UNIVERSIDADE ESTADUAL DE CAMPINAS

INSTITUTO DE BIOLOGIA

ELISA SILVA CÂNDIDO

Systematics of *Eriosema* (Leguminosae: Papilionoideae, Phaseoleae): Taxonomic Synopsis of *Eriosema* in Brazil and Phylogeny

Sistemática de *Eriosema* (Leguminosae: Papilionoideae, Phaseoleae): Sinopse Taxônomica de *Eriosema* no Brasil e Filogenia

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Thesis presented to the Institute of Biology of the University of Campinas in partial fulfillment of the requirements for the degree of Doctor in PLANT BIOLOGY

Tese apresentada ao Instituto de Biologia da Universidade Estadual de Campinas como parte dos requisitos exigidos para a obtenção do Título de Doutora em BIOLOGIA VEGETAL

ESTE ARQUIVO DIGITAL CORRESPONDE À VERSÃO FINAL DA TESE DEFENDIDA PELA ALUNA ELISA SILVA CÂNDIDO E ORIENTADA PELO PROF. DR. VIDAL DE FREITAS MANSANO.

Orientador: Vidal de Freitas Mansano

Co-orientadora: Ana Paula Fortuna Perez

CAMPINAS
2018

Agência(s) de fomento e nº(s) de processo(s): FAPESP, 2015/13386-0; CNPq, 400567/2016-4

Ficha catalográfica
Universidade Estadual de Campinas
Biblioteca do Instituto de Biologia
Mara Janaina de Oliveira - CRB 8/6972

C161s

Cândido, Elisa Silva, 1984-
Systematics of *Eriosema* (Leguminosae: Papilionoideae, Phaseoleae) : taxonomic synopsis of *Eriosema* in Brazil and phylogeny / Elisa Silva Cândido. – Campinas, SP : [s.n.], 2018.

Orientador: Vidal de Freitas Mansano.
Coorientador: Ana Paula Fortuna Perez.
Tese (doutorado) – Universidade Estadual de Campinas, Instituto de Biologia.

1. Filogenia. 2. Fabaceae. 3. Taxonomia vegetal. 4. Savanas. 5. *Rhynchosia*. I. Mansano, Vidal de Freitas. II. Fortuna-Perez, Ana Paula. III. Universidade Estadual de Campinas. Instituto de Biologia. IV. Título.

Informações para Biblioteca Digital

Título em outro idioma: Sistemática de *Eriosema* (Leguminosae: Papilionoideae, Phaseoleae) : sinopse taxonômica de *Eriosema* no Brasil e filogenia
Palavras-chave em inglês:
Phylogeny
Fabaceae
Plant taxonomy
Savannas
Rhynchosia
Área de concentração: Biologia Vegetal
Titulação: Doutora em Biologia Vegetal
Banca examinadora:
Vidal de Freitas Mansano [Orientador]
Rafael Barbosa Pinto
Ingrid Koch
Leandro Cardoso Pederneiras
Gustavo Hiroaki Shimizu
Data de defesa: 14-09-2018
Programa de Pós-Graduação: Biologia Vegetal

Campinas, 14 de Setembro de 2018.

COMISSÃO EXAMINADORA

Prof. Dr. Vidal de Freitas Mansano

Prof. Dr. Rafael Barbosa Pinto

Profa. Dra. Ingrid Koch

Dr. Leandro Cardoso Pederneiras

Dr. Gustavo Hiroaki Shimizu

Os membros da Comissão Examinadora acima assinaram a Ata de defesa, que se encontra no processo de vida acadêmica do aluno.

Dedico esta tese aos meus amados pais, José Donizete e Maria Aparecida, e minha irmã, Naiara, pelo amor incondicional e apoio fundamental para minha vida feliz. Amo vocês.

AGRADECIMENTOS

Agradeço à Ana Paula Fortuna Perez por me acalmar nas horas mais tensas e difíceis e me incentivar nos momentos de estagnação. E ainda, por me confiar um projeto de tão profundo apreço. Agradeço também toda a sua família por me receberem muitas vezes em Campinas e me auxiliarem em muitos momentos, inclusive no momento da matrícula do doutorado. Ao Vidal Mansano, por aceitar me orientar, mesmo me conhecendo tão pouco. Sem o seu aceite eu não poderia ter me matriculado na UNICAMP. Vocês dois, cada um a seu modo, me mostram como ser profissionais éticos, exemplares e amorosos com o que fazem. Sinto um imenso orgulho de fazer parte desta história com vocês e serei sempre grata pela amizade, experiências e ensinamentos compartilhados. Muito obrigada por tudo!

Agradeço à CAPES, CNPq, FAPERJ e principalmente à FAPESP 2015/13386-0, pelo fomento durante meu doutorado e a elaboração deste trabalho, por meio de bolsa de estudo, taxa de bancada e financiamentos destinados a este projeto.

Ao prêmio Rupert Barneby 2016 por apoiar minha viagem à Nova Iorque e possibilitar minha visita ao NYBG. Agradeço especialmente ao Benjamin Torke, Douglas Daly e a Lisa Fruscella por me auxiliarem todo o tempo que eu estive no New York Botanical Garden.

Agradeço aos membros da banca e da pré-banca pela disponibilidade e sugestões dadas ao meu trabalho.

Aos doutores Leandro Pederneiras, Maria Fernanda Calió e Ana Tozzi por participarem da banca de qualificação e por todas as sugestões neste período.

Ao Dr. Mohammad Vatanparast, por todas as conversas, as sugestões e contribuições no trabalho de filogenia e, principalmente, pela realização das análises com extrema eficiência.

Agradeço à UNICAMP, ao Instituto de Biologia, ao Programa de Pós-Graduação em Biologia Vegetal por todo o suporte fornecido para a realização deste trabalho. Muito obrigada a toda a equipe e todos os funcionários. Especialmente à Maria Roseli de Melo, da secretaria da pós-graduação e o Augusto Tedeschi Leão, do SAIP-IB, por serem extremamente eficientes, compreensivos e gentis.

Ao Departamento de Biologia Vegetal, a todos os professores por todas as experiências e os ensinamentos durante as disciplinas e nas horas de convivência no laboratório. Por manterem o contato próximo com os alunos e terem a disponibilidade da troca de ideias. Em especial a professora Ana Tozzi e o professor André Simões, que também fazem parte deste trabalho e sempre colaboraram e me auxiliaram em todos os momentos na UNICAMP.

Agradeço à UNESP/Botucatu por toda estrutura utilizada, principalmente o herbário BOTU e o LaPAV, Laboratório de Pesquisa em Anatomia Vegetal. Aos professores da UNESP/Botucatu que contribuíram para a realização deste trabalho.

Aos meus colegas do Departamento de Biologia Vegetal e do PPGBV, pela convivência, pelas trocas de experiências e todo o auxílio prestado para a realização desta tese e de toda minha trajetória no doutorado. Obrigada por manterem o laboratório como um ambiente tão colaborativo, harmônico, saudável e engraçado. Isso influenciou diretamente no meu rendimento e ânimo para o trabalho diário. Em especial agradeço os amigos Rafael Barbosa Pinto e Gustavo Shimizu. Vocês participaram ativamente de várias etapas deste trabalho! Contem sempre comigo, para a vida!

Aos colegas de Botucatu por sempre me receberem tão bem e serem agradáveis e prestativos todas as vezes que estive lá. Em especial as amigas Luísa Bezerra e Wanderleia Vargas, por também fazerem parte deste trabalho e por todo o auxílio no laboratório, na construção das planilhas, tabelas, pranchas, todas as conversas e ideias trocadas, o apoio em todos os momentos e pela amizade sincera. Muito obrigada meninas!

Aos amigos de Ouro Preto, principalmente os do herbário OUPR, Viviane Scalon, Cristina Messias, Laís Zeferino, Ambar Soldevila, Isabella Fantini, Luiz Guilherme Vieira e o querido, amado e inesquecível, Jorge... uma luz que brilhará eternamente!

Agradeço os curadores de todos os herbários visitados, aos que enviaram fotografias e empréstimo de materiais para realização desta tese. Em especial aos curadores e funcionários dos herbários que contribuíram com muitas amostras de espécies para a filogenia, como K, NYBG, S, SI, P, PRE, BOTU e OUPR.

Ao Cajaninae Time! Agradeço todo o auxílio, o aprendizado e a amizade! O trabalho em grupo é essencial ao crescimento profissional e pessoal! Sem a parceria de todos vocês este trabalho não existiria!

A todas as pessoas que me ajudaram de alguma forma nas expedições de campo pelo Brasil.

Agradeço à Lola por passar muitas tardes das suas férias no laboratório comigo, deixando o ambiente mais feliz, engraçado e motivador. E, principalmente, por ajudar minha caminhada de autoconhecimento de forma tão profunda.

Ao meu melhor companheiro de aventuras, Alan Bernardes, por todo o suporte, carinho, amor, sinceridade, compreensão, paciência, amizade, cumplicidade, troca, conhecimento e tudo mais que está envolvido em uma história bonita de amor profundo e verdadeiro! Obrigada por fazer parte da minha caminhada!

Agradeço à minha família, principalmente meus pais e minha irmã, por mesmo de longe estarem tão próximos! Aprendemos que a presença é importante, mas o amor sincero é essencial e é ele que faz cada um de vocês estarem presente em meu coração todos os dias! Sem vocês eu não seria tão feliz e não teria chegado até aqui. Amo vocês.

Agradeço a todas as pessoas que encontrei pela vida no decorrer destes anos! “Eu deixo e recebo um tanto...”

RESUMO

Eriosema (DC.) Desv. compreende cerca de 150 espécies, pertence à subtribo Cajaninae (Leguminosae: Papilionoideae, Phaseoleae) e possui distribuição pantropical, com dois centros de diversidade, um no continente Africano (110 espécies), e o outro nas Américas (41 espécies). Há ainda *Eriosema chinense* que ocorre no Sudeste da Ásia e Austrália. As espécies do gênero são caracterizadas morfologicamente pelas inflorescências em racemos axilares ou terminais com flores usualmente congestas, sementes com hilo linear e funículo apical inserido na extremidade terminal do hilo, além das estruturas secretoras peculiares, como tricomas de base bulbosa, tricomas de base secretora e as glândulas vesiculares, que são estruturas exclusivas da subtribo Cajaninae. As espécies ocorrem, preferencialmente, em ambientes savânicos tropicais, abarcando alguns dos ecossistemas mais ameaçados do planeta, os ambientes que ocorrem acima de 900 metros, como os campos rupestres da Cadeia do Espinhaço, no centro-leste do Brasil, e as montanhas Chimanimani, na fronteira entre Zimbábue e Moçambique na África. Algumas espécies são utilizadas na medicina popular para o tratamento da disfunção erétil, impotência sexual, infertilidade, tosse, infecções microbianas, como anti-inflamatório e laxante. Os estudos mais abrangentes para as espécies do gênero foram realizados por Baker, em 1895, e Grear, em 1970, com as espécies africanas e americanas, respectivamente. *Eriosema* é morfologicamente e filogeneticamente relacionado à *Rhynchosia* e, até o momento, não há estudos moleculares específicos para estes gêneros, o que dificulta uma precisa distinção entre eles. Considerando a riqueza de táxons de *Eriosema* no Brasil, a falta de um estudo recente que englobe todas as espécies que ocorrem no território brasileiro, a ausência da filogenia do gênero e sua interessante distribuição geográfica, esta tese apresenta a sinopse taxonômica das espécies que ocorrem no Brasil e a primeira e abrangente filogenia molecular do gênero. Herbários nacionais e estrangeiros foram consultados e coletas foram realizadas por todo o território brasileiro. A sinopse taxonômica inclui uma chave de identificação, descrições de táxons, detalhes dos tipos dos nomes das espécies com 15 lectotipificações; informações fenológicas, do habitat e distribuição geográfica; mapas de distribuição, imagens de espécies no campo e os principais caracteres morfológicos para auxiliar na identificação correta dos táxons. Há a ocorrência de 35 espécies do gênero no Brasil, com dois centros de diversidade, os estados de Goiás (29 spp., com 8 spp. endêmicas) e Minas Gerais (26 spp., com 4 spp. endêmicas). As espécies mais amplamente distribuídas no Brasil e em todo o continente americano são *Eriosema simplicifolium* (Kunth) G. Don e *Eriosema crinitum* (Kunth) G. Don. Estas duas espécies formam complexos que devem ser estudados futuramente para um melhor entendimento de suas possíveis delimitações. No estudo filogenético foram amostradas 94 espécies do gênero. Os resultados mostram a monofilia de *Eriosema*, fortemente sustentada em todas as análises para os marcadores ITS, rpl32 e trnQ, mas suas relações infragenéricas não foram elucidadas. Este trabalho mostrou também que o grupo irmão de *Eriosema* é uma das linhagens africanas de *Rhynchosia*.

ABSTRACT

Eriosema (DC.) Desv. comprises approximately 150 species, belongs to the subtribe Cajaninae (Leguminosae: Papilionoideae, Phaseoleae), and has pantropical distribution, with two centers of diversity, one in Africa with about 110 species, and another in the New World with about 41 species. In addition, *Eriosema chinense* is recorded in Southeast Asia and Australia. Species of the genus are characterized morphologically by inflorescences in axillary or terminal racemes with flowers usually congested, seeds with a linear hilum and an apical funicle embedded at its extremity, besides by peculiar secretory structures, such as bulbous-based trichomes, secretory-base trichomes and vesicular glands, which are exclusive structures of the Cajaninae subtribe. The species occur mainly in tropical savannas, covering some of the most threatened ecosystems on the planet, environments that occur above 900 meters, as the rocky fields of the Espinhaço Range, in east-central Brazil and the Chimanimani mountains, on the border between Zimbabwe and Mozambique in Africa. Some species are used in popular medicine for the treatment of erectile dysfunction, sexual impotence, infertility, cough, microbial infections, anti-inflammatory and laxative. The most comprehensive studies for species of the genus were conducted by Baker in 1895 and Grear in 1970 with the African and American species respectively. *Eriosema* is most morphologically and phylogenetically related to *Rhynchosia* and so far, there is no specific molecular study for this genus and the distinction between these genera is poor. Considering the large number of taxa of *Eriosema* in Brazil, the lack of a recent study that embraces all species that occur in the country, the absence of the phylogeny of the genus and its interesting geographical distribution this thesis presents a taxonomic synopsis of the Brazilian species and the first and comprehensive molecular phylogeny of the genus. National and foreign herbaria were consulted and field work were carried out in the Brazilian territory. The taxonomic synopsis includes an identification key, taxon descriptions, type specimen details with 15 lectotypifications; habitat, phenological and geographical records information; distribution maps, images of representative species in the field and main morphological characters are provided to assist in the correct identification of the taxa. There are 35 species of this genus in Brazil, with two main centers of diversity, the first, Goiás state (29 spp., with 8 endemic species) and the second Minas Gerais state (26 spp., with endemic 4 species). *Eriosema simplicifolium* (Kunth) G. Don and *Eriosema crinitum* (Kunth) G. Don have the broadest geographical distributions, both species occurring, throughout a large part of the American continent. They form a species complexes and future studies will be necessary in order to understand taxon boundaries and delimitations. In the phylogenetic study 94 species of the genus were sampled. The results show the monophyly of *Eriosema*, strongly supported in all analyzes for the ITS, rpl32 and trnQ markers, but their interspecific relationships have not yet been elucidated. This work also showed that the sister group of *Eriosema* is one of the African lineages of *Rhynchosia*.

SUMÁRIO

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INTRODUÇÃO GERAL

Leguminosae Juss., ou Fabaceae Lindl., uma das mais importantes famílias botânicas do ponto de vista econômico e ecológico, possui distribuição cosmopolita e é a terceira maior família de angiospermas do mundo. A família é considerada monofilética desde os primeiros estudos de filogenia molecular e possui seis subfamílias: Cercidoideae LPWG, Dialioideae LPWG, Duparquetioideae LPWG, Detarioideae Burmeist., Caesalpinioideae DC. e Papilionoideae DC., representadas por 765 gêneros e cerca de 19.600 espécies (LPWG 2017).

Nas últimas décadas vários estudos foram realizados permitindo uma melhor compreensão das relações evolutivas da família Leguminosae, mas poucos englobando toda a sua maior subfamília, Papilionoideae (Doyle *et al.* 1997; Wojciechowski *et al.* 2004; LPWG 2013). Nesta, os estudos focam alguns gêneros ou tribos (por exemplo: Crisp *et al.* 2000; Hu *et al.* 2000, 2002; Pennington *et al.* 2001; Lavin *et al.* 2001; Crisp & Cook 2003; Boatwright *et al.* 2008a, b; Egan & Crandall 2008; Torke & Schaal 2008; Cardoso *et al.* 2012a, b; Cardoso *et al.* 2013; Queiroz *et al*. 2015; Egan *et al.* 2016; Jabbour *et al.* 2018). Papilionoideae ocorre em quase todo o mundo e destaca-se por compreender mais de 71% de todas as espécies da família, cerca de 14.000, distribuídas em 503 gêneros (LPWG 2017). Assim como em Leguminosae, os estudos suportam o monofiletismo desta subfamília (Polhill 1994; Doyle 1995; Kass & Wink 1995,1996, 1997; Doyle *et al.* 1997, 2000; Pennington *et al.* 2001; Kajita *et al.* 2001; Herendeen *et al.* 2003; Wojciechowski 2003; Wojciechowski *et al*. 2004; Lavin *et al.* 2005; Lewis *et al*. 2005; LPWG 2017).

As principais características morfológicas de Papilionoideae são as flores frequentemente papilionáceas e bilateralmente simétricas; pétalas imbricadas no botão, sendo o estandarte a pétala mais externa e frequentemente maior; sépalas unidas, pelo menos na base; cálice formando um tubo; sementes com o hilo complexo; pleurograma ausente; e presença de nódulos nas raízes (LPWG 2017).

Dentre as tribos de Papilionoideae, Phaseoleae (Bronn) DC. é uma das maiores com 89 gêneros e aproximadamente 1.567 espécies (Schrire 2005), distribuídas principalmente nas regiões tropicais e subtropicais do mundo (Lackey 1981; Doyle & Doyle 1993; Schrire 2005). É a tribo mais importante economicamente incluindo espécies como *Phaseolus vulgaris* L. (feijão), *Glycine max* (L.) Merr. (soja), *Cajanus cajan* (L.) Huth (feijão-guandu) e *Cicer*

arietinum L. (grão-de-bico) (LPWG 2013). Phaseoleae pode ser reconhecida principalmente pelo hábito volúvel e as folhas trifolioladas com a base dos folíolos laterais assimétrica. Além de compartilhar com membros de outras tribos caracteres como as inflorescências em pseudorracemo, pólen com uma espessa camada de endexina, presença de estipelas e número cromossômico básico de 10 ou 11 (Bruneau *et al.* 1995).

Estudos moleculares apontam que Phaseoleae não é monofilética (Doyle & Doyle 1993; Delgado-Salinas *et al.* 1993; Bruneau *et al.* 1995; Doyle *et al.* 1997, 2000; Kajita *et al.* 2001; Lee & Hymowitz 2001), assim como a maior parte das tribos dentro de Papilionoideae estabelecidas por Polhill (1994) (Doyle *et al.* 2000; Pennington *et al.* 2000; Lavin *et al.* 2001). A classificação infratribal de Phaseoleae foi primeiramente proposta por Bentham em 1837. Desde então, não há um consenso com relação ao reconhecimento das subtribos e suas delimitações entre os sistemas taxonômicos propostos (Bruneau *et al.* 1995). Como tradicionalmente circunscrita, Phaseoleae é dividida em oito subtribos, Diocleinae, Phaseolinae, Cajaninae, Ophrestiinae, Clitoriinae, Kennediinae, Glycininae e Erythrininae (Lackey 1981).

A subtribo Cajaninae é a maior da tribo Phaseoleae com cerca de 490 espécies distribuídas em 10 gêneros: *Adenodolichos* Harms (15 spp.), *Bolusafra* Kuntze (1 sp.), *Cajanus* Adans. (34 spp.), *Carrissoa* Baker f. (1 sp.), *Chrysoscias* E. Mey. (3-4 spp.), *Dunbaria* Wight & Arn. (20 spp.), *Eriosema* (DC.) Desv. (150 spp.), *Flemingia* Roxb. ex W.T. Aiton (ca. 30 spp.), *Paracalyx* S.I. Ali (6 spp.) e *Rhynchosia* Lour. (ca. 230 spp.) (Schrire 2005). As espécies de Cajaninae se distribuem desde a região paleotropical até regiões temperadas do Velho Mundo, além de ocorrerem também nas regiões neotropical e subtropical, principalmente em ambientes secos e quentes, como as savanas (Schrire 2005). Morfologicamente Cajaninae apresenta plantas com o hábito variando de trepadeiras, ervas, subarbustos a arbustos, folhas trifolioladas, menos frequentemente uni ou 5-folioladas, ausência de canavanina e bractéolas (com exceção de *Adenodolichos*, que possui canavanina e bractéolas), presença de tricomas de base bulbosa, tricomas de base secretora e glândulas vesiculares, sendo esta última estruturas exclusivas desta subtribo (Lewis *et al.* 2005; Baudet 1978; Lackey 1977, 1981; Vargas *et al.* in press.).

Estudos moleculares do DNA de cloroplasto mostraram o monofiletismo de Cajaninae, apoiando os resultados de Lackey (1977, 1981) e Baudet (1978) (Bruneau *et al*. 1995). Recentemente os resultados de Egan *et al.* (2016) também mostraram Cajaninae como monofilética nas análises dos marcadores de cloroplasto. Já nas análises com o marcador nuclear AS2, Cajaninae incluiu o gênero *Apios* Fabr. Esta subtribo também foi considerada

monofilética no estudo de LPWG (2017), que utilizou a região do cloroplasto *matK* e realizou a nova classificação das subfamílias de Leguminosae, por meio do mais abrangente estudo filogenético da família. Vale ressaltar que estes estudos incluíram um número ínfimo de espécies de Cajaninae e que não existe nenhum estudo molecular focado nesta subtribo, assim como em nenhum dos seus gêneros.

