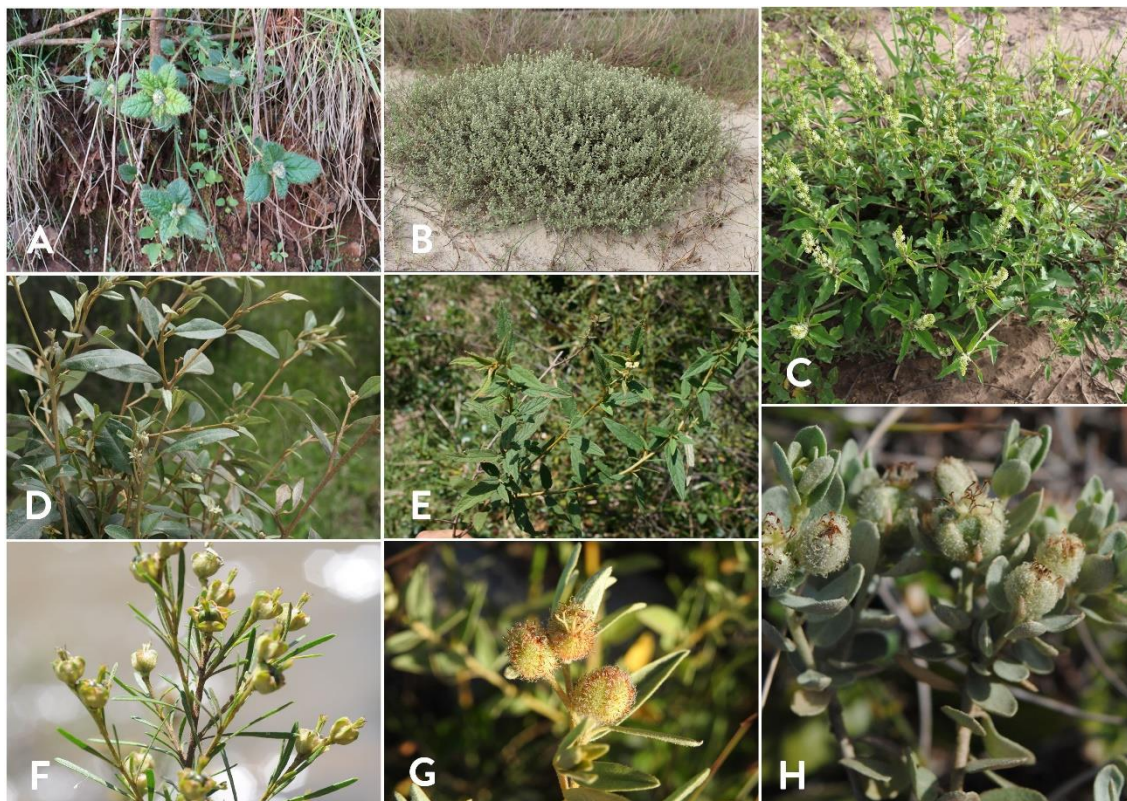


Figure 9. Species of *Croton* (Euphorbiaceae) from the Pampas grasslands. *Croton aberrans* (A), *C. bacupariensis* (B), *C. bonplandianus* (C), *C. clycireduplicatus* (D), *C. ceanothifolius* (E), *C. cuchillae-nigrae* (F), *C. echinulatus* (G), *C. chamaepitis* (H). Photographs: (A, B, C, D, E) E. Valduga, (F) S. Bordignon and (G, H) A. Gonzalez.