Dos gêneros de Cajaninae, *Eriosema* é o segundo maior em número de espécies, aproximadamente 150. O nome *Eriosema* vem do grego e em sua etimologia refere-se a duas palavras: "erion", que significa lã, e "sema", que significa estandarte, em alusão ao aspecto lanoso do estandarte das espécies (Don 1832; Miotto 1988; Grear 1970; Schrire 2005). *Eriosema* foi primeiramente tratado por Augustin Pyramus de Candolle em 1825, na obra *Prodromus systematis naturalis regni vegetabilis*, como uma das seções do gênero *Rhynchosia*: sect. *Monophyllae*, sect. *Phaseoloideae* e sect. *Eriosema*. De Candolle (1825) separou estas seções com base no tamanho do pecíolo, número de folíolos e tipo de inflorescência, e ainda sugeriu que a seção *Eriosema*, que incluía oito espécies, poderia constituir um gênero distinto. Em 1826, Desvaux revisou o grupo e o elevou a gênero, acrescentando uma nova espécie à circunscrição original e modificando o nome para "*Euriosma*" DC. O correto nome do autor do gênero foi objeto de discussão nas últimas décadas (Fortunato *et al.* 2002). Alguns estudiosos consideraram como um erro ortográfico de Desvaux, como Reichenbach (1828), que corrigiu aceitando o nome genérico *Eriosema* e atribuiu isto a Desvaux. Por sua vez, Grear (1968) citou que a grafia de Desvaux (1826) não era um erro ortográfico, mas o nome de um novo gênero, e fez uma proposta para conservar *Eriosema* G. Don, em vez de *Euriosma* Desv. Por fim, Fortunato *et al.* (2002) propuseram a correção de autoria do gênero para *Eriosema* (DC.) Desv., atribuindo a Desvaux que, elevou a gênero o equivalente à seção *Eriosema* estabelecida por De Candolle (1825). Esta proposta foi ratificada pelo Código de Viena (2006).

Algumas espécies de *Eriosema* possuem propriedades medicinais e são utilizadas na medicina popular. Como exemplo, os povos Zulu da África do Sul usam as raízes de *Eriosema* como remédio para o tratamento da disfunção erétil e/ou da impotência sexual (Ojewole 2007). Estudos científicos mostraram que *Eriosema kraussianum* Meisn. tem eficácia para esse tipo de doença e pode ser utilizada como alternativa alopática ou complementar à medicina convencional (Drewes *et al.* 2002; Ojewole *et al.* 2006). *Eriosema robustum* Baker é tradicionalmente usada para o tratamento da tosse na África Oriental (Kokwaro 2009), doenças de pele na região Oeste da República dos Camarões (Awouafack *et al*. 2013a) e para combater infecções microbianas (Awouafack *et al.* 2013b, 2008). *Eriosema laurentii* De Wild. é utilizada

na República dos Camarões para o tratamento da infertilidade e várias doenças ginecológicas e relacionadas à menopausa (Burkill 1985). Este uso tradicional foi cientificamente verificado, uma vez que esta espécie contém isoflavonoides e é dotada de propriedades semelhantes ao estrogênio (Ateba *et al.* 2013). Os povos que vivem nas montanhas da província de Yunnan na China usam as raízes de *Eriosema tuberosum* Rich no tratamento da orquite, diarreia, da hidrofobia e para desintoxicação (Ma *et al.* 1998). Nos Neotrópicos também são documentados alguns usos tradicionais das espécies, como laxante (*Eriosema glabrum* Mart. ex Benth.) e como anti-inflamatório (*E. benthamianum* Mart. ex Benth. e *E. campestre* var. *macrophyllum* (Grear) Fortunato) em regiões do cerrado brasileiro no estado de Minas Gerais (Hirschmann & De Arias 1990; Rodrigues & Carvalho 2001; Santos *et al.* 2016). Isso demonstra a importância desse gênero no campo da farmacologia, fitoquímica, medicina popular e usos tradicionais.

Eriosema possui distribuição pantropical (Grear 1970; Schrire 2005), com dois principais centros de diversidade, um no continente Africano, incluindo Madagascar, com a maioria das espécies, cerca de 110, e o outro nas Américas com cerca de 40 espécies. Nas Américas podem ser encontradas do México até o norte da Argentina, com exceção do Chile. Adicionalmente, *Eriosema chinense* Vogel ocorre do sudeste da Ásia até o norte da Austrália (Grear 1970; van der Maesen 2003; Lewis *et al.* 2005; Schrire 2005). As espécies de *Eriosema* ocorrem em ambientes savânicos, principalmente nas savanas tropicais da África, América do Sul, sudeste da Ásia e norte da Austrália. Na América Central e no Caribe, o gênero pode ser encontrado em savanas de pinheiros como a Ilha dos Pinheiros na costa sudoeste de Cuba (Grear 1970).

As espécies do gênero crescem em diversas fitofisionomias do cerrado, como cerrado *sensu stricto* (“woodland”), campo cerrado (“wooded grassland”), campo sujo (“woodland bushed”) e campo limpo (“grassland”) (termos recomendados por Lock 2006). Esses ambientes formam um gradiente de vegetação lenhosa que varia de uma cobertura de até 40%, como o cerrado *sensu stricto*, até a vegetação aberta com ocorrência limitada de arbustos, como o campo limpo (White 1983; Pennington *et al.* 2000; Lock 2006). As características climáticas, ambientais e estruturais desses habitats incluem: uma única estação seca maior que quatro meses, estrato herbáceo-subarbustivo com folhas estreitas e, muitas vezes, em rosetas e/ou formando tufos, plantas xeromórficas, cobertura arbórea de no máximo 40%, presença de fogo regular, campos naturais em locais com alagamento sazonal e solos rasos com alta concentração de íons metálicos (Lock 2006).

Nas porções mais elevadas da vegetação savânica, acima de 900 m de altitude, ocorrem mosaicos vegetativos que formam "ilhas de montanhas" dominadas pela seca sazonal e solos rasos rochosos ou arenosos de baixa fertilidade. Nestes ambientes a vegetação cresce em uma vasta diversidade de substratos, abrangendo principalmente afloramentos rochosos de quartzito ou arenito e campos arenosos, pedregosos e encharcados de água (Phipps & Goodier 1962; Coutinho 2006; Batalha 2011; Silveira *et al.* 2016; Timberlake *et al.* 2016). Nos Neotrópicos estes ambientes são referidos como campos rupestres, e o mais importante é a Cadeia do Espinhaço no centro-leste do Brasil (Giulietti *et al.* 1997), onde ocorrem espécies do gênero *Eriosema* (Grear 1970; Fortuna-Perez *et al.* 2013, 2017; Cândido *et al.* 2014a, 2014b). Nas montanhas tropicais africanas, uma vegetação muito semelhante é encontrada nas montanhas Chimanimani na fronteira Zimbábue-Moçambique (Lock 2006), onde um dos abundantes arbustos é *Eriosema montanum* Baker f. (Phipps & Goodier 1962; Timberlake *et al.* 2016). Além da semelhança edafoclimática, estes ambientes compartilham também a alta diversidade de plantas, elevado endemismo (Phipps & Goodier 1962; Giulietti *et al.*1997; Echternacht *et al.* 2011; Silveira *et al.* 2016; Timberlake *et al.* 2016) e são considerados alguns dos ecossistemas mais ameaçados do planeta, principalmente pela mineração e expansão urbana (Martinelli 2007; Timberlake *et al.* 2016).

Morfologicamente, *Eriosema* é caracterizado por possuir hábito herbáceo, subarbustivo ou arbustivo, com crescimento ereto, ascendente, procumbente ou decumbente, sistemas subterrâneos especializados (raiz principal lenhosa e espessa, napiforme ou fusiforme, muitas vezes chamada de xilopódio) (Fig. 1). As folhas podem ser uni ou trifolioladas, racemos axilares ou terminais, flores papilionáceas congestas ou esparsamente distribuídas ao longo do eixo da inflorescência (Fig. 2, 3 e 4). Os frutos possuem duas sementes, são oblongos a rômbicos ou ovados e elasticamente deiscentes. As sementes possuem o hilo linear e o funículo é inserido na extremidade terminal do hilo (Grear 1970) (Fig. 5). Como membro da subtribo Cajaninae, o gênero possui ainda estruturas secretoras peculiares, como tricomas de base bulbosa, tricomas de base secretora e glândulas vesiculares (Lackey 1978; Cândido *et al.* 2016; Vargas *et al*. in press.) (Fig. 6).

O estudo mais abrangente para as espécies africanas foi realizado por Edmund Baker, em 1895, que em sua revisão incluiu 49 espécies (Baker 1895). Já para as espécies do Novo Mundo, o mais relevante é a revisão das espécies americanas publicado por John Grear em 1970 (Grear 1970). Estudos posteriores que incluíram as espécies do gênero se restringiram a descrições de novos táxons, estudos de floras regionais ou mudanças nomenclaturais. Para as

espécies africanas, destacam-se os estudos realizados por Hauman (1954); Hepper (1958); Jacques-Félix (1971); Verdcourt (1971, 2001); Stirton & Gray (1978); Stirton (1981a, 1981b); van der Maesen & Walters (2011); van der Maesen & Wieringa (2012) e van der Burgt (2012). Nas Américas podemos citar os estudos de Lewis (1987), Miotto (1988); Lewis & Owen (1989); Fortunato (1993, 1999, 2000); Rogalski & Miotto (2011); Fortuna-Perez *et al.* (2013, 2017, 2018); Cândido *et al*. (2014a, 2014b, 2016) e Oliveira *et al*. (in press.).

Dos gêneros da subtribo Cajaninae, somente *Eriosema* e *Rhynchosia* ocorrem nos Neotrópicos, os outros são restritos ao continente africano ou ocorrem também na Ásia e Austrália. Com isso, é genuíno prever o íntimo relacionamento morfológico e filogenético entre estes dois gêneros. Do ponto de vista morfológico, a distinção entre eles é, basicamente, a localização do ponto de inserção do funículo da semente em relação ao hilo, sendo terminal em *Eriosema* e central, subcentral ou terminal em *Rhynchosia*. Contudo, Grear (1970) cita que esta é uma característica inconsistente para separar estes gêneros. Assim, Grear (1970) e Miotto (1988) utilizaram outros caracteres relacionados ao hábito, tamanho do pecíolo e peciólulo, incisão do cálice, forma do hilo, extensão do estrofíolo e cor das flores para distinguir *Eriosema* e *Rhynchosia*.

O trabalho fenético realizado por Fortunato (2000) mostra uma relação de afinidade entre *Eriosema* e *Rhynchosia*, assim como alguns estudos filogenéticos que incluem um diminuto número de espécies dos dois gêneros (Doyle & Doyle 1993; Kajita *et al.* 2001; Egan *et al*. 2016; LPWG 2017). Contudo, estes estudos não forneceram dados suficientes para mostrar os relacionamentos interespecíficos de *Eriosema* e sua relação com *Rhynchosia* ou com os outros gêneros de Cajaninae.

Perante o exposto e considerando a riqueza de táxons de *Eriosema* no Brasil, além das recentes descobertas de novas espécies, a uniformidade morfológica do gênero que dificulta a delimitação destas e que desde a revisão taxonômica realizada por Grear (1970) não há um estudo que abarca todas as espécies que ocorrem no território brasileiro, o primeiro capítulo desta tese apresenta uma sinopse taxonômica das espécies de *Eriosema* que ocorrem no Brasil [**"Taxonomic Synopsis of *Eriosema* (Leguminosae: Papilionoideae, Phaseoleae) in Brazil)"**]. Adicionalmente, diante da ausência da filogenia do gênero e sua interessante distribuição geográfica, o segundo capítulo desta tese retrata a filogenia molecular de *Eriosema*, com uma ampla amostragem, cobrindo toda a distribuição geográfica e a variação morfológica do gênero para verificar o seu monofiletismo, examinar as relações infragenéricas e suas

relações com os outros gêneros de Cajaninae [**"Phylogeny of the genus *Eriosema* (Leguminosae: Papilionoideae, Phaseoleae)"**].

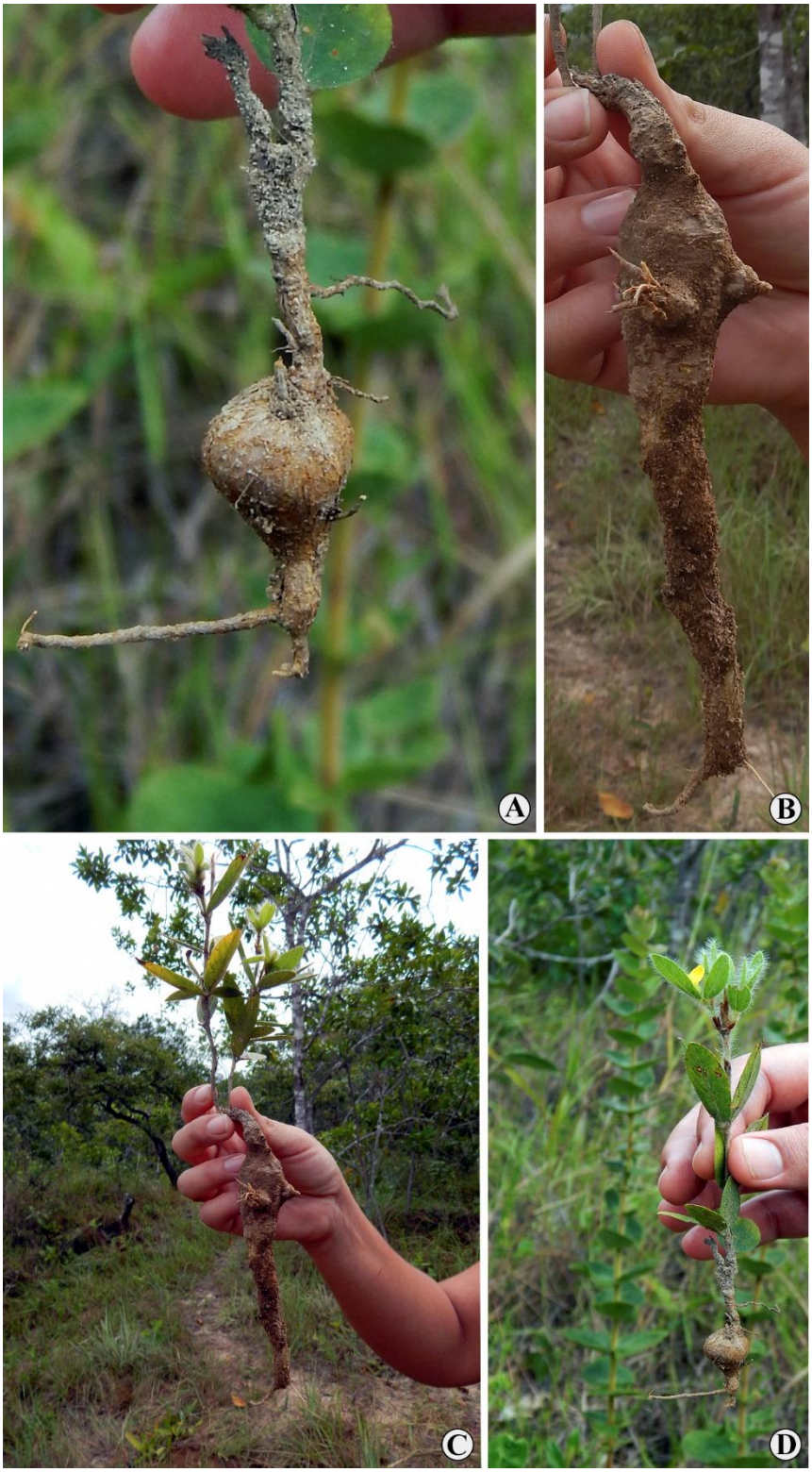

FIGURA 1. Sistemas subterrâneos especializados. A–D. *Eriosema crinitum* (Fotos: A. Soldevila).

FIGURA 2. Características vegetativas das espécies de *Eriosema*. A, F, H. *E. floribundum*. A. Detalhe da estípula; F. Folíolo com indumento tomentoso; H. Folíolos e ramos tomentosos. B, E. Folhas trifolioladas. B. *E. campestre* var. *campestre*; E. *E. crinitum*. C. Folhas unifolioladas, *E. simplicifolium*. D, G. *E. glabrum*. D. Folíolo glabro; G. Folíolos e ramos glabros (Fotos: A, F, H: A. Soldevila; B, C: E.S. Cândido; D, E, G: A.P. Fortuna-Perez).

FIGURA 3. Inflorescências das espécies de *Eriosema*. A, G. Racemos axilares. A. *E. congestum*; G. *E. floribundum*. B–F. Racemos terminais. B. *E. defoliatum*; C. *Eriosema irwinii*; D. *E. macrostipulatum*; E. *E. crinitum*; F. *E. brevipes*. (Fotos: A: A.P. Fortuna-Perez; B, C, F: E.S. Cândido; D: M.J. Silva; E, G: A. Soldevila). A, D and F: Fortuna-Perez et al. 2018.

FIGURA 4. Flores papilionáceas das espécies de *Eriosema*. A. *E. benthamianum*. B. *E. brevipes*. C. *E. campestre* var. *campestre*. D. *E. crinitum*. E. *E. defoliatum*. F. *E. floribundum*. G. *E. glabrum*. H. *E. hatschbachii*. I. *E. heterophyllum*. J. *E. irwinii*. K. *E. laxiflorum*. L. *E. prorepens*. (Fotos: A, C, E: E.S. Cândido; B, F, G, I: A.P. Fortuna Perez; D, H: A. Soldevila; K: M.J. Silva; L: J, M. Simon).

FIGURA 5. Frutos das espécies de *Eriosema*. A. Fruto seco com vista lateral das sementes, *E. cupreum*. B, F, H–J. Frutos maduros. B. *E. defoliatum*; F. *E. floribundum*; H. *E. elegans*; I. *E. glabrum*; J. *E. irwinii*. C–E, G. Frutos imaturos. C. *E. crinitum*; D. *E. defoliatum*; E. *E. hatschbachii*; G. *E. heterophyllum*. (Fotos: A, D, H, J: E.S. Cândido; B, C, E, F, I: A. P. Fortuna Perez; G. G.H. Shimizu). C: A.P. Fortuna-Perez et al. 2013.

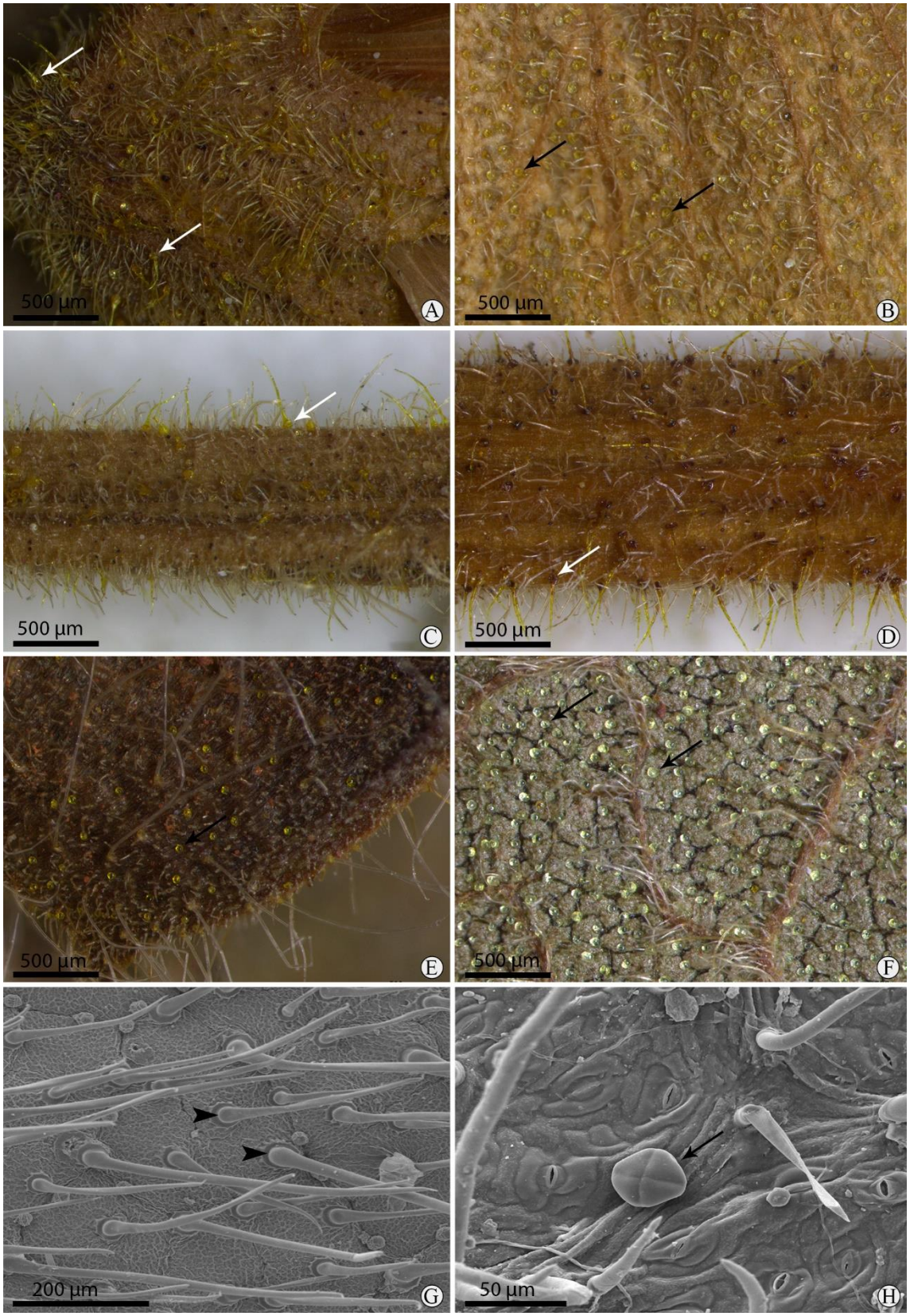

FIGURA 6. Imagens de estereomicroscópio (A–F) e microscopia eletrônica de varredura (G–H) dos tricomas glandulares em espécies de *Eriosema*. A, C, D. Tricomas de base bulbosa (setas brancas). A. Cálice de *E. campestre* var. *delicatula*; C. Caule de *E. campestre* var. *campestre*; D. Caule de *E. longiflorum*. B, E, F, H. Glândulas vesiculares (setas pretas). B. Face abaxial do estandarte de *E. campestre* var. *delicatula*; E. Fruto de *E. longiflorum*; F. Face abaxial do folíolo

de *E. platycarpon*; H. Face abaxial do folíolo de *E. heterophyllum*. G. Tricomas de base secretora (cabeça de seta) na face abaxial do folíolo de *E. grearii* (Imagens: W. Vargas; CME Unesp/Botucatu).

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Chapter I

Paper for Phytotaxa

Taxonomic Synopsis of *Eriosema* (Leguminosae: Papilionoideae, Phaseoleae) in Brazil

ELISA SILVA CÂNDIDO*[,1], WANDERLEIA DE VARGAS[2], LUÍSA MARIA DE PAULA ALVES BEZERRA[2], VIDAL DE FREITAS MANSANO[1,3], MOHAMMAD VATANPARAST[4], GWILYM PETER LEWIS[5], ANA MARIA GOULART DE AZEVEDO TOZZI[1] & ANA PAULA FORTUNA-PEREZ*[1,2]

[1]*Departamento de Biologia Vegetal, Programa de Pós-Graduação em Biologia Vegetal, Instituto de Biologia, Universidade Estadual de Campinas, 13083–862, Campinas, São Paulo, Brasil.*

[2]*Departamento de Botânica, Instituto de Biociências, Programa de Pós-Graduação em Ciências Biológicas (Botânica), Instituto de Biociências, Universidade Estadual Paulista, 18618-000, Botucatu, São Paulo, Brasil.*

[3]*Instituto de Pesquisas Jardim Botânico do Rio de Janeiro, Unidade de Botânica Sistemática, Rua Pacheco Leão, 915, Jardim Botânico - Rio de Janeiro, 22460030, RJ, Brasil.*

[4]*US National Herbarium (US), Department of Botany, Smithsonian Institution-NMNH, MRC 166, 10th and Constitution Ave, Washington, D.C., 20560, USA.*

[5]*Comparative Plant and Fungal Biology Department, Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AB, U.K.*

*Authors for correspondence (elisasilvacandido@gmail.com; bio.fortuna@gmail.com)

ABSTRACT

Eriosema (DC.) Desv. is a pantropical genus occurring mostly in the savannas and comprises approximately 150 species, with two centers of diversity, one in Africa with about 110 species, and the other in the Neotropics with about 40 species. Considering the large number of

Eriosema taxa in Brazil, including five recently described, together with the lack of any recent study that encompasses all species that occur in the country, a taxonomic synopsis of the Brazilian species of *Eriosema* was needed and is presented here. National and foreign herbarium collections, including type specimens, were consulted and field work was carried out across Brazil. Our study records 35 species of *Eriosema* in Brazil, making Brazil the most speciose country in the Neotropics, with 85% (35 out of 41) of the species reported for the entire American continent. The highest diversity of the genus, in the Neotropics, is in the Central Brazilian savannas, in the states of Goiás (with 29 taxa, eight of which are endemic), and Minas Gerais (with 26 taxa, four of which are endemic). *Eriosema simplicifolium* and *Eriosema crinitum* have the broadest geographical distributions, both species occurring throughout a large part of the American continent. They form species complexes and future studies will be necessary in order to understand taxon boundaries and delimitations. An identification key, taxon descriptions, information about type specimens, as well as information on the habitat, phenological and geographical records; distribution maps, images of representative species in the field and the main morphological characters are provided to assist in the correct identification of this important group of savanna plants. We present here 15 lectotypifications, out of which three are second-step, as an outcome of our analysis.

Keywords: Cajaninae, *Cerrado*, Fabaceae, Neotropics, *Rhynchosia*, taxonomy

RESUMO

Eriosema (DC.) Desv. é um gênero típico de savana, com distribuição pantropical e compreende aproximadamente 150 espécies, com dois centros de diversidade, um na África com cerca de 110 espécies e outro nos Neotrópicos com cerca de 40 espécies. Considerando o grande número de táxons de *Eriosema* no Brasil, incluindo cinco espécies recentemente descritas, e a falta de um estudo atual que inclua todas as espécies que ocorrem no país, é apresentada aqui uma sinopse taxonômica das espécies brasileiras de *Eriosema*. Foram consultados herbários

nacionais e estrangeiros, incluindo as coleções tipo, além de coletas em campo por toda a área de ocorrência das espécies no território brasileiro. No Brasil são registradas 35 espécies, o que o torna o país mais rico em espécies de *Eriosema* nos Neotrópicos, 85% (35/41) das espécies relatadas para todo o continente americano. A maior diversidade do gênero, nos Neotrópicos, está nas áreas de savana no Brasil Central, nos estados de Goiás (com 29 táxons, dos quais oito são endêmicos) e Minas Gerais (com 26, dos quais quatro são endêmicos). As espécies mais amplamente distribuídas no Brasil e em todo o continente americano são *Eriosema simplicifolium* e *Eriosema crinitum*. Estas duas espécies formam complexos que devem ser estudados futuramente para um melhor entendimento de suas possíveis delimitações. A sinópse taxonômica inclui uma chave de identificação, descrições de táxons, informações detalhadas sobre o tipo dos espécimes; informações fenológicas, do habitat e distribuição geográfica; mapas de distribuição, imagens de espécies no campo e os principais caracteres morfológicos são fornecidos para auxiliar na identificação correta deste importante grupo de plantas do cerrado. Como resultado deste estudo são aqui propostas 15 lectotipificações, das quais três são de segundo passo.

Palavras chave: Cajaninae, Cerrado, Fabaceae, Neotrópicos, *Rhynchosia*, taxonomia

Introduction

Eriosema (de Candolle 1825: 388) Desvaux (1826: 421) is a pantropical genus of the subtribe Cajaninae Bentham (1837: 49), tribe Phaseoleae (Bronn 1822: 133) de Candolle (1825: 381). It comprises about 150 species with centers of diversity in Africa (about 110 species) and the Neotropics (about 40 species) (Grear 1970, Schrire 2005). Some species are notable for their medicinal properties and are used by many African communities, such as the "Zulu" people of South Africa that use the roots of *Eriosema* species as a medicine for the treatment of erectile dysfunction and/or impotence (Ojewole 2007). Ethnic groups living in the mountains of the province of Yunnan in China use the roots of *Eriosema tuberosum* Richard (1847: 227)

in the treatment of diarrhoea, orchitis, hydrophobia and as a detoxifying medicine (Ma *et al.* 1998). In the Neotropics, traditional communities in the cerrado of Minas Gerais, southeastern Brazil, use *Eriosema glabrum* Mart. ex Bentham (1849: 522) as a laxative, as well as *E. benthamianum* Mart. ex Bentham (1849: 521) and *E. campestre* var. *macrophyllum* (Grear 1970: 52) Fortunato (1999: 375) as an anti-inflammatory (Hirschmann & De Arias 1990, Rodrigues & Carvalho 2001, Santos *et al.* 2016).

Species of *Eriosema* occur mainly in the tropical savannas (including cerrado) around the globe. Neotropical *Cerrado*, the most diverse tropical savanna in the world, is considered a biodiversity hotspot with high concentrations of endemic species, and it is suffering from a remarkable loss of area (Grear 1970, Myers *et al.* 2000). At higher elevations than the *Cerrado*, above 900 m, the *campo rupestre* (rocky field), a type of vegetation that generally occurs on quartzitic outcrops, stands out due to its rich biodiversity with high levels of endemism. The main area of *campo rupestre* is the Espinhaço mountain range, which extends across the states of Minas Gerais and Bahia (Giulietti & Pirani 1988, Coutinho 2006, Batalha 2011), where many species of *Eriosema* are found (Grear 1970, Fortuna-Perez *et al.* 2013, 2017, 2018, Cândido *et al.* 2014a, 2014b, Oliveira *et al. in press*).

The morphology of the species of *Eriosema* is directly related to the necessary adaptations for their survival in their environment of occurrence, as encountered in other endemic floristic elements of the *Cerrado* (Gottsberger & Silberbauer-Gottsberger 2006). Among the characteristics of these savannas are a pronounced dry season, xeromorphism, sites with waterlogging, shallow soils, high metallic ion concentration and often regular fire (Lock 2006). The Brazilian species of *Eriosema* are characterized by being subshrubs, frequently with a specialized underground root system (a woody rootstock, often called xylopodium), an abundance of trichomes throughout the plant, and secretory structures that are peculiar to subtribe Cajaninae (including bulbous-based trichomes, vesicular glands and secretory-based

trichomes) (Grear 1970, Lackey 1978, Cândido *et al.* 2016, Vargas *et al. in press*). Other important morphological characters that diagnose the genus are: leaves unifoliolate or trifoliolate, inflorescences in axillary or terminal racemes, with flowers sparsely distributed along the inflorescence rachis or congested apically, and seeds with a linear hilum and an apical funicle, inserted at the terminal hilum extremity (Grear 1970).

Eriosema and *Rhynchosia* Loureiro (1790: 460) are the two pantropical genera of subtribe Cajaninae that are morphologically and phylogenetically related. Although there is no detailed phylogenetic study for *Eriosema* to date, other phylogenetic studies that included a few species of this genus have identified it as monophyletic (Grear 1970, Doyle & Doyle 1993, Bruneau *et al.* 1995, Kajita *et al.* 2001, Egan *et al.* 2016, LPWG 2017).

The most recent and comprehensive taxonomic study for American species of the genus was conducted by Grear (1970), who recognized 38 species for the Neotropics. Studies of *Eriosema* in Brazil have been restricted to the description of new taxa or limited to regional floras (Lewis 1987, Miotto 1988, Lewis & Owen 1989, Rogalski & Miotto 2011, Cândido *et al.* 2014a, Oliveira *et al. in press.*); in the past six years, five Brazilian species of *Eriosema* have been described as new to science (Fortuna-Perez *et al.* 2013, 2017, 2018, Cândido *et al.* 2014b, 2016). Considering that since Grear (1970) there has been no other published work that covered all the species that occur in Brazil there is a need for a country-wide revision to update data on the number of species, their area of occurrence and the main diagnostic characteristics of each taxon. The aim of this study is, therefore, to present a taxonomic synopsis of *Eriosema* in Brazil, including an identification key to all taxa, information on habitat, phenological and geographical data, images of representative species in the field and consideration of the main morphological characters to assist in the correct identification of this important group of savanna plants.

Material and Methods

The study is based on a review of relevant literature, field work across the distribution range of *Eriosema* in Brazil and morphological analysis of specimens, including types, housed in the herbaria with the most important Brazilian *Eriosema* collections specimens (namely: ALCB, BHCB, BM, BOTU, CEN, CEPEC, CGMS, CVRD, ESA, HRB, HUEFS, HURB, IBGE, K, MBM, MBML, MO, NY, OUPR, P, PEUFR, PRE, R, RB, SI, SP, SPF, UB, UEC, UFG, US, VIC, and VIES (acronyms follow Thiers, continuously updated)).

All types were analysed either in person or as high resolution digital images in the following platforms (speciesLink available on http://www.splink.org.br; Reflora Herbário Virtual http://floradobrasil.jbrj.gov.br/reflora/herbarioVirtual/; JABOT http://aplicacoes.jbrj.gov.br/jabot/v2/consulta.php; Global Plants (http://plants.jstor.org/) and the nomenclatural data were extracted from relevant literature, mainly from Tropicos (http://www.tropicos.org/) and IPNI (http://www.ipni.org/). All the protologues were analysed from the BHL (http://www.biodiversitylibrary.org/). An exclamation mark ("!") is included for type materials seen by the authors. Photographs or digital images of type specimens seen by the authors are referred as "photograph!" or "digital image!".

For the taxon descriptions, only the characters that assist in their correct identification were prioritized. The characteristics of flowers and fruits are very similar among all species, differing essentially in size, so these are not detailed in the descriptions. Flowering and fruiting times (reproductive phenological states) were derived from herbarium specimen label data and field observations. The distribution maps were prepared using ArcGIS for Desktop 10.5 software (ESRI 2016, Redlands, California), under a site license for UNICAMP. The Cerrado Domain presented in our study is modified from ecoregions of the world (Olson *et al.*, 2001).

Results and Discussion

Taxonomy

Eriosema (DC.) Desv., Ann. Sci. Nat. (Paris) 9: 421. 1826. *Rhynchosia* sect. *Eriosema* DC., Prod. Syst. Nat. Reg. Veg. 2: 388. 1825.

Type species:—*Eriosema rufum* (Kunth) G. Don, Gen. Hist. 2: 347. 1832. Basionym: *Glycine rufa* Kunth, Nov. Gen. Sp. (ed.4) 6: 423. 1823.

Shrubs or subshrubs, erect or ascending, procumbent or prostate. Frequently with an underground specialized root system (a woody rootstock, often called a xylopodium). Stems angular or striate, simple or branched. Stipules usually lanceolate, chartaceous, striate, connate or free, persistent or caducous. Leaves trifoliolate or unifoliolate, short-petiolate or subsessile, the leaflets very diverse in size and shape, yellow punctiform glands on both surfaces or sometimes only on the abaxial surface. Inflorescences racemose, shorter or longer than the leaves, terminal or axillar, lax or congested (flowers distributed along the inflorescence axis or concentrated at the apex). Bracts usually lanceolate, chartaceous, striate, persistent or caducous. Corolla papilionaceous, usually yellow, rarely orange and violet-striate or flushed reddish purple; calyx campanulate, 5-lobed; standard usually obovate, 2-auriculate at the base, claw cupulate; wing petals narrowly obovate to oblong, uni-auriculate or not, claw attenuate; keel petals usually falcate to obovate, slightly incurved at apex, laterally saccate, claw attenuate. Stamens ten, diadelphous, the vexillary one free; anthers uniform. Ovary sessile to subsessile, densely villous, biovulate; style filiform, stigma apical, subcapitate. Fruit 2-valved, oblong to rhombic or ovate and obliquely beaked, elastically dehiscent. Seeds two per pod, reniform to oblong or oval, brown to black, lustrous, hilum long, linear, flanked by a conspicuous, whitish, bilobed strophiole.

Distribution, Habitat, and Endemism:—*Eriosema* is a genus restricted to savanna or Savanna-like environments and in Brazil is represented by 35 species, most of which occur in

the Cerrado biome. In the past six years, five new species of *Eriosema* have been described from Brazil: *Eriosema hatschbachii* Fort.-Perez & G. P. Lewis (2013: 641) and *E. tozziae* Cândido & Fort.-Perez (2014: 229) both from the state of Minas Gerais; *E. grearii* Cândido & Fort.-Perez (2016: 123) from the state of Mato Grosso do Sul; and *E. elegans* Fort.-Perez & M.J. Silva (2017: 82) and *E. macrostipulatum* Fort.-Perez, Cândido & M.J. Silva (2018: 198) both from the Chapada dos Veadeiros National Park, a conservation area located in the state of Goiás (Fortuna-Perez *et al.* 2013, 2017, 2018, Cândido *et al.* 2014b, 2016). Species grow in a diverse array of habitats including woodland, wooded grassland, bushy grassland and grassland. They can also occur in sites with seasonal waterlogging or in rocky or sandy soils with low fertility in areas of higher altitude, known as *campos rupestres* (rocky fields) (Fig. 1).

The state of Goiás (including the Distrito Federal), located in the Central-West region of Brazil, is considered one of the centers of diversity of the genus in the country, with 29 taxa, eight of them endemic: *E. brachyrhachis* Harms (1903: 30), *E. brevipes* Grear (1970: 57), *E. crassicaule* Grear (1970: 57), *E. elegans* Fort.-Perez & M.J. Silva (2017: 82), *E. irwinii* Grear (1970: 54), *E. laxiflorum* Harms (1903: 30), *E. macrostipulatum* Fort.-Perez, Cândido & M.J. Silva (2018: 198) and *E. pycnanthum* var. *veadeirense* Grear (1970: 65) (Grear 1970, Fortuna-Perez *et al.* 2017, 2018). The state of Minas Gerais is the second most speciose region in Brazil with 26 taxa, four of them endemic: *E. hatschbachii* Fort.-Perez, *E. prorepens* Benth., *E. pycnanthum* var. *pycnanthum* Benth. and *E. tozziae* Cândido & Fort.-Perez (Fig. 2). Most species occur in more than one state of Brazil and the most widely distributed species are *Eriosema crinitum* (Kunth) G. Don and *Eriosema simplicifolium* (Kunth) G. Don, occurring in almost all geographic regions of the country.

Nomenclatural and taxonomic notes:—*Eriosema* was first treated by Augustin Pyramus de Candolle in 1825, in *Prodromus systematis naturalis regni vegetabilis*, as one of the three sections of the genus *Rhynchosia* sect. *Eriosema*. De Candolle (1825) separated the three

sections based on petiole length, leaflet number and inflorescence type, and suggested that sect. *Eriosema*, which included eight species, might be a distinct genus. In 1826, Desvaux revised the group and elevated sect. *Eriosema sensu* De Candolle to the rank of genus, adding a new species to the original circumscription and modifying the name to "*Euriosma*" DC. Due to this orthographic variation of the genus name, the correct author of the genus became a point of discussion until the study of Fortunato *et al.* (2002), who proposed to reinstate the authorship of the genus, as *Eriosema* (DC.) Desv.

Generic Relationships:—The subtribe Cajaninae, in which *Eriosema* is placed, comprises a total of 490 species in ten genera. It is the most speciose subtribe of the tribe Phaseoleae (Schrire 2005) and is characterized by peculiar secretory structures, including bulbous-based trichomes, vesicular glands (Lackey 1978), and secretory-based trichomes (Cândido *et al.* 2016, Fortuna-Perez *et al.* 2017; Vargas *et al.* in press). *Eriosema* and *Rhynchosia* are the genera of subtribe Cajaninae that are most closely related morphologically and phylogenetically (Grear 1970, Doyle & Doyle 1993, Bruneau *et al.* 1995, Kajita *et al.* 2001, Egan *et* al. 2016, LPWG 2017). The character most often used to distinguish between these two genera is the location of the funicular attachment of the seed in relation to the hilum, being terminal in *Eriosema* and central, subcentral or sometimes terminal in *Rhynchosia* (Baker 1895, Grear 1970). Other authors have included other morphological characters to distinguish the American species of these two genera, including habit, petiole length and petiolule length, length of the calyx lobes, hilum form, extension of the strophiole and flower color (Grear 1970, Miotto 1988). Nevertheless, species of the two genera are still sometimes misidentified in herbaria. In the present study, the main characters that we use to separate the Brazilian species of *Eriosema* and *Rhynchosia* are given in Table 1. The two genera are best separated morphologically using a combination of characters. Although the two genera essentially have a pantropical distribution, *Rhynchosia* extends into some temperate regions, whereas *Eriosema* is restricted to savanna environments.

Additionally, *Rhynchosia* displays greater ecological flexibility, occurring also in forest environments, along streams and in disturbed vegetation (Grear 1978). In Brazil, the diversity centers of *Eriosema* are the states of Goiás and Minas Gerais, in Brazilian savanna. In contrast, *Rhynchosia* has more species occurring in the states of São Paulo and Paraná (Bezerra *et al.* in press.).

Vernacular names:—Species of *Eriosema* are not known by many common local names in Brazil. In a survey of medicinal plants of the Cerrado in the southeastern state of Minas Gerais, however, *Eriosema glabrum* is popularly known as "Seno-verdadeiro", and *Eriosema benthamianum* as "Bolsa-de-pastouro" and/or "Andu-do-campo" in the Serra do Cipó region, in the center of the Minas Gerais state (Hirschmann & De Arias 1990, Rodrigues & Carvalho 2001). In addition, Grear (1970) mentions that *Eriosema crinitum* is popularly known as "Postemeira-do-campo" in the states of Goiás and São Paulo.

Key to identify the taxa of *Eriosema* occurring in Brazil

1. Leaves unifoliolate 2
– Leaves trifoliolate 11
2. Stipules free 3
– Stipules entirely or partially connate 5
3. Racemes 3–6 cm long (shorter than mature leaves) ..... *E. obovatum*
– Racemes 7–17.5 cm long (longer than mature leaves) 4
4. Erect subshrub with caespitose aspect; leaves lacking when fertile; leaflets lanceolate, species endemic to Goiás state (including the Federal District)..... *E. laxiflorum*
– Erect subshrub without caespitose aspect; leaves present when fertile; leaflets elliptic to obovate, species endemic to Mato Grosso do Sul state ..... *E. grearii*
5. Racemes usually longer than mature leaves 6
– Racemes usually shorter than mature leaves 7
6. Stipules caducous; leaflets conspicuously variable in size on the same plant; shrubs or subshrubs with stems usually erect ..... *E. benthamianum*
– Stipules persistent; leaflets usually uniform in size on the same plant; prostrate subshrub with stems procumbent..... *E. heterophyllum*
7. Base of the leaflets with three veins evident and with margin slightly revolute; species endemic to Goiás state (including the Distrito Federal) ..... *E. brachyrhachis*

– Base of the leaflets with three veins not evident and with margin plane or slightly revolute 8
8. Leaflets usually linear or rarely narrowly lanceolate with midrib conspicuously prominent .....*E. stenophyllum*
– Leaflets ovate to cordate, lanceolate to ovate, slightly cordate, cordate-ovate or broadly oblong with midrib not prominent 9
9. Flowers 20–30 mm long; lealflets with conspicuous reticulate secondary veins on the abaxial surface ..... *E. venulosum*
– Flowers 7–15 mm long; lealflets without conspicuous reticulate secondary veins on the abaxial surface 10
10. Inflorescence densely whitish sericeous; stems whitish pubescent; leaflets coriaceous ..... *E. rigidum*
– Inflorescence glabrescent; stems yellowish pilose or rufous-pilose; leaflets chartaceous ..... *E. simplicifolium*
11. Racemes usually shorter than mature leaves 12
– Racemes usually longer than mature leaves 30
12. Plant with caducous leaves when fertile ..... *E. congestum*
– Plant with persistent leaves when fertile 13
13. Stipules free and caducous 14
– Stipules free or connate and persistent 15
14. Flowers congested on the inflorescence ..... *E. crassicaule*
– Flowers laxly arranged on the inflorescence ..... *E. platycarpon*
15. Leaflets generally more than five times longer than wide 16
– Leaflets generally less than five times longer than wide 19
16. Inflorescence always pauciflorous; 2–5 flowers laxly arranged in the inflorescence .....*E. crinitum*
– Inflorescence pauciflorous or multiflorous; flowers congested on the inflorescence 17
17. Leaflets elliptic to narrow-elliptic; inflorescence sericeous to hirsute .... *E. tacuaremboense*
– Leaflets linear, narrowly lanceolate or lanceolate; inflorescence glabrescent, rufous-pubescent or densely whitish pubescent 18
18. Stems usually yellowish or rufous-pubescent; inflorescence glabrescent or rufous-pubescent ..... *E. longifolium*
– Stems densely whitish pubescent; inflorescence densely whitish pubescent .....*E. strictum*
19. Stipules 17–25 mm long ..... *E. macrostipulatum*
– Stipules up to 15 mm long 20
20. Stems erect and whitish pubescent to densely whitish tomentose 21
– Stems erect, ascending or decumbent and not whitish pubescent to densely whitish tomentose (glabrous, glabrescent, yellow, whitish-sericeous; yellow or whitish pilose; rufous-pilose, rufous-tomentose or ferrugineous-pubescent) 22
21. Plant with persistent leaves when fertile often exceeding 1.2 m tall; leaflets with camptodromous venation and many reticulate secondary veins ..... *E. floribundum*
– Plant with persistent leaves only near the apex when fertile up to 1 m tall; leaflets with craspedodromus venation and many parallel secondary veins .....*E. hatschbachii*