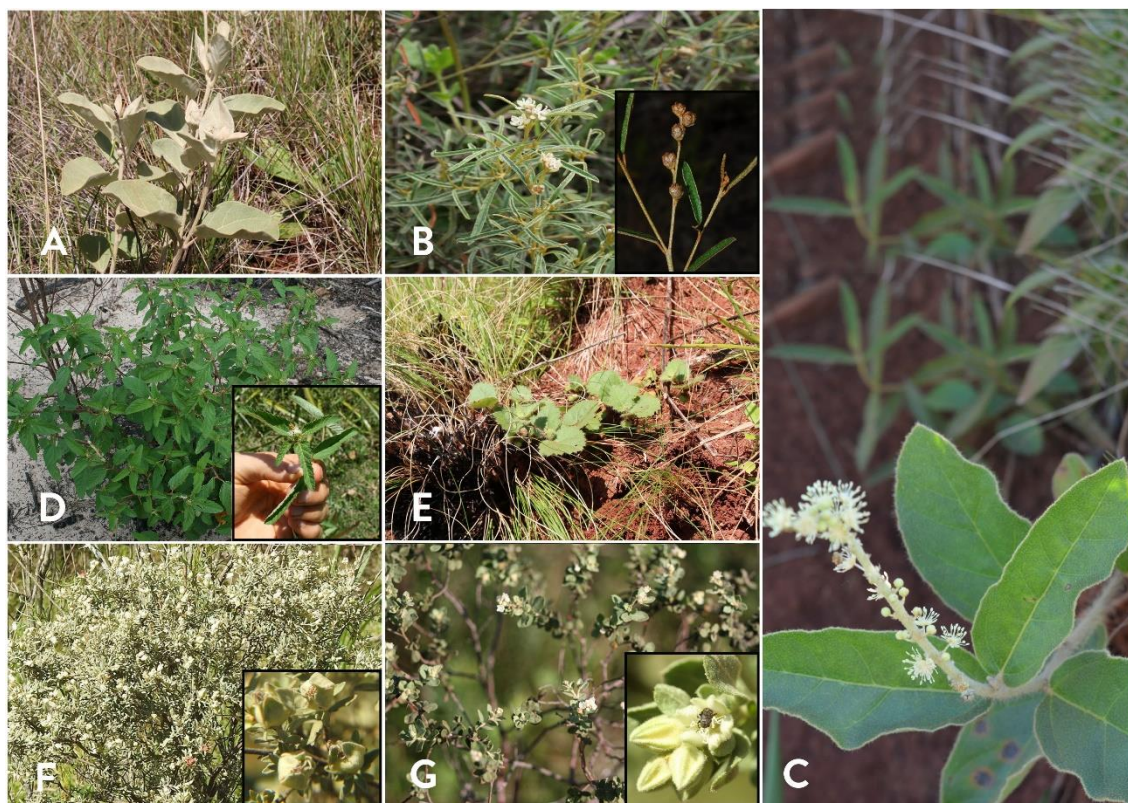


Figure 10. Species of *Croton* (Euphorbiaceae) from the Pampas grasslands. *Croton didrichsenii* (A), *C. ericoides* (B), *C. fulvus* (C), *C. glandulosus* (D), *C. glechomifolius* (C), *C. gnaphalii* (F), *C. helichrysum* (G). Photographs: (A, D, E, F) E. Valduga, (B) S. Bordignon, (G) F. Gonzatti and (C) P. Aguiar.