22. Stems yellow or whitish sericeous, yellow or whitish pilose, glabrous or glabrescent 23
– Stems rufous-pilose, rufous-tomentose or ferrugineous-pubescent 27
23. Stems erect, glabrous or glabrescent; multiflorous inflorescence (15–30 flowers) .... *E. irwinii*
– Stems erect or ascending, yellow or whitish sericeous, yellow or whitish pilose; pauciflorous inflorescence (2–7 flowers) 24
24. Leaflets lanceolate or slightly oblong, thin-coriaceous ..... *E. brevipes*
– Leaflets obovate to broadly-ovate, orbicular, elliptical to broadly-elliptical, ovate, oblong-obovate or narrowly-elliptical, papyraceous, membranaceous or chartaceous 25
25. Stipules lanceolate, 8–15 mm long; leaflets narrowly-elliptical; inflorescences with 6–7 flowers ..... *E. campestre* var. *macrophyllum*
– Stipules broadly lanceolate to oval, 2–7 mm long; leaflets obovate to broadly-ovate, orbicular, elliptical to broadly-elliptical, ovate or oblongo-obovate; inflorescences with 2–5 flowers 26
26. Leaflets chartaceous, 2.8–6 × 1.5–4 cm; inflorescence with 3.5–5.5 cm long .... *E. campestre* var. *campestre*
– Leaflets papyraceous, 2–4 × 1–2 cm; inflorescence up to 2.5 cm long .... *E. campestre* var. *delicatula*
27. Flowers 13–14 mm long; leaflets with plane margin; inflorescence often terminal racemes 28
– Flowers 6–12 mm long; leaflets with revolute margin; inflorescence always axillary racemes 29
28. Inflorescence 3.5–6.5 cm long; leaflets membranaceous to chartaceous; variety endemic to the Iron Quadrangle Region in Minas Gerais state .....*E. pycnanthum* var. *pycnanthum*
– Inflorescence 1.5–3 cm long; leaflets thin-coriaceous to coriaceous; variety endemic to the Parque Nacional da Chapada dos Veadeiros in Goiás state ....*E. pycnanthum* var. *veadeirense*
29. Inflorescence up to 3.5 cm long; stipules free and ovate ..... *E. rufum* var. *rufum*
– Inflorescence 3.6–6 cm long; stipules connate and lanceolate ..*E. rufum* var. *macrostachyum*
30. Prostrate subshrub, procumbent 31
– Erect or ascending shrub or subshrub..... 32
31. Stems and racemes hirsute; stipules 10–22 mm long, foliaceous; leaflets membranaceous; inflorescence pauciflorous (5–10 flowers) with flowers often laxly arranged; species endemic to Serra da Canastra region and surroundings in Minas Gerais state .....*E. prorepens*
– Stems and racemes pilose; stipules 6–9 mm long, not foliaceous; leaflets thin-coriaceous; inflorescence multiflorous (15–65 flowers) with flowers conspicuously congested; species occurring in Distrito Federal and in the states of Goiás, Minas Gerais and São Paulo ..... *E. glaziovii*
32. Base of the leaflets with three veins evident 33
– Base of the leaflets with three veins not evident 34
33. Inflorescence 12–25 cm long with flowers laxly arranged; stipules caducous; leaflets narrowly elliptic to narrowly obovate, rarely narrowly oblong; species endemic to the Parque Nacional da Chapada dos Veadeiros in Goiás state ..... *E. elegans*

– Inflorescence 3–9 (11) cm long with flowers congested; stipules persistent; leaflets oblong to obovate; species occurring in Distrito Federal and in the states of Goiás, Mato Grosso, Minas Gerais and Paraná ..... *E. glabrum*
34. Flowers 5–7.5 mm long; leaflets linear-oblong, chartaceous .....*E. violaceum*
– Flowers 10–35 mm long; leaflets slightly obovate, obovate, broadly obovate, obovate to elliptical, ovate to broadly ovate, broadly oblong, elliptical, rounded, or elliptic to broadly elliptic, coriaceous, thin-coriaceous or membranaceous 35
35. Inflorescence 6.5–9 cm long with flowers congested or somewhat laxly arranged; stems rufous, ferruginous or cupreous-tomentose ..... *E. cupreum*
– Inflorescence 10–27 cm long with flowers laxly arranged; stems whitish villous, yellowish pubescent, brownish pubescent or rufous pubescent 36
36. Plants with caducous leaves when fertile ..... *E. defoliatum*
– Plants with persistent leaves when fertile 37
37. Flowers 10–13 mm long ..... *E. tozziae*
– Flowers 21–35 mm long 38
38. Leaflets elliptical; when immature yellowish pubescent or rufous-pubescent; species occurring in Goiás, Minas Gerais and Tocantins states ..... *E. longiflorum*
– Leaflets usually obovate; when immature always silvery tomentose or silvery velutinous; species occurring in Goiás, Mato Grosso and Mato Grosso do Sul states ..... *E. riedelii*

1. Eriosema benthamianum Mart. ex Benth., Linnaea 22: 521. 1849. (Fig. 3 C–D)

Type:—BRAZIL, Minas Gerais, "In. prov. Minas Geraes", *Martii Herbar. Florae Brasil. N° 1132* (lectotype: K! 000530002, designated by Grear 1970; isolectotypes: BR 0000005172566 digital image!, LE 00002553 digital image!, M 0240787 digital image!, P! 00709029).

Shrub or subshrub, 0.5–1.6 m tall, stems erect or ascending, sparsely rufous-pilose or yellow-glandular. Stipules 4.5–6 mm long, connate or partially connate, lanceolate, caducous. Leaves unifoliolate, persistent when the plant is fertile. Leaflets conspicuously variable in size and shape on the same plant, 2–12 × 2–6 cm, ovate, elliptic, cordate or broadly oblong, thin-coriaceous, base with three veins not evident, margin plane, venation camptodromous. Inflorescences terminal or axillary racemes, 3–7.5 cm long (including the peduncle), usually longer than mature leaves, pubescent, pauciflorous or multiflorous (4–15-flowered), flowers laxly arranged, 12–18 mm long. Fruit 11–18 × 6–10 mm.

Nomenclatural and taxonomic notes:— In the protologue of *Eriosema benthamianum* the author cited: “Mart. Fl. Bras. n° 1132. In prov. Minas Geraes, *Pohl*, *Claussen*, *Riedel*, *Gardner n° 4508* (et *4512*?)”. Although Grear (1970) attributed the collection number 1132 to *C.F.P. von Martius*, this number actually refers to the catalog number of the Flora Brasiliensis Herbarium (and does not correspond to a gathering made by *C.F.P. von Martius*). In 1970 Grear erroneously cited the collection "*Martius 1132*" housed in the K herbarium as the “holotype”, in fact he unintentionally lectotypified this specimen (see Turland et al. 2018, Art. 7.11 and Art. 9.10). With this, the K specimen with barcode number 000530002 is the lectotype of *Eriosema benthamianum*. Considering the other collections cited in the protologue: *Gardner 4508* is a remaining syntype; *Gardner 4512* was not traced in our study. As *Pohl*, *Claussen*, and *Riedel* collections were cited in the protologue without a collector`s number, we have been unable to locate with certainty these collections, but the following collections have been referred to (i.e. these are possibly remaining syntypes): *P. Claussen 1764* (P! 02749478); *P. Claussen 951* (P! 02749476); *P. Claussen & B. Delessert 13* (K! 000502995); *L. Riedel 704* (K! 000503000); *L. Riedel 2231* (K! 000503001).

Eriosema benthamianum is one of the largest species in the genus, often a shrub exceeding one meter in height. It frequently has erect stems, with yellow-glandular trichomes and leaflets of variable size and shape on the same plant. This species is morphologically similar to *E. heterophyllum* Benth., but that species has prostrate stems and leaflets uniform in size and shape on the same plant.

Reproductive phenological states:—Flowering from March to November and fruiting from June to November.

Distribution and habitat:—*Eriosema benthamianum* is endemic to Brazil and occurs in the Distrito Federal and the states of Goiás, Mato Grosso do Sul, Minas Gerais and São Paulo, (Fig.

4). It grows in wooded grassland ("campo cerrado"), along roadsides and in "campo rupestre" vegetation (Grear 1970).

Remaining syntypes:—BRAZIL. Minas Gerais: "Prov. Minas Geraes", 1841 (fl.), *G. Gardner 4508* (K! 000502998); "Serra das Araras", June 1840 (fl.), *G. Gardner 4508* (K! 000502999).

Representative specimens examined:—BRAZIL. Distrito Federal: Brasília, Chapada da Contagem, 28 October 1965 (fl.), *H.S. Irwin 9635* (NY); Rio Preto, 10 August 1963 (fl.), *E.P. Heringer 9279* (NY); Samambaia, Parque Boca da Mata, entre a fábrica da coca-cola e a área da polícia, 07 August 1995 (fl./fr.), *J.M. Rezende 47* (HUEFS). Goiás: 12 July 1895 (fl./fr.), *A.F.M. Glaziou 20889* (P); Pirenópolis, Santuário de Vida Silvestre de Vaga Fogo, 28 August 2003 (fl./fr.), *M.L. Fonseca et al. 4862* (RB); Silvânia, Floresta Nacional de Silvânia, 06 October 2012 (fl.), *A.P. Fortuna-Perez et al. 1427* (OUPR). Mato Grosso do Sul: Selvíria, Fazenda de Ensino e Pesquisa da UNESP campus de Ilha Solteira, 12 October 1989 (fl./fr.), *M.P. Pereira-Noronha & J. dos Santos M739 S145* (RB). Minas Gerais: Arcos, 07 June 1990 (fl./fr.), *P.C. Vinha 1089* (VIES); Brasilândia de Minas, Fazenda Brejão, 30 August 1999 (fl./fr.), *A. A. Azevedo 121* (BHCB); Curvelo, 05 November 1972 (fl./fr.), *G. Hatschbach 26984* (UEC); Frutal, 18 July 1974 (fl./fr.), *G. Hatschbach 34562* (UEC); Serra da Piedade, Divisa de Betim e Brumadinho, 08 July 1994 (fl./fr.), *J. Evangelista de Oliveira* 104 (BHCB, UB); São Roque de Minas, São Sebastião do Paraíso, São Sebastião do Paraíso-Passos Km 12, 21 September 1977 (fl./fr.), *G. Buffarah*, without number, (UEC 004729); Uberaba, 23 km N of Uberaba on BR-106, 07 July 1967 (fl./fr.), *R. Goodland 3151* (UB). São Paulo: Buritizal, 27 July 1994 (fl./fr.), *K. D. Barreto et al. 2724* (ESA, SPF); Cajuru, Fazenda Santa Carlota, 20 August 1989 (fl.), *A. Sciamarelli & J. V. C. Nunes 209* (SPF); 24 March 1989 (fl.), *A. Sciamarelli & J. V. C. Nunes 274* (SPF).

2. *Eriosema brachyrhachis* Harms, Bot. Jahrb. Syst. 33, Beibl. 72: 30. 1903.

Type:—BRAZIL, "Brasilien: Goyaz, Ponte Alta, auf stenigem Camp", October 1894 (fl.) *A.F.M. Glaziou 20893* (**lectotype, designated here: R! 000008614**; isolectotypes: BAB 00000354 (fragment) digital image!, G 00365258 digital image!, K! 000530006, LE 00002554 digital image!, P! 00709030, P! 00709031, S S-R-9736 digital image!; B, destroyed, F negative 2418 photograph!).

Prostrate subshrub, 0.5–1.6 m tall, stems procumbent, sparsely rufous-pilose. Stipules 8–14 mm long, connate or partially connate, narrowly lanceolate, persistent. Leaves unifoliolate, persistent when the is fertile. Leaflets uniform in size and shape on the same plant, 3–11 × 0.5–1.5 cm, linear to narrowly lanceolate or narrowly oblong, thin-coriaceous, base with three veins evident, margin slightly revolute, venation camptodromous, Inflorescences axillary racemes, 1.2–2 cm long (including the peduncle), shorter than mature leaves, pubescent, pauciflorate (2–6-flowered), flowers congested, 7–10 mm long. Fruit not seen.

Nomenclatural and taxonomic notes:— Grear (1970) only saw the photograph negative of the type collection (probably registered as F negative 2418). The original specimen was probably destroyed in Berlin during the Second World War. For this reason, the material at R with barcode 000008614 is here chosen as the lectotype of *Eriosema brachyrhachis*.

This species is morphologically similar to *Eriosema simplicifolium* (Kunth) G. Don but differs mainly by its axillary racemes (vs. terminal racemes in *E. simplicifolium*), leaflets linear to narrowly lanceolate or narrowly oblong, and thin-coriaceous (vs. leaflets lanceolate, oval-lanceolate or oblong-lanceolate, and chartaceous in *E. simplicifolium*) and leaflets with conspicuous deep veins (vs. not deep veins in *E. simplicifolium*). In addition, *E. brachyrhachis* is endemic to Goiás, including the Distrito Federal, while *E. simplicifolium* is widely distributed throughout the country.

Reproductive phenological states:—Flowering in March, July, September and October. It has not been collected in fruit.

Distribution and habitat:—*Eriosema brachyrhachis* is endemic to state of Goiás, including the Distrito Federal (Fig. 4). It occurs in stony fields prone to annual fires.

Representative specimens examined:—BRAZIL. Distrito Federal: ca. 35 km SW of Brasília, on road to Anápolis, 5 September 1964 (fl.), *H.S. Irwin & T.R. Soderstrom 6021* (NY, UB); Entre Gama e o Rio Corumbá, 12 July 1964 (fl.), *A.P. Duarte 8365 & A. Mattos 456* (NY, UB). GOIÁS: Santo Antônio do Descoberto, Cidade Eclética, 10 March 1974 (fl.), *E.P. Heringer 13156* (MO, UB, US).

3. *Eriosema brevipes* Grear, Mem. New York Bot. Gard. 20(3): 57–58. 1970. (Fig. 3 G–I).

Type:—BRAZIL, Goiás, Chapada dos Veadeiros, ca. 15 km W of Veadeiros, elev. 1000 m, 10 February 1966 (fl./fr.), *H.S. Irwin, J.W. Grear Jr., R. Souza & R. Reis dos Santos 12461* (**lectotype, designated here: NY! 00007849**; isolectotypes: BAB 00000355 (fragment) digital image!, F 0044189F digital image!, G 0003534 digital image!, GH 00066308 digital image!, IAN not seen, K! 000530019, LE 00002555 digital image!, MO not seen, NY! 00007850, S S-R-9737 digital image!, U 0003534 digital image!, UB! 4705, US 00004813 digital image!).

Subshrub, 0.7–1 m tall, stems erect or ascending, yellow-sericeous or whitish sericeous. Stipules 4–12 mm long, connate, lanceolate, persistent. Leaves trifoliolate, persistent when the plant is fertile. Leaflets uniform in size and shape on the same plant, 2.5–8 × 0.6–2.5 cm, lanceolate or slightly oblong, thin-coriaceous, base with three veins not evident, margin plane, venation camptodromous. Inflorescences terminal or axillary racemes, 2–3 cm long (including the peduncle), shorter than mature leaves, pubescent, pauciflorous (2–5-flowered), flowers congested, 12–14 mm long. Fruit 10–16 × 5–10 mm.

Nomenclatural and taxonomic notes:—There are two sheets of *H.S. Irwin et al. 12461* in NY (the herbarium that Grear cited in the protologue). In one of the sheets (NY 00007849) is annotated "holotype" and in the other (NY 00007850) is labeled as "isotype", but he did not distinguish them in his publication (Grear 1970). Then, the sheet NY 00007849 is chosen here as the lectotype of *Eriosema brevipes*.

Eriosema brevipes resembles *E. congestum* Benth. in presenting racemes (with congested flowers) shorter than mature leaves. In *E. brevipes* the leaflets are, however, conspicuously smaller, lanceolate or slightly oblong and persistent when the plant is fertile. In contrast, in *E. congestum* the leaflets are larger, elliptic or narrow-elliptic and caducous when the plant is fertile.

Reproductive phenological states:—Flowering and fruiting in February, March and July.

Distribution and habitat:—*Eriosema brevipes* is endemic to cerrado from the highlands of the Chapada dos Veadeiros National Park (Fig. 4). It often occurs on the slopes of rocky outcrops surrounded by grassland. The elevational range of the species is 900–1600 m (Grear 1970).

Representative specimens examined:—BRAZIL. Goiás: Alto Paraíso de Goiás, 24 March 2005 (fl./fr.), *E. Chaves & C.E.B. Proença 247* (UB); Chapada dos Veadeiros, ca. de 1 km W of Veadeiros, 13 February 1966 (fl.), *H. S. Irwin et al. 12732* (NY); ca. 19 km N of Alto Paraíso, 20 March 1971 (fl.), *H. S. Irwin et al. 32806* (NY); ca. 20 km by road N of Alto Paraíso, 03 March 1973 (fl.), *W.R. Anderson 6208* (UB); Parque Nacional da Chapada dos Veadeiros, 29 July 2016 (fl./fr.), *E.S. Cândido 1108* (BOTU, UEC).

4. *Eriosema campestre* Benth., Mart., Fl. Bras. 15(1): 212. 1859.

Type:—BRAZIL, Minas Gerais, "in siccis prope Jaguari", October 1824, (fl./fr.), *L. Riedel 607* (holotype: LE 00002556 digital image!; isotypes: K! 000530015).

Subshrub, 0.2–1 m tall; stems erect or ascending, yellow-pilose or whitish pilose. Stipules 2–15 mm long, connate or free, lanceolate or broadly lanceolate to oval, persistent. Leaves trifoliolate, persistent when the plant is fertile. Leaflets uniform in size and shape on the same plant, 2–8 × 1–4 cm, obovate to broadly-ovate, orbicular, elliptical to broadly-elliptical, oblong-obovate, narrowly-elliptical, papyraceous, membranaceous or chartaceous, base with three veins not evident, margin plane, venation camptodromous. Inflorescences terminal or axillary

racemes, 2–6.5 cm long (including the peduncle), shorter than mature leaves, pubescent, pauciflorous (2–7-flowered), flowers congested, 12–13 mm long. Fruit 15–20 × 8–11 mm.

Nomenclatural and taxonomic notes:—In the protologue of *Eriosema campestre*, Bentham (1859) stated: "*Eriosema campestre* Benth. in Herb. Acad. Petrop.; Habitat in siccis prope Jaguari (prov. Minarum?): Riedel". "Herb. Acad. Petrop." is the herbarium LE of Saint Petersburg in Russia. The only specimen that has all this information written on the label is *L. Riedel 607* housed in the LE herbarium (barcode 00002556), and we consider this to be the holotype of *Eriosema campestre*. Grear erroneously cited as the holotype the collection housed in the K herbarium (Grear 1970). The collection housed in the K herbarium (K 000530015) carries the same habitat information as given in the protologue and the number 607 corresponding to the collection of Riedel, and only this collection should be considered as an isotype of *Eriosema campestre*.

Eriosema campestre comprises three varieties: *E. campestre* var. *campestre*, *E. campestre* var. *delicatula* and *E. campestre* var. *macrophyllum*. *Eriosema campestre* var. *delicatula* is very similar to the typical variety of the species, mainly in having similar shaped leaflets, stipules broadly lanceolate to oval and 2–7 mm long, and inflorescences with few flowers (often 2–5), but it is a smaller subshrub than the other varieties, often not exceeding 30 cm in height. It has papyraceous leaflets, these 2–4 × 1–2 cm, smaller inflorescences (at most 2.5 cm long, including the peduncle), and has a more restricted distribution than the other varieties of the species, occurring in Brazil only in the states of Rio Grande do Sul and Mato Grosso do Sul. The typical variety of the species has chartaceous leaflets, these 2.8–6 × 1.5–4 cm, inflorescences 3.5–5.5 cm long, and has a wider distribution than *E. campestre* var. *delicatula*. he *Eriosema campestre* var. *macrophyllum* is a larger subshrub, has lanceolate stipules, 8–15 mm long, narrowly-elliptical leaflets and inflorescences with 6–7 flowers.

4.1 *Eriosema campestre* Benth. var. *campestre* (Fig. 3 A–B).

Reproductive phenological states:—Flowering and fruiting reported in January, March, April and October to December.

Distribution and habitat:—This taxon occurs in Brazil, in the Distrito Federal and in the states of Mato Grosso do Sul, Minas Gerais, Paraná, Santa Catarina, São Paulo and Tocantins (Fig. 5), as well as in Paraguay (Fortunato 1999).

Representative specimens examined:—BRAZIL. Distrito Federal: Brasília, Parque das Sucupiras, Setor Sudoeste, 22 December 2004 (fl./fr.), *F.B. Passos & C.A.S. Correia 32* (ESA). Mato Grosso do Sul: Campo Grande, RPPN da UFMS, 09 October 2015 (fl./fr.), *E.S. Cândido et al. 1098* (BOTU, UEC). Minas Gerais: Without locality data, October 1833 (fl.), *L. Riedel 1569* (US). Paraná: Campo Mourão, 09 December 1960 (fl./fr.), *G. Hatschbach 7628* (US); Guarapuava, estrada para Laranjeiras do Sul, 15 November 1957 (fl.), *G. Hatschbach 4337* (US); Senges, by the road to Jaguariaíva, 19 January 1965 (fl./fr.), *L. B. Smith 14868* (US). Santa Catarina: Abelardo Luz, 8-9 km north of Abelardo Luz, 08 December 1964 (fl.), *L.B. Smith 13875* (US); Campo Erê, 17 km west of Campo Erê, 07 December 1964 (fl./fr.), *L.B. Smith & R.M. Klein 13817* (US); Xanxerê, 11 km north of Abelardo Luz, 25 December 1956 (fl.), *L.B. Smith & Pe. R. Reitz 9233* (US). São Paulo: Itapetininga, km 180 Rodovia Raposo Tavares, 03 December 1974 (fl./fr.), *L. d´Ávila Freire de Carvalho et al. 143* (RB); Itararé, Estrada Itararé-Itapeva, próximo à ponte do Rio Verde, 14 November 1994 (fl./fr.), *V.C. Souza et al. 7285* (ESA); Estrada para a Fazenda Santa Andréia, ca. de 1 km da Rodovia Itapeva-Itararé e do Rio Verde, 30 October 1993 (fl.), *V.C. Souza 4511* (ESA); Fazenda Cofesa, 10 November 1994 (fl./fr.), K.D. Barreto *et al. 3196* (ESA); Mogi Mirim, 19 October 1983 (fl./fr.), *T. Nucci & R.R. Rodrigues 15492* (UEC). Tocantins: Lagoa da Confusão, Ilha do Bananal, Parque Nacional do Araguaia, próximo à sede do IBAMA, estrada que dá acesso à aldeia indígena Macaúba (Carajás), 19 March 1999 (fr.), *R.C. Mendonça et al. 3896* (NY).

Additional specimens examined:—PARAGUAY. Amambay: Alredores de Pedro Juan Cabarello, predio de la Universidad Catolica, 28 April 2008 (fl./fr.), *M. Dematteis et al. 2883* (RB).

4.2 *Eriosema campestre* var. *delicatula* Fortunato, Kurtziana 27: 374. 1999.

Type:—ARGENTINA, Prov. Corrientes, Depto. Mburucuyá, Ea. Santa Teresa (propiedad del Dr. T. Pedersen.), em patizal cercano al rio Santa Lucía, 29 November 1990 (fl./fr.), *R. H. Fortunato, Múlgura & Martinez 1778* (holotype: BAB 00000356 digital image!).

Reproductive phenological states:—Flowering and fruiting in November and December.

Distribution and habitat:—It occurs only in the states of Mato Grosso do Sul and Rio Grande do Sul (Fig. 5), as well as in Argentina and Paraguay (Fortunato 1999).

Paratype:—BRAZIL. Mato Grosso do Sul: Ponta Porã, Sanga Puitã, 14 December 1983, (fl./fr.), *G. Hatschbach & R. Callejas 47242* (BAB, CEPEC!, K!, MBM!, MO, US).

Representative specimens examined:— BRAZIL. Rio Grande do Sul: Tupanciretã, Posto Zootécnico da Serra, 15 November 1934, (fl./fr.), *A.A. Araújo 155* (BLA, SI).

Additional specimens examined:—ARGENTINA. Corrientes: Mburucuyá, Ea. Santa Teresa near río Santa Lucía, 19 December 1949(fl./fr.), *T. Pedersen 528* (K, NY, SI, US). PARAGUAY. Canendiyú: Ñanduro kai, 01 November 1978, (fl./fr.), (MO, NY).

4.3 *Eriosema campestre* var. *macrophyllum* (Grear) Fortunato, Kurtziana 27: 375. 1999.

Eriosema crinitum var. *macrophyllum* Grear, Mem. New York Bot. Gard. 20(3): 52–53. 1970. Type:—BRAZIL. Distrito Federal, Summit of Chapada da Contagem, ca. 10 km E of Brasília, 1100 m.s.m., *H.S. Irwin et al. 11593* (holotype: NY! 00007859; isotypes: F 0059241F digital image!, GH 00066311 digital image!, IAN not seen, K! 000530029, MO not seen, UB! 4702, US 00004810 digital image!).

Reproductive phenological states:—Flowering and fruiting from January to April in September, November and December.

Distribution and habitat:—*Eriosema campestre* var. *macrophyllum* occurs in Brazil, in the Distrito Federal and in the states of Bahia, Goiás, Minas Gerais, Paraná, Rio de Janeiro and São Paulo (Fig. 5).

Representative specimens examined:—BRAZIL. Bahia: Ibicoara, estrada entre Brejo de Cima e a rodovia Mucugê-Barra da Estiva, ca. 5–10 km de Brejo de Cima, 05 February 2003 (fl./fr.), *F. França et al. 4303* (HUEFS). Distrito Federal: Brasília km 16, BR 20 (Rod. Brasília-Fortaleza), área do CPAC/EMBRAPA, 07 February 1980 (fl./fr.), *M.C.G. Kirkbride 101*(RB). GOIÁS: Alto Horizonte Região da Sururuca, Fazenda Cajás, 23 November 2015 (fl.), *J.E.Q. Faria 5212* (RB, UB, HUEG); Niquelândia, Macedo, Estrada paralela à estrada da barragem, 15 December 1995 (fl./fr.), *M.L. Fonseca et al. 745* (RB). Minas Gerais: Corinto, ca. 15 km W of Corinto, 02 March 1970 (fl./fr.), *H.S. Irwin et al. 26790* (RB, NY); Diamantina, Galheiros, próximo ao campo experimental da UFVJM, 11 February 2014 (fl./fr.), *M. Verdi et al. 6800* (RB); Francisco Sá, ca. 10 km N.E. of Francisco Sá, road to Salinas, 12 February 1969 (fl./fr.), *H.S. Irwin et al. 23148* (RB); Sacramento, Parque Nacional da Serra da Canastra, Guarita de Sacramento, caminho para o Córrego dos Coelhos, 23 September 1996 (fl.), *R. Romero & J.N. Nakajima 3669* (OUPR, UFU, VIC); Serra do Cabral, ca. de 3 km W of Cantoni, 09 March 1970 (fl./fr.), *H.S. Irwin et al.27206* (UB). Paraná: Ponta Grossa, BR 277 km 144. Curitiba-Maringá, 26 January 1985 (fl./fr.), *J.M. Margarido*, without number (ESA2179). Rio de Janeiro: Itatiaia, 17 February 1942 (fl./fr.), *W. Duarte Barros 613* (RB). SÃO PAULO: Itararé, Rod. SP 258 junto ao Rio Verde, 08 April 1989 (fl.), *C.A.de M. Scaramuzza & V.C. Souza 44* (ESA); Eldorado, Eldorado Paulista, P.E. Jacupiranga, Núcleo Cedro, 14 February 1995 (fl./fr.), *H.F. Leitão Filho et al. 33272* (UEC).

5. *Eriosema congestum* Benth., Mart. Fl. Bras. 15(1): 214. 1859. (Fig. 3 E–F).

Type:—BRAZIL. Piauí, "in districtu Paranaguá prov. Piauhiensis; dry hills dist. of Paranaguá, Piauhy", September 1839 (fl./fr.) *G. Gardner 2541* (lectotype: K! 000207330, designated by Grear 1970; isolectotypes: BAB 00000357 (fragment) digital image!, BM 00093184 digital image!, BM 000931846 digital image!, E 00296764 digital image!, F 0044190F digital image!, F 0044191F digital image!, G 00365266 digital image!, NY! 00007854, NY! 00007855, P! 00709034, P! 00709035, P! 00709036; F 0BN002420 photograph!).

Subshrub, 0.4–1.2 m tall, stems erect, yellow-sericeous, whitish pubescent or ferrugineous-pubescent. Stipules 2–5 mm long, free, ovate to lanceolate, caducous. Leaves trifoliolate, caducous when the plant is fertile. Leaflets uniform in size and shape on the same plant, 2.5–7 × 1.3–2.6 cm, oblong to narrowly elliptic, rarely lanceolate, coriaceous, base with three veins not evident, margin plane or slightly revolute, venation camptodromous. Inflorescences axillary racemes, 2–4.5 cm long (including the peduncle), shorter than mature leaves, pubescent, pauciflorous or multiflorous (5–15-flowered), flowers congested, 10–13 mm long. Fruit 15–20 × 9–11 mm.

Nomenclatural and taxonomic notes:—Grear (1970) mentioned the collection *G. Gardner 2541* housed in K as the holotype of *Eriosema congestum*, but this corresponds to an effective lectotype designation.

The main characteristics of this species are the short (2–4.5 cm long) and sessile or subsessile racemes (with numerous congested flowers); the plant is leafless at flower anthesis. *Eriosema defoliatum* is similarly leafless during flower anthesis but it has larger racemes (8–22 cm long) with laxly arranged flowers.

Reproductive phenological states:—This species is encountered in flower and fruit in the dry season of the year, flowering from June to October and fruiting in July, August to October.

Distribution and habitat:—*Eriosema congestum* is a species endemic to Brazil, occurring in cerrado areas of the Distrito Federal and the states of Bahia, Goiás, Maranhão, Mato Grosso, Minas Gerais, Pará, Piauí and Tocantins (Fig. 6).

Remaining syntypes:—BRAZIL. "Piauhy, Goyaz, Brazil, 1837-1841 (fl./fr.), *G. Gardner 3109* (P! 02749489); "Goyaz, 1841 (fl./fr.), *G. Gardner 3109* (K! 000530021); "Serra da Chapada", (fl.), *L. Riedel 650* (LE 00002559 digital image!); Bahia, Caetité, "in campis siccis ad Caiteté, Provinciae Bah.", (fl.), *C.F.P. von Martius*, without number (M 0240790 digital image!).

Representative specimens examined:—BRAZIL. Bahia: Palmeiras, Estrada Palmeiras-Guiné., 05 September 2006 (fl.), A.A. Conceição & P.D. Carvalho 1791 (HUEFS). Distrito Federal: Sobradinho, Fercal. Apa da Cafuringa, a 38 km do Cenargen, 09 August 1990 (fl.), *T.B. Cavalcanti et al. 585* (CEN). Goiás: Luziânia, Rodovia Brasília-Cristalina, km 55., 07 June 1978 (fl.), *P.R. Salgado & D. Bianchini*, without number (UEC004832). Maranhão: Balsas, Agrovila Nova de Carli, Área de Proteção Ambiental, 04 August 1998 (fl./fr.), *R.C. Oliveira et al. 1227* (RB). Mato Grosso: Nova Xavantina, Trilha do Pequi, 23 August 2005 (fl./fr.), *E.F. Silva et al. 012* (RB). Minas Gerais: Patos de Minas, 19 August 1950 (fl.), *A.P. Duarte 2841* (RB). Pará: São Geraldo do Araguaia, Serra das Andorinhas, 08 July 1995 (fl./fr.), *I.L. Aragão & M. N. Bastos 76* (HUTO, IAN, MFS); Vargem Grande, região do Araguaia; campos gerais, 17 June 1953 (fl.), *R.L. Froés 29867* (IAN, US). Piauí: Uruçuí, entre Uruçuí e Bertolina, 22 July 1990 (fl./fr.), *A. Fernandes & E. Nunes*, without number (EAC8827). Tocantins: Dianópolis, Bacia do Tocantins, 17 October 2008 (fl./fr.), *F.C.A. Oliveira et al. 1421* (RB); Paranã, Fazenda São João. Proprietário Aldair Freire, 08 September 2003 (fl.), *A.C. Sevilha et al. 3432* (CEN).

6. *Eriosema crassicaule* Grear, Mem. New York Bot. Gard. 20(3): 57. 1970.

Type:—BRAZIL. Goiás, "Ad. Ponte ficto, Cap Goyaz", without date (fl./fr.), *J.B.E. Pohl 2861* (holotype: K not seen; isotypes: BAB 00000360 (fragment) digital image!, F 0044192F digital image!, NY! 00007858).

Subshrub, ca. 0.6 m tall, stems erect, whitish sericeous. Stipules 2–9 mm long, free, triangular, caducous. Leaves trifoliolate, persistent when the plant is fertile. Leaflets uniform in size and shape on the same plant, 3–7 × 1–2.3 cm, oblong-lanceolate, chartaceous, base with three veins not evident, margin revolute, venation camptodromous. Inflorescences terminal racemes, 1.5–3 cm long (including the peduncle), shorter than mature leaves, pubescent, pauciflorous (3–5-flowered), flowers congested, 10–16 mm long. Fruit 10–13 × 5–6 mm.

Nomenclatural and taxonomic notes:—The holotype of *Eriosema crassicaule* mentioned by Grear (1970) was not found in herbarium K in our detailed search of this herbarium, so additional investigations are required.

This species resembles *E. brevipes* in having pauciflorous, short inflorescences (up to 3 cm long) but differs mainly by its oblong-lanceolate leaflets with revolute margins (vs. leaflets often lanceolate with a plane margin in *E. brevipes*), and the stipules free, triangular and caducous (vs. stipules connate, lanceolate and persistent in *E. brevipes*).

Reproductive phenological states:—Flowering in January.

Distribution and habitat:—Previously, *E. crassicaule* was known only from the type locality, but while analysing materials for this study, we discovered another specimen of the species occurring in the municipality of Cavalcante, of Goiás state. Nevertheless, the species seems to be rare and endemic to this region of Goiás (Fig. 6).

Representative specimens examined:—GOIÁS: Cavalcante, ca. de 3.5 km canteiro da obra para o rio do Carmo, 23 January 2001 (fl.), *G.P. da Silva et al. 4587* (CEN, RB).

7. *Eriosema crinitum* (Kunth) G. Don, Gen. Hist. 2: 348. 1832. (Fig. 3 J–K).

Glycine crinita Kunth, Nov. Gen. Sp. (ed.4) 6: 421–422. Tab. 573. 1823. Type:—VENEZUELA. "Crescit locis apertis, montosis Novae Andalusiae, in Cerro del Cocollar, alt. 408 hex, floret septembri, tab. DLXXIII", *A.J.A. Bonpland & F.W.H.A. von Humboldt 289* (holotype: P! 00660112).

Subshrub, 0.2–0.6 m tall, stems erect, ascending or occasionally decumbent, glabrescent, yellowish pubescent, rufous-pubescent or whitish pubescent. Stipules 3.5–15 mm long, connate, linear to lanceolate, persistent. Leaves trifoliolate, persistent when the plant is fertile. Leaflets variable in size but uniform in shape on the same plant, 1.2–13 × 0.2–2 cm, linear, linear-lanceolate, linear-oblong, narrowly elliptic, lanceolate, ovate, obovate, chartaceous, base with three veins not evident, margin plane or slightly revolute, venation camptodromous. Inflorescences terminal or axillary racemes, 0.5–3 cm long (including the peduncle), shorter than mature leaves, glabrescent or pubescent, pauciflorous (2–5-flowered), flowers laxly arranged, 6–12 mm long. Fruit 11–17 × 2–3 mm.

Nomenclatural and taxonomic notes:—The only specimen that has the same information of the protologue "Cocollar, *A.J.A. Bonpland & F.W.H.A. von Humboldt 289*" is housed in the P herbarium (P 00660112) and we consider this to be the holotype of *Eriosema crinitum*.

Several varieties have been established by previous authors for *Eriosema crinitum*. Grear in 1970 proposed *E. crinitum* var. *fusiformes* and *E. crinitum* var. *macrophyllum*, and this latter taxon was transferred to *Eriosema campestre* by Fortunato in 1999 (Grear 1970; Fortunato 1999). Fortunato (1999) also proposed other nomenclatural changes in the *Eriosema crinitum* complex, establishing two new varieties: *E. crinitum* var. *stipulare* (Benth.) Fortunato and *E. crinitum* var. *discolor* Fortunato; as well as accepting the variety proposed by Bentham (1859): *Eriosema crinitum* var. *pulchellum* Benth. Currently, three varieties are accepted in the species, *E.* var. *discolor*, *E.* var. *stipulare* and *E.* var. *crinitum*. Within the species there is a continuous gradient of many morphological characters, with some overlap between the varieties. Further study is necessary to fully resolve the number of taxa that should be recognized in the complex.

Reproductive phenological states:—Flowering and fruiting throughout the year.

Distribution and habitat:—This species is widely distributed throughout the American continent, occurring from Mexico and the Greater Antilles to the south of Brazil (Grear 1970).

Eriosema crinitum is the species with the largest distribution in Brazil, occurring in the Distrito Federal and in almost all the states of the country (Fig. 7). The extensive area of occurrence of the species is reflected in the enormous morphological diversity that it presents. This species occurs at elevations of 200–3000 m in areas of cerrado, in palm and pine savannas (Grear 1970). In addition, it grows on quartzite and ferruginous geology in *campos rupestres* (rupestrian fields), in degraded areas and on roadsides, usually on sandy soil or stony ground.

Representative specimens examined:—BRAZIL. Amapá: Macapá, Estrada para Fazendinha, campos gerais, 19 July 1961 (fl.), *R.L. Fróes & C.A. Mack 27498* (INPA). Amazonas: Iranduba, Cacau-Pirêra, margem direita do Rio Negro, 28 June 1986 (fl./fr.), *M.L. Kawasaki et al. 18* (INPA). Bahia: ca. 150 km. S.W. of Barreiras, drainage of the rio Corrente, Western Bahia, rio Piau, 14 April 1966 (fl./fr.), *H.S. Irwin et al. 14856* (MO, NY, UNB, US). Ceará: Serra do Araripe, without date (fl./fr.), *G. Gardner 1549* (IPA, NY). Distrito Federal: Brasília, Fazenda Sucupira, área ao lado da antiga sede do clube da EMBRAPA, 05 October 2000 (fl./fr.), *E.S.G. Guarino & J.B. Pereira 458* (CEN, RB). Goiás: Abadiânia, Serra dos Pirineus, ca. 14 km S. of Corumbá de Goiás, 30 November 1965 (fl./fr.), *H.S. Irwin et al. 10732* (NY, US). Mato Grosso: ca. 75 km. N. of Xavantina, Serra do Roncador, 05 June 1966 (fl./fr.), *H.S. Irwin et al. 16633* (NY, SP, SPF, UNB, US). Mato Grosso do Sul: Corumbá, Serra Urucum, Planalto Residual do Urucum, 03 October 2003 (fl./fr.), *R.R. Silva & Iziel 289* (UEC). Maranhão: Balsas, 21 March 1997 (fl./fr.), *R.C. Oliveira & G.P. Silva 666* (HEPH, UEC). Minas Gerais: São Gonçalo do Rio Preto, Parque Estadual do Rio Preto, trilha do Poço do Veado, entre o Poço do Veado e o Rio Lento, 28 October 2013 (fl.), *E.S. Cândido et al. 1002* (OUPR). Pará: Santarém, Alter do Chão, 1998 (fl./fr.), *W.E. Magnusson*, without number (INPA 212056). Paraíba: Capim Azul, REBIO Guaribas, 14 July 2002 (fl.), *L.P. Félix & S.M.C. Barbeiro 9765* (EAN). Paraná: Almirante Tamandaré, Parque Santa Maria, 10 January 1967 (fl./fr.), *G. Hatschbach 15673* (FLOR, MBM, UPCB). Piauí: Ribeiro Gonçalves, Estação Ecológica de Uruçuí-Una, 16 April

1981 (fl.), *A. Fernandes & Del'Arco*, without number (EAC 10059). Rio Grande do Sul: Bom Jesus, Fazenda Caraúna, 06 May 1984 (fl./fr.), *S.T.S. Miotto 954* (ICN). Rondônia: Vilhena, T.F. de Rondônia a 4 km de Vilhena, 30 October 1979 (fl./fr.), *M.G. Vieira et al. 790* (INPA, NY, US). Roraima: Boa Vista, Grade de Savana do PPBio na região do Água Boa, 27 December 2007 (fl./fr.), *R.I. Barbosa & C.O. Cavalcante 211* (INPA). Santa Catarina: Lages, rodovia BR 116 ao lado da Associação dos Funcionários da Uniplac em frente à Loja Maçônica,4 February 2006 (fl./fr.), *L.D. Rogalski 2* (ICN). São Paulo: Bom Sucesso de Itararé, Balneário junto à ponte sobre o Rio Verde, 27 October 2001 (fl./fr.), *A.S. Flores & R.S. Rodrigues 706* (UEC). Tocantins: Araguaína, ca. 10 km S. of Araguaína, 16 March 1968 (fr.), *H.S. Irwin et al. 21241* (NY, UB).

Additional specimens examined:—VENEZUELA. Guárico: Cerro Platanal, north ridge of Cerro Arimagua, 25 October 1953 (fl./fr.), *B. Maguire et al. 35993* (RB).

8. ***Eriosema cupreum*** Harms, Bot. Jahrb. Syst. 33, Beibl. 72: 32. 1903.

Type:—BRAZIL. "Brasilien: Goyaz, Gipfel des Morro Canastra", 24 November 1894 (fl./fr.) *A.F.M. Glaziou 20888* (**lectotype, designated here: P! 00709041**; isolectotypes: BR 0000005196708 digital image!, C 10012127 digital image!, F 0044193f (fragment) digital image!, F 0044194f (fragment) digital image!, G 00365269 digital image!, K! 000530034, LE 00002561 digital image!, P! 00709042, S S-R-9739 digital image!; B, destroyed, F negative 2421 photograph!).

Subshrub, 0.5–1 m tall, stems erect, rufous, ferruginous or cupreous-tomentose. Stipules 8–14 mm long, free, broadly ovate, usually caducous. Leaves trifoliolate, persistent when the plant is fertile. Leaflets uniform in size and shape on the same plant, 3.7–14 × 2.3–7.1 cm, broadly obovate, ovate to broadly ovate, rounded or elliptic to broadly elliptic, coriaceous, base with three veins not evident, margin revolute, venation camptodromous. Inflorescences terminal racemes, 6.5–9 cm long (including the peduncle), longer than mature leaves, tomentose or

pubescent, multiflorous (10–20-flowered), flowers congested or slightly laxly arranged in the inflorescence. Flowers 14–25 mm long. Fruit 14–15 × 8–10 mm.

Nomenclatural and taxonomic notes:— In the protologue of *Eriosema cupreum* Harms just cited the collection *Glaziou 20888*. Grear (1970) only saw a photograph of the type collection (probably the F negative 2421); the original specimen was probably destroyed in Berlin during the Second World War. The specimen at P with the barcode number 00709041 is the most complete extant material, presenting flowers and fruits, and we select it here as the lectotype of *Eriosema cupreum*.

The species resembles *E. riedelii* and *E. longiflorum*, mainly by size of the flowers, and the size and shape of the leaflets. *Eriosema cupreum* can be differentiated from these two species by its tomentose indumentum which is often rufous, ferruginous or cupreous on the leaflets, stems and inflorescences.

Reproductive phenological states:—Flowering from January to April, in August and from October to December; fruiting in March and April.

Distribution and habitat:—*E. cupreum* occurs only in the state of Goiás, although one collection (*H.S. Irwin* 10307, NY) was made along the border between Goiás and Minas Gerais, between the cities of Formosa (in Goiás) and Garapuava (in Minas Gerais), but the precise locality of the collection is not known. (Fig. 7).

Representative specimens examined:—BRAZIL. Distrito Federal: Brasília, Fundação Zoobotânica, 30 April 1963 (fl.), *J.M. Pires et al. 9587* (RB); APA da Cafuringa, 24 October 2010 (fl.), *R.G. Chacon et al. 670* (CEN). Goiás: Alto Paraíso de Goiás, region of Chapada dos Veadeiros, 4 km north of Veadeiros, 30 April 1956 (fl./fr.), *E.Y. Dawson 14751a* (NY); Cavalcante, Chapada dos Veadeiros, ca. 37 km north of Veadeiros, (fl./fr.), *H.S. Irwin et al. 24359* (NY); Formosa, buraco das Araras, km 35 da BR-20, 19 March 2003 (fl.), *M.L. Fonseca 4353* (RB); Fazenda J. Teles, ca. 10 km N.W. of Formosa, near source of Rio Paraná, 29 April

1966 (fl./fr.), *H.S. Irwin et al. 15467* (NY); Serra do Rio Preto, ca. 5 km E. of Goiás boundary on road to Garapuava, Minas Gerais, 16 November 1965 (fl.), *H.S. Irwin et al. 10307* (NY); Teresina de Goiás, estrada velha para Nova Roma, a 7 km do entroncamento com a GO-118, 04 April 1997 (fl.), *T.B. Cavalcanti et al. 2213* (CEN, NY).

9. *Eriosema defoliatum* Benth., Linnaea 22: 524. 1849. (Fig. 8 A–B).

Type:—BRAZIL. Minas Gerais, "In prov. Minas Geraes, ad Rio Claro", June 1840 (fl./fr.) *G. Gardner 4507* (lectotype, first-step, designated by Grear 1970; **lectotype, second-step, designated here: K! 000530036**, isolectotypes: BM 000931847 digital image!, K! 000530038).

Subshrub, 0.5–1.2 m tall, stems erect or ascending, whitish villous. Stipules 8–12 mm long, connate or free, lanceolate to broadly ovate, persistent. Leaves trifoliolate, caducous when the plant is fertile. Leaflets uniform in size and shape on the same plant, 4.5–10 × 1.5–3.5 cm, broadly oblong, obovate or slightly obovate, coriaceous, base with three veins not evident, margin plane or slightly revolute, venation camptodromous. Inflorescences terminal or axillary racemes, 15–22 cm long (including the peduncle), longer than mature leaves, villous, tomentose or pubescent, multiflorous (with up to 25 flowers per inflorescence), flowers laxly arranged, 10–15 mm long. Fruit 9–14 × 5–7 mm.