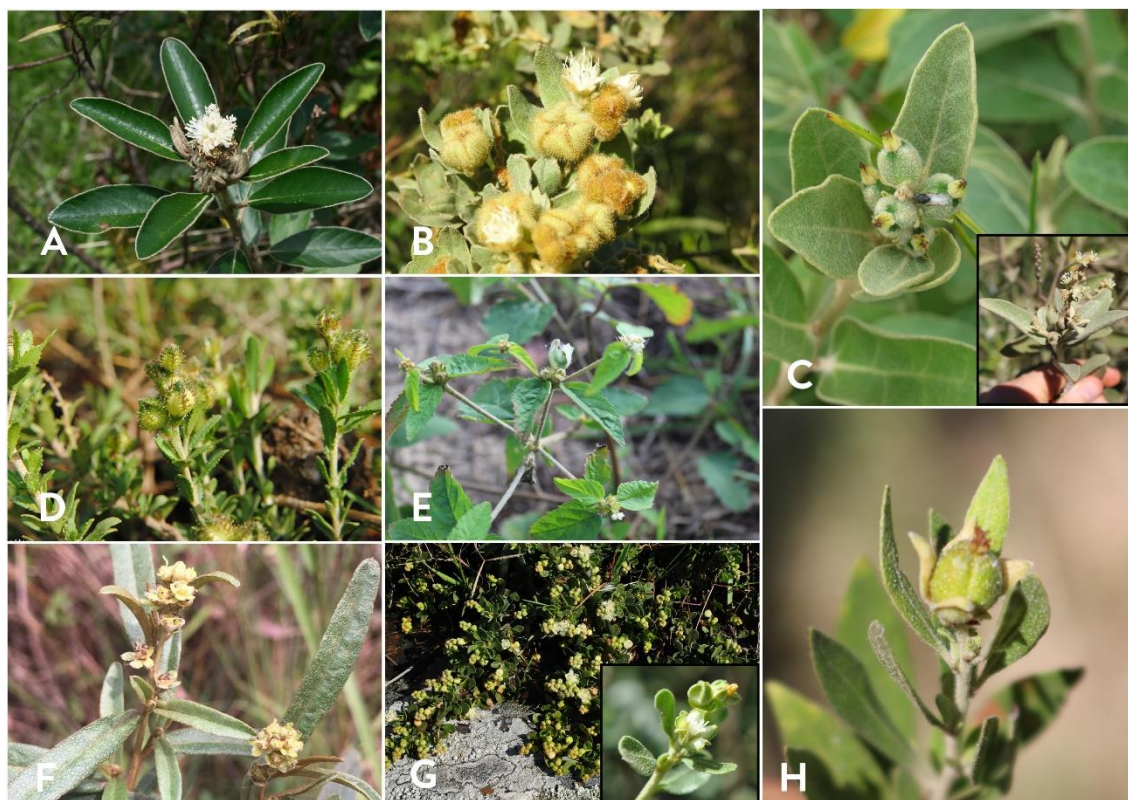


Figure 11. Species of *Croton* (Euphorbiaceae) from the Pampas grasslands. *Croton hilarii* (A), *C. lachnostephanus* (B), *C. lanatus* (C), *C. lombardianus* (D), *C. lundianus* (E). *C. myrianthus* (F), *C. nitrariifolius* (G) and *C. montevidensis* (H). Photographs: (A, C, E, F, H) E. Valduga, (B, D, G) A. Gonzalez.



Figure 12. Species of *Croton* (Euphorbiaceae) from the Pampas grasslands. *Croton parvifolius* (A), *C. pycnocephalus* (B), *C. quintasii* (C), *C. serratifolius* (D), *C. ramboi* (E), *C. uruguayensis* (F). Photographs: (A, B, C, D, E) E. Valduga, (F) A. Gonzalez.

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General Conclusion

This thesis made significant contributions to the knowledge of *Croton* species in southern South America. This genus has been neglected in this region, especially due to its taxonomic difficulty, and the species are often identified only up to the generic level. The species have several similarities to each other, and, from the perspective of non-specialized professionals, it is very difficult to correctly identify them. In this work, we propose an in-depth look at this genus, with the aim of facilitating the future work of scientists and environmental managers. The thesis is divided into three chapters, in form of articles. In the first chapter, we present *Croton allemii* as a synonym for *Croton triqueter*, *Croton stenorichus* as a synonym for *Croton hilarii*, and a lectotype for *Croton stenorichus*. *Croton lombardianus*, previously considered as endemic to Uruguay, is presented as a new record for Brazil and *Croton macrobothrys*, a species recorded from the state of Alagoas to Santa Catarina, is now documented as a new record for the Atlantic MoistForest in the state of Rio Grande do Sul. In the second chapter, we present a new species of *Croton* from the Pampas grasslands for science, *Croton bacupariensis*, which was honored in the epithet with the name of the lake from which, in the surrounding sands, the species occurs: the Lagoa do Bacupari in the municipality of Mostardas. In the third chapter, we present a synopsis for the 31 species recorded for the Pampas grasslands, including Argentina, Brazil and Uruguay. In this manuscript, four new synonyms and two lectotypes were designated. We present the first identification key for *Croton* species from the Pampas grasslands, in addition to taxonomic comments, distribution maps and images of the species. At the present, there were few studies covering *Croton* species for the Pampas grasslands and, during the review of herbaria in Argentina, Uruguay and southern Brazil, mainly, variations of Pampas grasslands species in herborized material could be observed. Added to this, field trips made it possible to observe, in an irreplaceable way, the variations of these species in nature, expanding the range of characters that help to understand the taxonomy of the group and the consequent elaboration of an identification key. With this

key, it is expected that the community can use it both in the scientific field and in the context of environmental management, even subsidizing conservation programs for these species. Considering the results of this work, we suggest that it would be important to use integrative approaches in further studies in order to elucidate taxonomic difficulties about complex species (eg. *C. chamaepitis*, *C. lachnostephanus*, *C. pycnocephalus*). In addition, an alternative would be to invest in phylogenetic research involving endemic *Croton* species which have been little sampled until now, as they have strong potential to elucidate the history of the genus in the Pampas grasslands.