Nomenclatural and taxonomic notes:—Grear (1970) chose the collection of *G. Gardner 4507* housed in K as a lectotype of *Eriosema defoliatum*, but there are two sheets of *G. Gardner 4507* in the K herbarium. Although Grear has annotated one as the "holotype" (K 000530036), he did not distinguish them in his publication (Grear 1970). Then, this type designation made by Grear (1970) should be treated as the first-step lectotypification and following Turland et al. (2018: Art. 9.17), a second-step lectotype is needed, so we have chosen the specimen annotated as "holotype", the specimen subsequently barcoded K 000530036, to be a second-step lectotype of *Eriosema defoliatum*.

Eriosema defoliatum is easy to distinguish from all other species of Brazilian *Eriosema* by its 15–22 cm long racemes, each with up to 25 flowers and a conspicuous whitish indumentum. The flowers are laxly arranged in the inflorescence and the standard petal is often wine-reddish. The plants lose their leaves when they are fertile and the leaves and flowers are very rarely collected together.

Reproductive phenological states:—*Eriosema defoliatum* flowers and fruits during the dry season of the year, from June to October.

Distribution and habitat:—The species is endemic to Brazil and occurs in woodland (cerrado sensu stricto) in the Distrito Federal and in the states of Goiás and Minas Gerais (Fig. 9).

Remaining syntypes: —"Inter Manuel Souza et San Ingrazia", date not legible (fl./fr.), *J.B.E. Pohl*, without number (K! 000530040); "Inter Man. Souza & San Ingrazia", without date (fl.) *J.B.E. Pohl 3191* (NY! 00007861; W 0052948 digital image!). **Representative specimens examined:**—BRAZIL. Distrito Federal: Brasília, área ao lado da antiga sede do clube da EMBRAPA, à direita da entrada, na Faz. pelo Riacho Fundo, 05 October 2000 (fl./fr.), *E.S.G. Guarino & J.B. Pereira 448* (CEN); Reserva Biológica Chapada da Contagem, 29 July 1980, (fl.), *L. Fiedler & T.S.M. Grandi 329* (BHCB). Goiás: Alto Paraíso de Goiás, Parque Nacional Chapada dos Veadeiros (PNCV), imediações do alojamento Lobo Guará, 30 July 2016 (fl./fr.), *E.S. Cândido et al. 1109* (BOTU, UFG, UEC); Anápolis, 21 July 1952, (fl.), *A. Macedo 3564* (RB, SP). Minas Gerais: Buritis, Minas Gerais-Goiás boundary, ca. 175 km. E. to fazenda Furquilha Nova, ca. 200 km E. of Brasília, (Prop. Sr. Edson Portillo), 22 August 1964 (fl./fr.), *H.S. Irwin & T.R. Soderstrom 5449* (NY); Perdizes, Unidade de Conservação do Galheiro/CEMIG, 09 September 1999, (fl.), *J.A. Lombardi 3159* (BHCB); Serra do Salitre, Distrito de Catiara, Serra de Catiara, vertente de Patos, 29 August 1950 (fl./fr.), *A.P. Duarte 3031* (NY, RB).

10. *Eriosema elegans* Fort.-Perez & M.J. Silva, Phytotaxa 296(1): 081–087. 2017. (Fig. 8 E).

Type:—BRAZIL. Goiás: Alto Paraíso de Goiás, Parque Nacional Chapada dos Veadeiros, imediações do alojamento Lobo Guará em Cerrado sensu stricto, 14º 9' 27.4" S, 47º 46' 57" W, alt.1.122 m, 6 January 2016 (fl./fr.) *M.J. Silva et al. 7228* (holotype UFG!; isotypes: BOTU!, OUPR!, NY!).

Subshrub, up to 0.7 m tall, stems erect or ascending, glabrescent to strigose. Stipules ca. 5 mm long, connate or free, narrowly lanceolate, caducous. Leaves trifoliolate, persistent when the plant is fertile. Leaflets uniform in size and shape on the same plant, 4–8 × 0.8–1.5 cm, narrowly elliptic to narrowly obovate, rarely narrowly oblong, coriaceous, base with three veins evident, margin plane, venation camptodromous. Inflorescences terminal or axillary racemes, 12–25 cm long (including the peduncle), longer than mature leaves, villous, glabrescent, multiflorous (with up to 25 flowers per inflorescence), flowers laxly arranged, 13–15 mm long. Fruit 18–25 × 7–10 mm.

Taxonomic notes:—This species is morphologically similar to *Eriosema glabrum* but differs mainly by its 12–25 cm long inflorescences with flowers laxly arranged (vs. inflorescences 3–9 (–11) cm long with flowers congested in *E. glabrum*), stipules caducous (vs. stipules persistent in *E. glabrum*) and leaflets narrowly elliptic to narrowly obovate, rarely narrowly oblong (vs. leaflets oblong to obovate in *E. glabrum*). Additionally, *Eriosema elegans* has a peculiar type of trichome on the adaxial leaflet surface, referred to as secretory-based trichomes (Fortuna-Perez *et al.* 2017).

Reproductive phenological states:—Flowering and fruiting in January; fruiting in July.

Distribution and habitat:—*Eriosema elegans* grows in open areas of cerrado sensu stricto vegetation in clayey soil and is known only from the type locality (Parque Nacional Chapada dos Veadeiros, Goiás state) (Fig. 9).

Representative specimens examined:— BRAZIL. Goiás: Alto Paraíso de Goiás, Parque Nacional Chapada dos Veadeiros (PNCV), imediações do alojamento Lobo Guará, 30 July

2016 (fr.), *A.P. Fortuna-Perez et al. 2655* (BOTU, UFG); 29 July 2016 (fr.), *E.S. Cândido 1114* (BOTU, UFG).

11. *Eriosema floribundum* Benth., Linnaea 22: 524. 1849. (Fig. 8 F–G).

Type:—BRAZIL. "Inter Columbis et Barreros ad Viera do Matto", without date (fl./fr.) *J.B.E. Pohl 3144* (**lectotype, designated here: W 0052946** digital image!; isolectotypes: BAB 00000363 (fragment) digital image!, F 0059245F digital image!, NY! 00007864, US 00004807 digital image!, W 0052947 digital image!).

Shrub or subshrub, 0.6–1.7 m tall (often exceeding 1.2 m alt.), stems erect, whitish pubescent to densely whitish tomentose. Stipules 4–15 mm long, connate or free, cymbiform to lanceolate, persistent. Leaves trifoliolate, persistent when the plant is fertile. Leaflets uniform in size and shape on the same plant, 2–8 × 0.6–3.5 cm, elliptic to narrowly elliptic, coriaceous, base with three veins not evident, margin plane, venation camptodromous (conspicuously reticulate secondary veins on the abaxial surface). Inflorescences terminal or axillary racemes, 2.5–5.5 cm long (including the peduncle), shorter than the mature leaves, pubescent to tomentose, pauciflorous or multiflorous (5–20-flowered), flowers congested, 10–20 mm long. Fruit 14–17 × 5–8 mm.

Nomenclatural and taxonomic notes:— Bentham (1849) in the protologue of *Eriosema floribundum* stated: "*E. floribundum* Benth. in Herb. Mus. Vind. MS.; Inter Columbio et Barreiros, *Pohl*". Herbarium "Mus. Vind." is the herbarium W of Vienna in Austria. Grear (1970) erroneously cited the specimen apparently housed in the K herbarium as the "holotype" but there is no trace of the specimen in K. There are two sheets with the information "Inter Columbio et Barreiros, *Pohl*" in W (the herbarium Bentham cited in the protologue), and the specimen that best matches the protologue is W (with barcode number 0052946), which is here selected as the lectotype of *Eriosema floribundum*.

Eriosema floribundum is a shrub or subshrub with erect stems, usually whitish tomentose, and often exceeding 1.2 m tall. It is morphologically similar to *E. hatschbachii*, but

can be distinguished by its leaflet size (up to 5 × 1.6 cm in *E. hatschbachii* vs 2–8 × 0.6–3.5 cm in *E. floribundum*), the pattern of the secondary veins (parallel in *E. hatschbachii* vs reticulate in *E. floribundum*). In addition, *E. hatschbachii* is a subshrub up to 1 m tall.

Reproductive phenological states:—Flowering throughout the year; fruiting January and from June to November.

Distribution and habitat:—This species is endemic to Brazil and occurs in areas of cerrado and "campos rupestres" of the states of Minas Gerais, Goiás and in the southwest region of the state of Bahia (Fig. 9).

Representative specimens examined:—BRAZIL. Bahia: Igaporã, estrada Igaporã-Caetité, BR 430, cerca de 38 km de Caetité, serra Curva do Vento, 18 July 2005 (fl.), *R.C. Forzza et al. 4087* (HUEFS, RB); Cerca de 5 km de Igaporã, estrada vicinal próxima a BR-430, 18 August 2016 (fl.), *W.M.B. São-Mateus 265* (HUEFS); parque eólico Porto Seguro, 19 October 2016 (fr.), *L. Alves et al.*, without number (HUNEB-Coleção Caetité). Goiás: Alto Paraíso de Goiás, ca. 20km da estrada de Alto Paraíso de Goiás em direção à Teresina de Goiás, 16 August 2007 (fl.), *A.P Fortuna-Perez et al. 1473* (OUPR). Minas Gerais: Brejo das Almas (atualmente, Francisco Sá), Serra do Catuny, 10 November 1938 (fl.), *F. Markgraf et al. 3304* (SP); Diamantina, fazenda da Glória-Merces, 25 November 1937 (fl./fr.), *Mello Barreto 10036* (SP); Grão Mogol, estrada para o Rio Ventania, 13 December 1989 (fl.), *T.R.S. Silva et al.*, without number (SPF 67806); Joaquim Felício, Serra do Cabral, ca. 5,9 km da cidade, 13 October 2007(fl./fr.), *J. Paula-Souza et al. 9393* (SPF); São Gonçalo do Rio Preto, Parque Estadual do Rio Preto, trilha secundária para a cachoeira da Sempre Viva, 08 June 2014 (fl./fr.), *E.S. Cândido et al. 1083* (OUPR).

12. *Eriosema glabrum* Mart. ex Benth., Linnaea 22: 522. 1849. (Fig. 8 C–D).

Type:—BRAZIL. Minas Gerais: "In campis siccis graminosis prov. Minarum", 1841 (fl./fr.) *Martii Herbar. Florae Brasil. N° 1131* (lectotype: K! 000530048, designated by Grear 1970; isolectotypes: BM 000931849 digital image!, BR 0000005172894 digital image!, G 00365274 digital image!, HAL 0119581 digital image!, LE 00002562 digital image!, LE 00002563 digital image!, M 0240797 digital image!, NY! 00007867).

Subshrub, 0.25–1.25 m tall, stems erect or ascending, glabrate to slightly-strigose. Stipules 2–6 mm long, free, narrowly lanceolate, persistent. Leaves trifoliolate, persistent when the plant is fertile. Leaflets uniform in size and shape on the same plant, 1.6–7×0.7–3 cm, oblong to obovate, coriaceous to thin-coriaceous, base with three evident veins, margin plane, venation camptodromous. Inflorescences terminal or axillary racemes, 3–9 (–11) cm long (including the peduncle), longer than mature leaves, glabrescent, pauciflorous or multiflorous (5–15-flowered), flowers congested, 7–15 mm long. Fruit 15–18×6–7 mm.

Nomenclatural and taxonomic notes:—Bentham (1849) in the protologue of *Eriosema glabrum* cited: "Mart. Fl. Bras. n° 1131. Ad Caldas prov. Minas Geraes, *A. Regnell ser.1 n. 62.* et in variis locis ejusdem provinciae leg. *Riedel, Pohl* etc." Collection 1131 does not correspond to a collection by *C.F.P. von Martius*, this number actually belongs to the Flora Brasiliensis Herbarium collection, with catalog number 1131. Grear (1970) stated that the holotype of the species is deposited in K, and we interpret this as a lectotypification (Turland et al. 2018, Art. 7.11 and Art. 9.10). As in the K herbarium there is only one material with the information of the protologue, K with barcode number 000530048, this is the lectotype of *Eriosema glabrum*.

The species is morphologically similar to *Eriosema elegans* (see comments under that species). *Eriosema glabrum* has as its main diagnostic characters: glabrescent to glabrous leaflets and stems, oblong to obovate leaflets with three veins evident, persistent stipules and flowers congested at the apex of the inflorescence.

Reproductive phenological states:—Flowering throughout the year; fruiting from January to June, and in October and November.

Distribution and habitat:—*Eriosema glabrum* occurs in the Distrito Federal and in the states of Goiás, Mato Grosso, Minas Gerais and Paraná (Fig. 10). Grear (1970) also reported this species from Argentina. The species is frequently collected in cerrado but mainly in "campos rupestres" on sandy soils, occurring between 800–1200 m (Grear 1970).

Representative specimens examined:—BRAZIL. Distrito Federal: Brasília, bacia do Rio São Bartolomeu, 24 February 1981 (fl./fr.), *E.P. Heringer 6284* (NY); Reserva Ecológica do IBGE, 07 November 1977 (fl.), *E.P. Heringer et al. 246* (SP). Goiás: Alto Paraíso de Goiás, Parque Nacional da Chapada dos Veadeiros, próximo à sede do parque, 10 March 2012 (fl./fr.), *Fortuna-Perez et al. 1456* (OUPR); Caldas Novas, na pista de acesso à UHE Corumbá, 16 km da estrada Caldas Novas-Marzagão, 10 February 1993 (fl./fr.), *T.A.B. Dias 301* (CEN, NY); Cocalzinho de Goiás, Serra dos Pirineus, 75 km N. of Corumbá de Goiás on road to Niquelândia, valley of Rio Maranhão, 22 January 1968 (fl./fr.), *H.S. Irwin et al. 19014* (NY); Goiânia, Rodovia Goiânia- Brasília, BR -060, a 10 km E do acesso a Alexânia, 10 February 1988 (fl.), *J.R. Pirani 2090* (NY); MATO GROSSO: Chapada dos Guimarães, Santa Ana Da Chapada, 15 May 1903 (fl./fr.), *G.O.A. Malme*, without number (S15-34085). Minas Gerais: Itabirito, estrada de Itabirito (ITA 330) para BR 040, sentido São Gonçalo do Bação, 13 June 2012 (fl./fr.), *E.S. Cândido 1067* (OUPR); Itutinga, cerca de 2.9 km da cidade na estrada em direção à Carrancas, 12 October 2001 (fl.), *R.R. Schütz et al. 1204* (OUPR, UEC); Montes Claros, Serra do Espinhaço, Serra dos Três Irmãos, ca. 32 km west of Montes Claros, road to Água Boa, 23 February 1969 (fl.), *H.S. et al. Irwin 23747* (NY, UB, US); Paracatu, ca. 2km N of Paracatu, 03 February 1970 (fl.), H.S. Irwin 25915 (UB); Poços de Caldas, Campo do Saco, 02 October 1980 (fl./fr.), *F.R. Martins 222* (UEC). Paraná: Palmeira, Recanto dos Papagaios, 08 November 1996 (fl.), *E.P. dos Santos 229* (MBM, NY, UPCB); Ponta Grossa, Parque Vila Velha, 05 November 2014 (fl.), *F. Trzeciak 55* (HUEM, UEC); Porto Amazonas, PR-277, km

164, 4 km após trevo Porto Amazonas-Palmeira, 12 December 1998 (fl.), *S.T.S. Miotto 1649* (ESA, ICN).

13. *Eriosema glaziovii* Harms, Bot. Jahrb. Syst. 33, Beibl. 72: 31. 1903.

Type:—BRAZIL. "Brasilien: Goyaz, Vargem do Rio Torto, Morro das Melancias," November 1894 (fl./fr.,) *A.F.M. Glaziou 20891* (**lectotype, designated here: P! 00709049**; isolectotypes: BAB 00000364 (fragment) digital image!, BR 0000005172573 digital image!, C 10012128 digital image!, F 0044195F digital image!, F 0077032F (fragment) digital image!, G 00365272 digital image!, K! 000530030, K! 000530031, LE 00002564 digital image!, MPU 023326 digital image!, P! 00709050, P! 00709051, S S-R-9743 digital image!; B, destroyed, F negative 2424 photograph!).

Prostrate subshrub, 0.3–1 m tall, stems procumbent, sparsely rufous-pilose to yellowish pilose. Stipules 6–9 mm long, free, broadly lanceolate to lanceolate, persistent. Leaves trifoliolate, persistent when the plant is fertile. Leaflets uniform in size and shape, 4–9.5×(1.5–) 2.3–5.5 cm, elliptic, slightly rhomboid, ovate, rarely oblong, thin-coriaceous, base with three veins not evident, margin plane, venation camptodromous. Inflorescences axillary racemes, (4.5–) 7–16 cm long (including the peduncle), longer than mature leaves, sparsely pilose, multiflorous (15–65-flowered), flowers conspicuously congested, 12–15 mm long. Fruit 12–16×6–9 mm.

Nomenclatural and taxonomic notes:—In the protologue of *Eriosema glaziovii* the author just cited the collection *Glaziou 20891*. Grear (1970) only saw a photograph of the type collection (probably the F negative 2424), which was probably destroyed during the Second World War. Of extant type material, the specimen at P 00709049 best fits the protologue and is here chosen as the lectotype of *Eriosema glaziovii*.

Specimens of *Eriosema glaziovii* have sometimes been misidentified in herbaria as *E. prorepens*, especially due to the similarity in prostate subshruby habit, procumbent stems and long racemes. *Eriosema glaziovii* differs, however, by its sparsely pilose stems, broader and more rigid leaflets, smaller stipules and flowers conspicuously congested on the inflorescence.

Reproductive phenological states:—Flowering from January to March and from November to December; fruiting in January, March, and November.

Distribution and habitat:—*Eriosema glaziovii* is endemic to Brazil and commonly occurs in Distrito Federal and Goiás. However, it is rarely found in the states of Minas Gerais and São Paulo (Fig. 10). It grows in woodland, wooded grassland and on rocky slopes and roadsides in sandy soil at elevations of 900–1200 m (Grear 1970).

Representative specimens examined:—BRAZIL. Distrito Federal: Brasília, Parque Nacional de Brasília, 31 January 2007 (fl./fr.), *J.R. Santos et al. 721* (CEN); Reserva Ecológica do Guará, 28 December 1993 (fl.), *G. Pereira-Silva 2163* (CEN, HUEFS, NY); Estrada Brasília- Luziânia, ca. 30 km de Luziânia, 12 January 1975 (fl./fr.), *E.P. Heringer 14276* (RB). Goiás: Cocalzinho de Goiás, estrada de terra saída para a Fazenda Bombaça do proprietário Sr. Isidoro, 22 March 2002 (fl./fr.), *M.A. da Silva et al. 5124* (RB); São João d'Aliança, 3 km by road S of São João da Aliança, Serra Geral do Paraná, 23 March 1973 (fl./fr.), *W.R. Anderson 7835* (UB, NY). Minas Gerais: Cabeceira Grande, região da ponte sobre o Rio Preto, a 29 km do entroncamento Brasília/Unaí/Palmital, na direção de Palmital, divisa DF/MG, 14 February 2002 (fl.), *B.M.T. Walter 5093* (CEN). São Paulo: Campos do Jordão, estrada do Areal, vale do rio Coxim, 18 March 1964, (fl.), *J. Correa Gomes Jr. 1670* (HRCB, UB).

14. *Eriosema grearii* Cândido & Fort.-Perez, Phytotaxa 263(2): 122–130. 2016.

Type:—BRAZIL. Mato Grosso do Sul, Municipality of Ponta Porã, Cabeceira do APA, 23°53’S; 55°46’W, 16 October 1980 (fl.), *J.G. Guimarães 1196* (holotype: HRB!).

Subshrub, ca. 0.25 m tall, stems erect, yellowish velutinous or tomentose. Stipules 5–9 mm long, free, elliptic, lanceolate to ovate, persistent. Leaves unifoliolate, persistent when the plant is fertile. Leaflets uniform in size and shape on the same plant, 3–7 × 2–4 cm, elliptic to obovate, membranaceous, base with three veins not evident, margin plane, venation camptodromous.

Inflorescences axillary racemes, 7–15 cm long (including the peduncle), longer than mature leaves, villous, pauciflorous (6–10-flowered), flowers laxly arranged, 6–13 mm long. Fruit not seen.

Taxonomic notes:—*Eriosema grearii* is morphologically similar to *E. heterophyllum*, mainly in both species having unifoliolate leaves and axillary racemes longer than mature leaves. Nevertheless, these species can be differentiated mainly by free stipules in *E. grearii* (vs. connate in *E. heterophyllum*), membranaceous leaflets (vs. papyraceous to chartaceous in *E. heterophyllum*), flowers distributed along the inflorescence axis (vs. congested at its apex in *E. heterophyllum*).

Reproductive phenological states:—Flowering in October; this species has yet to be collected in fruit.

Distribution and habitat:—*Eriosema grearii* occurs in Ponta Porã, Mato Grosso do Sul in disturbed grassy cerrado, on red latosol and stony soils, areas liable to frequent fires (Cândido *et al.* 2016) (Fig. 10).

Representative specimens examined:—MATO GROSSO DO SUL: Ponta Porã, Cabeceira do APA, 16 October 1980, *J.G. Guimarães 1196* (HRB).

15. *Eriosema hatschbachii* Fort.-Perez & G. P. Lewis, Kew Bulletin 68: 641–645. 2013. (Fig. 8 H–J).

Type:—BRAZIL. Minas Gerais, Gouveia, Serra do Espinhaço, em direção à Diamantina na BR-259, c. 1 km antes da Usina Eólica Experimental da CEMIG, 18 September 2012 (fl./fr.), *A.P. Fortuna-Perez et al. 1401* (holotype OUPR!; isotypes K!, UEC!).

Subshrub, ca. 1 m tall, stems erect, whitish pubescent to densely whitish tomentose. Stipules 3–6 mm long, mostly free, elliptic, lanceolate, persistent. Leaves trifoliolate, persistent only near the apex when the plant is fertile. Leaflets uniform in size and shape on the same plant, 2–5 × 0.5–1.6 cm, obovate to elliptic, rarely oblong, thin-coriaceous, base with three veins not

evident, margin plane, venation craspedodromus (many parallel secondary veins on the leaflets). Inflorescences terminal or axillary racemes, 3–7.5 cm long (including the peduncle), usually shorter than mature leaves, pubescent to tomentose, multiflorous (10–25-flowered), flowers congested, 13–17 mm long. Fruit 15–18×9–10 mm.

Taxonomic notes:—*Eriosema hatschbachii* is morphologically similar to *E. floribundum* and *E. pycnanthum* Benth. var. *pycnanthum* but is distinguished by its many parallel secondary veins on the leaflets (similar to the venation seen on nearly all species of the genus *Tephrosia* Pers.), and its erect stems with leaves only near the apex (Fortuna-Perez *et al.* 2013).

Reproductive phenological states:—Flowering and fruiting in September.

Distribution and habitat:—The species is endemic to Minas Gerais state and occurs in the Espinhaço Range, in the municipality of Gouveia (Fig. 10). *Eriosema hatschbachii* grows in campo rupestre vegetation on stony soil (Fortuna-Perez *et al.* 2013).

Paratypes: —BRAZIL. Minas Gerais: Gouveia, Serra do Espinhaço, 6 September 1971 (fl.), *G. Hatschbach 27353* (K!, MBM!).

16. *Eriosema heterophyllum* Benth., Linnaea 22: 520. 1849. (Fig. 3 L–M).

Type:—BRAZIL. "In campis aridis ad Registo Velho", 1827 (fl.), *J.B.E. Pohl 141* (**lectotype designated here: W 0052949** digital image!; isolectotypes: BM 000931843 digital image!; K! 000530089).

Prostrate subshrub, 0.3–1 m tall, stems procumbent, whitish pilose or rufous-pilose. Stipules 3–10 mm long, connate, lanceolate to broadly lanceolate, persistent. Leaves unifoliolate, persistent when the plant is fertile. Leaflets uniform in size and shape on the same plant, 1.5–9×1.3–5.5 cm, cordiform to cordiform-lanceolate, ovate or elliptic, chartaceous, base with three veins not evident, margin plane, venation camptodromous. Inflorescences axillary racemes, 3.5–17 cm long (including the peduncle), usually longer than mature leaves, glabrescent,

pauciflorous or multiflorous (5–20-flowered), flowers laxly arranged or rarely congested, 8–16 mm long. Fruit 10–15×6–8 mm.

Nomenclatural and taxonomic notes:— In the protologue of *Eriosema heterophyllum* Bentham (1849) stated: "*Eriosema heterophyllum* Benth. in Herb. Mus. Vind. MS.; Ad Caldas prov. Minas Geraes, *A. Regnell ser. I n. 63*; Registo Velho, *Pohl*; in campis siccis Barbacena, *Riedel*; Caxoeiros do Campo, *Claussen*; idemque loco incerto legit., *Schott*". Herbarium "Mus. Vind." is the herbarium W of Vienna in Austria, but Grear (1970) erroneously cited the specimen *A.F. Regnell ser. I n. 63* housed in the K herbarium as the lectotype of *E. heterophyllum*. The only collections that are cited in protologue and are housed at W are "Registo Velho, *Pohl*" (W 0052949) and "in campis siccis Barbacena, *Riedel*" (W 18920013666). Of them, the specimen at W 0052949 best fits the protologue and is here chosen as the lectotype of *Eriosema heterophyllum*. The specimens "*A.F. Regnell ser. I n. 63*" S 15-34701, S 15-34702, S 15-34703, S 15-34704 are considered doubtful because Regnell's collections must be tied to dates and these materials are not available online in digital images and unfortunately we are unable to see them in person.

The species is morphologically similar to *E. grearii* (see comments under that species) and *E. simplicifolium* and has often been confused with the latter species but, in most cases, it can be distinguished by its broader and conspicuously cordiform leaflets (vs. lanceolate to ovate or slightly cordate leaflets of *E. simplicifolium*) and racemes usually longer than mature leaves, often with more than 6 flowers (vs. racemes usually shorter than mature leaves, with no more than 5 flowers). *E. heterophyllum* exhibits morphological variation and further studies are needed to better understand this taxon.

Reproductive phenological states:—Flowering and fruiting throughout the year.

Distribution and habitat:—This species occurs in cerrado areas of the states of Goiás, Mato Grosso do Sul, Minas Gerais, São Paulo, Paraná, and Santa Catarina (Fig. 11).

Remaining syntypes:—BRAZIL. Without precise location: 1827 (fl.), *H.W. Schott*, without number (K! 000530088). Minas Gerais: "Ad Caldas", 20 November 1863 (fl.), *A.F. Regnell* without number "Ex herb. Regnelli., ser. I, n° 63, 20.11.1863" (P! 02921339, K! 000530087). "Barbacena" June 1827 (fl.), *L. Riedel 121* (BM 000931842; K! 000530090; US 00004805; W 18920013666); "Caxoeiras do Campo" 1839 (fl.fr.), *P. Claussen & B. Delessert 132* (K! 000530092).

Representative specimens examined:—BRAZIL. Goiás: Caiapônia, Serra do Caiapó, ca. 50 km. S. of Caiapônia, road to Jataí, 27 June 1966 (fl.), *H.S. Irwin et al. 17845* (NY, SPF). Mato Grosso do Sul: Dourados, Estrada Dourados/Rio Brilhante, 20 July 1977 (fl./fr.), *P.E. Gibbs et al. 5335-A* (CEN). Minas Gerais: Carrancas, cachoeira da Fumaça e Serra de Carrancas, 09 December 1983 (fl./fr.), *H.F. Leitão Filho et al. 15401* (UEC); Ouro Preto, Falcão, ao lado da estrada de Ouro Preto para Rodrigo Silva, Km 19 da Escola de Farmácia de Ouro Preto, 05 April 1978 (fl./fr.), *J.P.P. Fontella & J. Badini 1113* (OUPR, RB). Paraná: São Luiz do Purunã, Balsa Nova, Morro do Cristo, 26 September 2009 (fl.), *C. Snak et al. 246* (RB, UPCB). Santa Catarina: Abelardo Luz, 7 km ao norte da cidade, em frente à Fazenda Silvi., 20 February 2008 (fl./fr.), *L.D. Rogalski 174* (ICN, UPCB). São Paulo: Mogi Guaçu, Fazenda Campininha, km 10 de Pádua Sales, 09 July 1961 (fl./fr.), *A. de Mattos et al. 132* (RB).

17. *Eriosema irwinii* Grear, Mem. New York Bot. Gard. 20(3): 54–56. 1970. (Fig. 12 A–B).

Type:—BRAZIL. Goiás: "Chapada dos Veadeiros, creek margin, among rocks, ca. 20 km W of Veadeiros, elev 1000 m, 09 February 1966 (fl./fr.), *H.S. Irwin et al. 12427* (holotype: NY! 00007869; isotypes: K! 000530020, UB 3026 not seen, US 00004804 digital image!).

Subshrub, 0.2–0.8 m tall, stems erect, glabrous or glabrescent. Stipules 5–12 mm long, connate, lanceolate to broadly lanceolate, persistent. Leaves trifoliolate, persistent when the plant is fertile. Leaflets uniform in size and shape on the same plant, 3–7.7 × 0.7–2.3 cm, oblong to slightly oblanceolate, coriaceous, base with three veins not evident, margin plane, venation

camptodromous. Inflorescences terminal racemes, 3–6 cm long (including the peduncle), shorter than mature leaves, slightly strigose, multiflorous (15–30-flowered), flowers congested, 10–14 mm long. Fruit 13–15×5–5.5 mm.

Taxonomic notes:—The most evident morphological characteristic of *Eriosema irwinii* is its multiflorous, terminal inflorescence with conspicuously orange flowers congested at its apex. Other diagnostic characteristics of this species are its erect habit, glabrescent or glabrous leaflets, persistent stipules and leaves trifoliolate and persistent when the plant is fertile.

Reproductive phenological states:—Flowering in February, June, July, and September; fruiting in February and July.

Distribution and habitat:—*Eriosema irwinii* is endemic to the Chapada dos Veadeiros National Park and surroundings in the northern state of Goiás (Fig. 11). The species occurs in savanna, and rocky fields on sandy soils, at an elevation above 900 m (Grear 1970).

Representative specimens examined:—BRAZIL. Goiás: Alto Paraíso de Goiás, Parque Nacional da Chapada dos Veadeiros, Região do Pouso Alto, 29 July 2016 (fl./fr.), *E.S. Cândido et al.* 1106 (BOTU, UEC); 8 km W de Alto Paraíso, portal da chapada, 01 June 2013 (fl.), *M.F. Simon 1821* (CEN, HUFU); Teresina de Goiás, GO-118, Teresina de Goiás-Alto Paraíso de Goiás, 45 km, 01 September 2004 (fl.), *T.B. Cavalcanti et al. 3545* (CEN, HUEFS).

18. *Eriosema laxiflorum* Harms, Bot. Jahrb. Syst. 33, Beibl. 72: 30. 1904. (Fig. 12 C–D).

Type:—BRAZIL. "Brasilien: Goyaz, Rio Areas, in Campo", September 1894 (fl.), *A.F.M. Glaziou 20929* (**lectotype, designated here: P! 02921317**; isolectotypes: BAB 00000367 (fragment) digital image!, BR 0000005172245 digital image!, C 10012129 digital image!, F 0059251F digital image!, K! 000530007, MPU 023324 digital image!, P! 02921315, P! 02921316, S S-R-9746 digital image!; B, destroyed, F negative 2425 photograph!).

Subshrub, 0.1–0.26 m tall, stems erect (plant caespitose), rufous-pilose. Stipules 5–5.5 mm long, free, ovate, persistent. Leaves unifoliolate, caducous when the plant is fertile. Leaflets uniform in size and shape on the same plant, 2.5–4 × 0.4–1. cm, lanceolate, membranaceous,

base with three veins not evident, margin plane, venation camptodromous. Inflorescences terminal or axillary racemes, 7–17.5 cm long (including the peduncle), longer than the mature leaves, pubescent, pauciflorous, (3–8-flowered), flowers laxly arranged, 10–15 mm long. Fruit not seen.

Nomenclatural and taxonomic notes:—In the protologue of *Eriosema laxiflorum* Harms just cited the collection *Glaziou 20929*, which was probably destroyed in Berlin during the Second World War. Grear (1970) only saw a photograph of the type collection (probably the F negative 2425). For this reason, the material at P with the barcode number of 02921317 is the most complete material and the one that best matches the description in the protologue, and it is here chosen as the lectotype of *Eriosema laxiflorum*.

The species is easily recognized in being a small subshrub (0.1–0.26 m tall) with an erect habit and caespitose appearance. The inflorescences are longer than the mature leaves and appear to emerge directly from the ground; the leaves are membranaceous and caducous when the plant is fertile, and the stipules are free.

Reproductive phenological states:—Flowering in August and September; this species has not been collected with fruits.

Distribution and habitat:—*Eriosema laxiflorum* occurs in the Distrito Federal and in Goiás state (Fig. 11) in cerrado areas that are prone to frequent fires. It blooms soon after the fire. To date there are only three collections of this species, which may indicate that it is rare.

Representative specimens examined:—Distrito Federal: Brasília, August 1961 (fl.), *W. Macedo 57* (HB, RB). Goiás: Parque Nacional da Chapada dos Veadeiros, (fl.), *M.J. Silva 4407* (UFG).

19. *Eriosema longiflorum* Benth., Linnaea 22: 523. 1849.

Type:—BRAZIL. "Ad San Pedro d'Alcântara, Rio d'Ourada et Parahybura & ad. S. Luzia", without date (fl./fr.), *J.B.E. Pohl 349* (**lectotype, designated here: W 0052953** digital image!; isolectotypes: BAB 00000369 (fragment) digital image!, BR 0000005172900 digital image!, F F0059252F digital image!, K! 000530041, W 0052951 digital image!, W 0052952 digital image!)

Shrub or subshrub, 0.5–1.3 m tall, stems erect or ascending, yellowish pubescent or rufous-pubescent. Stipules 8–9.5 mm long, free, lanceolate, caducous. Leaves trifoliolate, persistent when the plant is fertile. Leaflets uniform in size and shape on the same plant, 5–10 × 2.3–6 cm, elliptical, thin-coriaceous, base with three veins not evident, margin plane, venation camptodromous. Inflorescences terminal racemes, 13–27 cm long (including the peduncle), longer than mature leaves, pubescent, multiflorous (10–30-flowered), laxly arranged, 21–35 mm long. Fruit 20–30×10–15 mm.

Nomenclatural and taxonomic notes:—Bentham (1849) in the protologue of *Eriosema longiflorum* stated: "*E. longiflorum* Benth. in Herb. Mus. Vind. MS.; Ad San Pedro d'Alcântara, Rio d'Ourada et Parahybura". That is, Bentham cited the collection of *Pohl* with this information housed in the W (Herb. Mus. Vind. MS.) herbarium as holotype of *E. longiflorum*. However, Grear (1970) erroneously annotated as "holotype" the collection of *Pohl* housed in the K herbarium. There are three sheets with the information "Ad San Pedro d'Alcântara, Rio d'Ourada et Parahybura & ad. S. Luzia, *Pohl 349* in the W herbarium and the specimen that best matches the protologue is W (barcode number 0052953). We here select this specimen as the lectotype of *Eriosema longiflorum*.

Eriosema longiflorum presents the largest flowers of the genus in Brazil It is similar to *E. riedelii*, but can be differentiated in having leaflets, stems and inflorescences yellow or rufous-pubescent. In addition, *E. longiflorum* usually has elliptic leaflets, whereas in *E. riedelii* the leaflets are usually obovate.

Reproductive phenological states:—Flowering and fruiting from January to March.

Distribution and habitat:—This species is endemic to Brazil occurring in the states of Goiás, Minas Gerais and Tocantins and occurs in grasslands and campos in sandy soils (Grear 1970) (Fig. 11).

Representative specimens examined:—BRAZIL. Goiás: Niquelândia, ca. 14 km S of Niquelândia, 21 January 1972 (fl./fr.), *H.S Irwin et al. 34694* (MO, NY, RB, UB); Serra Dourada, na subida da Serra, 29 January 1966 (fl./fr.), *G. Pabst et al. 8820* (NY). Minas Gerais: Ibiá, ca. 8 km of the Araxá junction on Highway 262 to Belo Horizonte, 29 February 1976 (fl./fr.), *G. Davidse & W.G. D'Arcy 10874* (MO, SP); Indianópolis, Fazenda bela Tanda and neighbouring fazendas, nearby the cascade of the Rio Mandaguari, 07 March 1986 (fl.), *G.K. Gottsberger & J. Doring 716-7386* (NY); Ituiutaba, Campos do Carmo, 06 March 1949 (fl./fr.), *A. Macedo 1757* (MBM, NY, SP); Nova Ponte, Fazenda do Sr. Antonino, 30 March 1987 (fl./fr.), *G. Pedralli et al. 683* (UEC). Tocantins: Araguatins, do entroncamento da Belém-Brasília com a Transamazônica, direção a Araguatins, a 80 km da cidade, 14 January 1974 (fl./fr.), *J.A. Rizzo 9564* (UFG).

20. *Eriosema longifolium* Benth., Linnaea 22: 519. 1849.

Type:—BRAZIL. "Ad. Serra de Chrystaes, Cap. Goyaz", without date (fl./fr.), *J.B.E. Pohl & Schüch 876* (**lectotype, designated here: W 0067659** digital image!; isolectotype: K! 000530011, NY! 00007872)

Subshrub, 0.5–1 m tall, stems erect, glabrescent or yellowish pubescent, rufous-pubescent. Stipules 14–25 mm long, connate, lanceolate, persistent. Leaves trifoliolate, persistent when the plant is fertile. Leaflets uniform in size and shape on the same plant, 5–17×0.3–1.5 cm, linear to narrowly lanceolate, thin-coriaceous, base with three veins not evident, margin slightly revolute, venation camptodromous. Inflorescences axillary racemes, 2–5.5 cm long (including the peduncle), shorter than mature leaves, glabrescent or pubescent, multiflorous (10–15-flowered), flowers congested, 6–11 mm long. Fruit 10–15×6–8 mm.

Nomenclatural and taxonomic notes:—Bentham (1849) in the protologue of *Eriosema longifolium* stated: "*Eriosema longifolium* Benth. in Herb. Mus. Vind. MS.; Ad Caldas prov. Minas Geraes, *A. Regnell ser. 2 n. 82*; Serro do Chrystois, *Pohl*". However, Grear (1970) erroneously annotated as a "holotype" the collection of *A.F. Regnell II-82* housed in the K herbarium. Of the collections cited in the protologue, only "Ad. Serra de Chrystaes, Cap. Goyaz", without date (fl./fr.), *J.B.E. Pohl & Schüch* 876" (W 0067659) was found in the W herbarium ("Mus. Vind. MS."), so we consider this to be the lectotype of *Eriosema longifolium*. Although we have not seen the collections at S herbarium (S15-34591 and S15-34558) all the evidence (locality and date of collection), lead us to believe that these collections are remaining syntypes of *E. longifolium*.

Eriosema longifolium is frequently misidentified as *E. crinitum* or *E. strictum*, especially because of the long leaflets and short inflorescences. The species differs, however, from *E. crinitum* by its multiflorous racemes (each with usually more than 10 congested flowers), whereas *E. crinitum* has pauciflorous racemes (each with 2–5 laxly arranged flowers). The characteristics that differentiate *Eriosema longifolium* from *E. strictum* are the indument of the stems (usually yellowish or rufous-pubescent in *E. longifolium* vs. densely whitish pubescent in *E. strictum*) and the inflorescence (glabrescent or rufous-pubescent in *E. longifolium* vs. densely whitish pubescent in *E. strictum*), as well as the shape of the leaflets (usually linear in *E. longifolium* vs. usually lanceolate in *E. strictum*).

Reproductive phenological states:—Flowering and fruiting from January to March and from October to December.

Distribution and habitat:—*Eriosema longifolium* occurs in Paraguay, and in Brazil in the Distrito Federal and the states of Goiás, Mato Grosso do Sul, Minas Gerais, Paraná, Rio Grande do Sul, Santa Catarina and São Paulo (Fig. 13). The species grows in areas of campo cerrado and near streams or in flooded fields (Grear 1970).

Remaining syntypes: —BRAZIL. Minas Gerais: "Ad Caldas", without date (fl./fr.), *A.F. Regnell* without number "Ex herb. Regnelli., ser. II, n° 82" (K! 000530012, MEL 302373 digital image!). "Prov. Minas Geraes, Serra de Caldas" 15 December 1845 (fl./fr.), *A.F. Regnell* without number "Ex herb. Regnelli., ser. II, n° 82, 15.12.1845" (S15-34591 not seen); 31 December 1856 (fl./fr.), *A.F. Regnell* without number "Ex herb. Regnelli., ser. II, n° 82, 31.12.1863" (S15-34558 not seen).

Representative specimens examined:—BRAZIL. Distrito Federal: Brasília, parque Olhos D'Água, 27 February 1997 (fr.), *A.P. da Silva 235* (CEN). Goiás: Alto Paraíso de Goiás, Chapada dos Veadeiros, ca. 8 km N.W. of Veadeiros, road to Cavalcante, 22 October 1965 (fr.), *H.S. Irwin & R.R. dos Santos 9477* (NY). Mato Grosso do Sul: Rio Brilhante, Aroeira, 26 October 1970 (fl.), *G.G. Hatschbach et al. 25258* (IPA, MBM, NY). Minas Gerais: Datas, 5 km de Datas em direção à Diamantina, km 469, 13 March 1995 (fl./fr.), *V.C. Souza et al. 8500* (BHCB, ESA, SPF). Paraná: Palmeira, Recanto dos Papagaios, 08 November 1996 (fl.), *E.P. dos Santos et al. 220* (K, NY, UPCB). Rio Grande do Sul: Bom Jesus, estrada Bom Jesus-São José dos Ausentes, 16 January 2011(fl./fr.), *A.P. Fortuna-Perez et al. 1442* (OUPR). Santa Catarina: Lages, 10 January 2006 (fl./fr.), *S.T.S. Miotto & R.L.C. Bortoluzzi 2308* (ICN, LUSC). São Paulo: Águas de Santa Bárbara, Estação Ecológica de Santa Bárbara, 09 January 2015 (fl./fr.), *G.B. Assis et al. 203* (RB).

Additional specimens examined:—PARAGUAY. Amambay: Pedro Juan Cabarello, Fazenda Cerro-Cora, 15 February 1964 (fl./fr.), *J.C. Gomes Jr. 1555* (OUPR, SP, UB).

21. ***Eriosema macrostipulatum*** Fort.-Perez, Cândido & M.J. Silva, Syst. Bot. 43(1):198–205. 2018. (Fig. 12 F–G).

Type:—BRAZIL. Goiás: Alto Paraíso de Goiás, Parque Nacional Chapada dos Veadeiros, campo limpo, à esquerda do Morro da Baleia, 9 February 2017 (fl.), *M. J. Silva et al. 4696* (holotype: UFG!; isotypes: BOTU!, OUPR!).

Subshrub ca. 40 cm tall, stems erect or decumbent, yellow or whitish sericeous or villous. Stipules 17–25 mm long, free, lanceolate, persistent. Leaves trifoliolate, persistent when the plant is fertile. Leaflets uniform in size and shape on the same plant, 4.5–10 × 1.5–3.5 cm, elliptical, narrowly obovate to obovate, chartaceous, base with three veins not evident, margin plane, venation brochidodromous. Inflorescences terminal or axillary racemes, 5–7 cm long (including the peduncle), shorter than mature leaves, pubescent, pauciflorous or multiflorous (7–30-flowered), flowers congested, 11–21 mm long. Fruit 15–25 × 6–10 mm.

Taxonomic notes:—*Eriosema macrostipulatum* is similar to *E. campestre* var. *macrophyllum*, but is distinguished mainly by its huge stipules, 17–25 mm long (vs. 8–15 mm long in *E. campestre* var. *macrophyllum*) and inflorescences often with more than 10 flowers (vs. 6–7 flowers in *E. campestre* var. *macrophyllum*).

Reproductive phenological states:—Flowering February , March, and November; fruiting in February to March.

Distribution and habitat:—This species is endemic to the Chapada dos Veadeiros National Park in the state of Goiás (Fig. 13). *Eriosema macrostipulatum* grows in cerrado vegetation, campos limpos, campos sujos, and campos rupestres (rocky fields) in sandy or clayey soils between 1130 to 1470 meters elevation (Fortuna Perez *et al.* 2018).

Paratypes:—BRAZIL. Goiás: Alto Paraíso de Goiás, Parque Nacional Chapada dos Veadeiros (PNCV), altura da RPPN Cara Preta cerca de 2 km para dentro do Parque, 25 March 2017 (fl./fr.), *M. J. Silva et al. 8441, 8442, 8443, 8444, 8445, 8446* (UFG!); ib., PNCV, Vale da Lua, 08 March 2012 (fl.), *A.P. Fortuna-Perez et al. 1445*, *1447*, *1450* (BOTU!, OUPR!); ib., PNCV, 25 February 2017 (fl./fr.), *A.P. Fortuna-Perez et al. 3448* (BOTU!).

Representative specimens examined:—BRAZIL. Goiás: Alto Paraíso de Goiás, estrada para Colinas, 3.5–4 km da sede do IBDF, 30 November 1988 (fl.), *T.B. Cavalcanti et al. 49* (K).

22. *Eriosema obovatum* Benth., Fl. Bras. 15(1): 324. 1862.

Type:—VENEZUELA. "In prov. S. Marthae, Venezuelae 1845 (fl./fr.), *Purdie*, without number (lectotype, first-step, designated by Grear 1970; **lectotype, second-step, designated here: K! 000530076**; isolectotype: K! 000530077).

Subshrub, 0.15–0.2 m tall, stems erect, rufous-pilose. Stipules 8–12 mm long, free, narrowly lanceolate, persistent. Leaves unifoliolate, persistent when the plant is fertile. Leaflets uniform in size and shape on the same plant, 5–11 × 3–6 cm, obovate to sub-elliptic, membranaceous to chartaceous, base with three veins not evident, margin plane, venation camptodromous. Inflorescences terminal or axillary racemes, 3–6 cm long (including the peduncle), shorter than mature leaves, pubescent, pauciflorous (3–5-flowered), flowers congested, 11–12 mm long. Fruit 18–20 × 4–6 mm.

Nomenclatural and taxonomic notes:—Grear (1970) chose the collection of *Purdie* housed in K as the lectotype of *Eriosema obovatum*, but now there is a sheet with two different collections each one of them with a different barcode and collection date but bearing the same locality ("In prov. S. Marthae, Venezuelae, 1845" and "Altus de Mines St. Marta", July 1844"). Although Grear has annotated one as the "holotype" (K 000530076), he did not distinguish them in his publication (Grear 1970). Then, this type designation made by Grear (1970) should be treated as the first-step lectotypification and following Turland et al. (2018: Art. 9.17), a second-step lectotype is needed, so we have chosen the specimen annotated as "holotype", the specimen subsequently barcoded as K 000530076, to be a second-step lectotype of *Eriosema obovatum*.

Eriosema obovatum is easily differentiated from the other species by its obovate to sub-elliptic unifoliolate leaves, free stipules and racemes shorter than the leaves.

Reproductive phenological states:—Flowering and fruiting in March, April, August, October and December.

Distribution and habitat:—This species has a disjunct distribution, occurring in Honduras to Colombia (Grear 1970) and Brazil, in the states of Goiás, Mato Grosso, Mato Grosso do Sul,

Minas Gerais and Paraná (Fig. 13). It is reported from savannas, campos rupestres (rocky fields) and surrounding wetlands and from lake shores in clay soils (Grear 1970).

Remaining syntype:—BRAZIL. Minas Gerais: "In prov. Minarum" 1845 (fl./fr.), *Widgren*, without number (S15-34604 not seen).

Representative specimens examined:—BRAZIL. Goiás: Jataí, estrada de Jataí para Serranópolis, a 20 km do ribeirão Ariranha, 18 October 1972 (fl./fr.), *J.A. Rizzo 8478* (UFG). Mato Grosso: Primavera do Leste, BR-070, ca. 5–10 km entre Primavera do Leste em direção à Barra do Garças, 06 October 1988 (fl./fr.), *M.G.L. Wanderley & R. Kral 1210* (SP). Mato Grosso do Sul: Campo Grande, Embrapa Gado de Corte, Lagoão, cerca de 1km leste da sede, 01 August 2006 (fl./fr.), *S.A. Cunha & A. Pott 148* (CGMS). Minas Gerais: São Gonçalo do Sapucaí, Rodovia Fernão Dias, km 326, posto Moinho, 05 April 1978 (fl./fr.), *J.E. de Almeida et al. IZ-362* (UEC). Paraná: Campo Largo, serra de São Luiz do Purunã, próximo ao Cristo Redentor, 12 March 1999 (fl./fr.), *R. Goldenberg et al. 471* (NY, UPCB); Ponta Grossa, December 1969 (fl./fr.), *P.L. Krieger 8163* (RB).

23. *Eriosema platycarpon* Micheli, Mém. Soc. Phys. Genève 28(7): 34. 1883.

Type:—PARAGUAY. "In montibus prope Peribebuy", December 1876-January 1877 (fl./fr.), *B. Balansa 1541a* (lectotype: G 00381472 digital image!, designated by Grear 1970; isolectotypes: F 0059253F (fragment) digital image!, P! 02921083, P! 02921082).

Subshrub, 0.5–1 m tall, stems erect, brown-pubescent or yellowish pubescent. Stipules 4–7 mm long, free, broadly lanceolate, caducous. Leaves trifoliolate, persistent when the plant is fertile. Leaflets uniform in size and shape on the same plant, 3.5–7 × 0.8–2.5 cm, narrow-elliptic to oblong, chartaceous, base with three veins not evident, margin conspicuously revolute, venation camptodromous to craspedodromus. Inflorescences terminal or axillary racemes, 3–7 cm long (including the peduncle), shorter than mature leaves, pubescent, pauciflorous (5–10-flowered), flowers laxly arranged, 11–16 mm long. Fruit 18–21 × 8–10 mm.

Taxonomic notes:—The distinctive morphological features of *Eriosema platycarpon* include the elliptic to narrowly elliptic (rarely oblong) leaflets with their margin conspicuously revolute, the free stipules and racemes not exceeding the leaf length when fully expanded.

Reproductive phenological states:—Flowering and fruiting from January to May, and from November to December.

Distribution and habitat:—*Eriosema platycarpon* occurs in Paraguay, Argentina (Misiones) and Brazil, in the Distrito Federal (probably cultivated) and in the states of Mato Grosso do Sul, Minas Gerais (to date a single collection from the south of state is known) and São Paulo (Fig. 14). The species grows in savannas and near streams on sandy soil (Grear 1970).

Remaining syntypes:—PARAGUAY. Guairá: "Santa Barbara, près Villa Rica, in pratis", 01 March 1876 (fl./fr.), *B. Balansa 1541* (K! 000530044; P! 02921088; P! 02921093; P! 02921087). Caaguazu: "Caaguazu, dans les campos", 16 November 1874 (fl.), *B. Balansa 1541b* (P! 02921086).

Representative specimens examined:—BRAZIL. Distrito Federal: Brasília, Chapada da Contagem, Legume Garden, experimental station, campus of Universidade de Brasília, 04 February 1968, (fl.), *H.S. Irwin et al. 19504* (MO, NY, RB). Mato Grosso do Sul: Campo Grande-Aquidauana, 09 November 1977 (fl.), *I.A. Rodrigues et al. 343* (RB). Minas Gerais: Ritápolis, N.E.A.- Eflex de Ritápolis, 24 April 1995 (fl./fr.), *M. Barbosa 2295* (RB). São Paulo: Araraquara, boundary between municípios of Araraquara and Boa Esperança do Sul, at Rio Jacaré-Guaçu where crossed by Araraquara-Jaú road, 17 February 1964 (fl.), *D.O. Norris 17* (NY, UB); Porto Ferreira, Rod. Anhanguera, km 233, 13 January 1997 (fl./fr.), *A.D. Faria et al. 97/01* (OUPR, UEC).

24. ***Eriosema prorepens*** Benth., Linnaea 22: 524. 1849. (Fig. 12 H–I).

Type:—BRAZIL. Minas Gerais, "In Serra Urubu, Ad Serra Urubu in pascuis", November 1818 (fl./fr.), *J.B.E. Pohl 468* (lectotype: K! 000530032, designated by Grear; isolectotypes: BAB 00000373 (fragment) digital image!; F 0059254F digital image!; LE not seen; NY! 00007874 digital image!; W 0052955 digital image!; W 0052956 digital image!).

Prostrate subshrub, 0.30–1 m tall, stems procumbent, conspicuously rufous-hirsute or yellowish hirsute. Stipules 10–22 mm long, free, ovate-lanceolate (with a foliaceous appearance), persistent. Leaves trifoliolate, persistent when the plant is fertile. Leaflets uniform in size and shape on the same plant, 6–13×0.5–2.5 cm, oblong-lanceolate, membranaceous, base with three veins not evident, margin plane, venation camptodromous. Inflorescences axillary racemes, 6–24 cm long (including the peduncle), longer than mature leaves, conspicuously hirsute, pauciflorous (5–10-flowered), flowers laxly arranged or rarely slightly congested, 18–30 mm long. Fruit 14–15×4.5–5 mm.

Nomenclatural and taxonomic notes:—In the protologue of *Eriosema prorepens* Bentham (1849) gave the collection locality and collector ("In Serra Urubu, *Pohl*") without mentioning the herbarium where it is housed. Grear (1970) stated that the "holotype" of the species is deposited in K, and we interpret this as a lectotypification. Therefore, K specimen barcode 000530032 is the lectotype of *Eriosema prorepens*.

This species is morphologically similar to *Eriosema glaziovii* (see comments under that species) and shares the prostrate habit, but is the only species of the genus in Brazil that has conspicuously large and foliaceous stipules. In addition, it can be characterized morphologically by hirsute stems and racemes, membranaceous leaflets and flowers often laxly arranged in the mature inflorescence.

Reproductive phenological states:—Flowering from August to November; fruiting in September and November.

Distribution and habitat:—*Eriosema prorepens* is endemic to Serra da Canastra region and surroundings in the state of Minas Gerais (Fig. 14). Grear (1970) reported that the type of this species was collected in the state of Goiás, but the locality of the type material given in the original description is "Serra de Urubu", which is located about 70 km from the National Park of Serra da Canastra, the locality of all known collections of the species. Consultation of Pohl's diaries shows that the type of the species was collected between the 5th or 6th of November 1818, when *Pohl* was in Minas Gerais (Pohl 1832). **Representative specimens examined:**—BRAZIL. Minas Gerais: São Roque de Minas, Parque Nacional da Serra da Canastra, estrada para Sacramento, entrada para a garagem de Pedras, 16 October 1997 (fl.), *R. Romero et al. 4653* (UFU, VIC); estrada para fazenda do Fundão, 23 August 1997 (fl.), *R. Romero et al. 4551* (BOTU, UFU, VIC); estrada vicinal a 13 km W da entrada para a cachoeira Casca d'Anta, 22 August 2013 (fl.), *M.F. Simon et al. 1995* (CEN, UFU, VIC); estrada vicinal da garagem de Pedras, 29 August 2014 (fl.), *M.F. Devecchi 332* (SPF); 3 km após a garagem de Pedras, 27 September 1995 (fl./fr.), *R. Romero et al. 2887* (UFU, HRCB); 2 km da garagem de Pedras, 18 October 1994 (fl.), *R. Romero et al. 1357* (UFU, HRCB); trilha para a parte de baixo da cachoeira da Casca d'Anta, 29 September 1995 (fl.), *J.N. Nakajima et al. 1410* (UFU, HRCB); trilha para a parte inferior da cachoeira Casca d'Anta, partindo do alto da Serra, 30 September 1999 (fl.), *M.A. Farinaccio et al. 391* (HUEFS).

25. *Eriosema pycnanthum* Benth., Fl. Bras. 15(1): 212. 1862.

Type:—BRAZIL. Minas Gerais, “in Serra da Ibitituba prov. Minarum. Voyage d’Auguste de Saint Hilaire, de 1821 à 1822” (fl.), *A. de S. Hilaire D233* (holotype: P! 00709059).

Subshrub, 0.2–0.5 m alt.; stems erect, ascending or decumbent, rufous-pilose. Stipules 8–13 mm long, free, lanceolate, persistent. Leaves trifoliolate, persistent when the plant is fertile. Leaflets uniform in size and shape on the same plant, 3.5–8 × 0.6–2 cm, oblong-lanceolate, membranaceous to chartaceous or thin-coriaceous to coriaceous, base with three veins not

evident, margin plane, venation camptodromous to craspedodromus. Inflorescences terminal or (rarely) axillary racemes, 1.5–6.5 cm long (including the peduncle), shorter than mature leaves, pubescent, pauciflorous or multiflorous (8–30-flowered), flowers congested, 13–14 mm long. Fruit 13–14 × 8–9 mm.

Nomenclatural and taxonomic notes:—Grear (1970) cited the holotype of *Eriosema pycnanthum* var. *pycnanthum* as being housed in the K herbarium, but this was an error; it is in the Paris herbarium (P).

Eriosema pycnanthum has persistent leaves when the plant is fertile, oblong-lanceolate leaflets with camptodromous to craspedodromus venation. The varieties of *E. pycnanthum* are distinguished morphologically mainly by the size of the inflorescence (3.5–6.5 cm long in *E. pycnanthum* var. *pycnanthum* vs. 1.5–3 cm long in *E. pycnanthum* var. *veadeirense*) and leaflet texture (membranaceous to chartaceous in *E. pycnanthum* var. *pycnanthum* vs. thin-coriaceous to coriaceous in *E. pycnanthum* var. *veadeirense*).

25.1 *Eriosema pycnanthum* Benth. var. *pycnanthum*

Reproductive phenological states:—Flowering from January to April; fruiting in January, February and April.

Distribution and habitat:—*Eriosema pycnanthum* var. *pycnanthum* is endemic to the Iron Quadrangle Region (Fig. 15), an area of ca. 7200 km^2, located in Minas Gerais state (Dorr 1969). This taxon occurs in areas of iron-rich rocky fields or “cangas” (ironstones), which are one of the most diverse and threatened ecosystems of southeast Brazil. The threat is mainly from mining, and urban expansion (Jacobi *et al.* 2007).

Representative specimens examined:—BRAZIL. Minas Gerais: Brumadinho, Serra da Moeda, without date (fl.), *Sellow*, without number (K 000930846); Serra da Moeda, entrada para Moeda, cerca de 33 km S de Belo Horizonte a partir do entroncamento do anel rodoviário

com a BR-040, 08 March 2007 (fl.), *J.A.N. Batista 1985* (BHCB); morros a esquerda da pista em direção a Moeda, cerca de 2 km após o entroncamento com a BR-040, 26 April 2007 (fl.), *J.A.N. Batista & C.A.N. Martins 2075* (BHCB); Itabirito, Sítio Lagartixa, próximo a BR-040, 02 February 2007 (fl./fr.), *S.G. Rezende & M.S. Medens 2088* (BHCB); Moeda, Marinho da Serra/C1, 23 January 2006 (fl.), *F.F. Carmo 180* (BHCB); Marinho da Serra/C2, 14 January 2008 (fl.), *F.F. Carmo et al. 1957* (BHCB); Serra do Rola Moça, 22 April 2006 (fl./fr.), *F. Marino & M. Alvim 57* (BHCB); Ouro Preto, Miguel Burnier, 31 January 1921 (fl.), *F.C. Hoehne*, without number (OUPR 26931, SP026693); Santa Bárbara, Serra da Gandarela, 24 January 2011, (fl./fr.), *T. Mansur et al. 198* (BHCB).

25.2 *Eriosema pycnanthum* var. *veadeirense* Grear, Mem. New York Bot. Gard. 20(3): 65–67. 1970.

Type:—BRAZIL, Goiás, "burned-over campo, ca. 7 km W of Veadeiros, Chapada dos Veadeiros, elev. 950 m, 15 February 1966 (fl./fr.), *H.S. Irwin et al. 12885* (holotype: NY! 0000787; isotypes: F 0059255F digital image!, GH 00066315 digital image!, UB! 4701 not seen, UC 1369648 digital image!, US 00004796 digital image!).

Reproductive phenological states:—Flowering in February; fruiting in February and March.

Distribution and habitat:—*Eriosema pycnanthum* var. *veadeirense* is endemic to the Parque Nacional da Chapada dos Veadeiros in the state of Goiás (Fig. 15) and occurs in campos at elevations less than 1000 m (Grear 1970).

Paratypes:—BRAZIL. Goiás: Chico Costa, 1893–94, *A.F.M. Glaziou 20895* (F not seen, G not seen, K not seen, LE not seen, S 15-34623 not seen).

Representative specimens examined:—GOIÁS: Alto Paraíso de Goiás, Chapada dos Veadeiros, ca. 10 km north of Veadeiros, 15 March 1969 (fr.), *H.S. Irwin et al. 24471* (NY).

26. *Eriosema riedelii* Benth., Linnaea 22: 523. 1849.

Type:—BRAZIL. "In campis siccis ad Rio Pardo", September 1826 (fl.), *L. Riedel 511* (**lectotype, designated here: LE 00002571** digital image!; isolectotypes: A 00066316 digital image!, F 0059256f (fragment) digital image!, K! 000530042, K! 000530043, LE 00002572 digital image!, LE 00002573 digital image!; B, destroyed, F negative 2426 photograph!).

Subshrub, 0.3–0.8 m tall, stems erect, yellowish pubescent or rufous-pubescent. Stipules 4–12 mm long, free, lanceolate, caducous. Leaves trifoliolate, persistent when the plant is fertile. Leaflets uniform in size and shape on the same plant, 6–10 × 2.5–6.5 cm, obovate, rarely elliptic, thin-coriaceous, base with three veins not evident, margin plane, venation camptodromous. Inflorescences terminal racemes, 13–27 cm long (including the peduncle), longer than mature leaves, pubescent, multiflorous (10–21-flowered), laxly arranged, 21–30 mm long. Fruit 20–30 × 12–14 mm.

Nomenclatural and taxonomic notes:—Grear erroneously cited as the holotype the collection housed in the herbarium K (Grear 1970). However, in the protologue of *Eriosema riedelii* Bentham (1859) stated: "*E. riedelii* Benth. in Herb. Acad. Petrop.; In campis siccis ad Rio Pardo, Riedel". Herbarium "Herb. Acad. Petrop." is the LE herbarium in Saint Petersburg, Russia. There are three sheets with the information found in the protologue in the LE herbarium. The specimen that have the most complete information label and best matches the protologue is LE (barcode 00002571), and we designate this to be the lectotype of *Eriosema riedelii*.

Eriosema riedelii is similar to *E. longiflorum* (see comments under that species) and has one of the largest flowers of the genus in Brazil. The silvery indumentum of the leaflets in *Eriosema riedelii* is the main characteristic that distinguishes it from *E. longiflorum*. Noteworthy is that the abaxial surface of immature leaflets (which are located at the apex of the stems) are always silvery-tomentose or silvery-velutinous in *E. riedelii* and but never have a silvery indumentum in *E. longiflorum*.

Reproductive phenological states:—Flowering in October and November; fruiting in October.

Distribution and habitat:—*Eriosema riedelii* is endemic to Brazil and occurs in cerrado in the states of Goiás, Mato Grosso and Mato Grosso do Sul (Fig. 15).

Representative specimens examined:—BRAZIL. Goiás: Jataí, Queixada, 31 October 1950 (fl.), *A. Macedo 2679* (MO, SP); Mineiros, Parque Nacional das Emas, 21 October 1989 (fr.), *H.D. Ferreira et al. 2444* (UFG). Mato Grosso: Chapada dos Guimarães, just above Cachoeira Furada, Reserva Buriti, 12 October 1973 (fl.), *G.T. Prance et al. 18836* (INPA, MO, R, S). Mato Grosso do Sul: Campo Grande, 1949 (fl.), *Amado & Guerra 124*; *152* (RB); Sidrolândia, Rod. BR 163, 10 November 1973 (fl.), *G. G. Hatschbach & C. Koczicki 33014* (MBM, NY).

27. *Eriosema rigidum* Benth., Linnaea 22: 522. 1849.

Type:—BRAZIL. "Inter Corumba et Rio San Marcos", 1837 (fl./fr.), *J.B.E. Pohl 2335* (holotype: W 0052957 digital image!; isotype: K! 000530094).

Subshrub, 0.6–1.3 m tall, stems erect or ascending, whitish pubescent. Stipules 4–8 mm long, connate, lanceolate, persistent. Leaves unifoliolate, persistent when the plant is fertile. Leaflets uniform in size and shape on the same plant, 4–10 × 2–5.5 cm, ovate to cordate, coriaceous, base with three veins not evident, margin plane or slightly revolute, venation camptodromous. Inflorescences terminal or axillary racemes, 2–3 cm long (including the peduncle), shorter than mature leaves, sericeous, pauciflorous (5–10-flowered), flowers congested, 11–13 mm long. Fruit 10–15 × 5–10 mm.

Nomenclatural and taxonomic notes:—Bentham (1849) in the protologue of *Eriosema rigidum* stated: "*E. rigidum* Benth. in Herb. Mus. Vind. MS.; Inter Corumba et San Marcos, *Pohl*". Herbarium "Mus. Vind." is the herbarium W of Vienna in Austria. The only specimen that has all this information written on the label is *J.B.E. Pohl 2335* housed in herbarium W (barcode 0052957), and we consider this to be the holotype of *Eriosema rigidum*. Grear (1970) erroneously cited the specimen housed in the K herbarium as the "holotype", but this should be considered isotype.

Eriosema rigidum most closely resembles *E. benthamianum* in morphology, but differs mainly by the uniform size and shape of its leaflets on the same plant (vs. leaflets variable in size and shape on the same plant in *E. benthamianum*) and stipules persistent in *E. rigidum* (vs. stipules caducous in *E. benthamianum*). In addition, *E. rigidum* has inflorescences which are densely whitish sericeous and shorter than mature leaves.

Reproductive phenological states:—Flowering in March, June, and July; fruiting in March, June, July, and September.

Distribution and habitat:—The species is endemic to Brazil and occurs in the Distrito Federal and in the states of Goiás, Minas Gerais and São Paulo (Fig. 15). It grows in areas of cerrado, on rocky outcrops or along stream margins (Grear 1970).

Representative specimens examined:—BRAZIL. Distrito Federal: Brasília, rodovia Brasília-Planaltina de Goiás (DF-128), km 6, próximo à Estação Ecológica de Águas Emendadas, 29 July 2000 (fl./fr.), *V.C. Souza et al. 24554* (ESA); Parque das Sucupiras, setor Sudoeste, 30 July 2004 (fl.), *C. Proença et al. 2942* (ESA). Goiás: BR 040, Estrada que liga Luziânia a Cristalina, 10 June 2002 (fl./fr.), *R.C. Mendonça et al. 4788* (RB); Cristalina, 06 July 1963 (fl.), *A. Mattos et al. 307* (RB); Cristalina, Serra dos Cristais, 26 March 1983 (fl./fr.), *G. Hatschbach 46657* (FLOR, MBM, MO, RB). Minas Gerais: Capitólio, Represa Hidroelétrica de Furnas, 01 July 1989 (fr.), *H.F. Leitão-Filho et al. 21629* (UEC); Delfinópolis, Complexo do Claro, em campo rupestre próximo à Cachoeira do Claro, 10 June 1999 (fr.), *A.M. Filliettaz et al. 63* (UEC); Santana do Riacho, estrada Santana do Riacho-Lapinha, ca. 7 km após Santana do Riacho, 01 March 2002 (fl./fr.), *V.C. Souza et al. 28685-A* (ESA). São Paulo: Altinópolis, Reserva Estadual de S. Simão, 17 September 1977 (fr.), *H.F. Leitão-Filho & F.R. Martins 5919* (UEC).

28. *Eriosema rufum* (Kunth) G. Don, Gen. Hist. 2: 347. 1832.

Glycine rufa Kunth, Nov. Gen. Sp. (ed.4) 6: 423. Tab. 574. 1823. Type:—VENEZUELA. "Crescit locis humidis, prope Caripe et in Cerro del Cocollar, alt. 400 hex., Nova Andalusia, floret septembri, tab. DLXXIV", without date, (fl./fr.), *A.J.A. Bonpland & F.W.H.A. von Humboldt 291* (holotype: P! 00660114).

Subshrub, 0.8–1.2 m tall, stems erect or ascending, rufous-pilose to rufous-tomentose or ferrugineous-pubescent. Stipules 6–10 mm long, connate or free, lanceolate or ovate, persistent. Leaves trifoliolate, persistent when the plant is fertile. Leaflets uniform in size and shape on the same plant, 2.5–9 × 1.4–3.5 cm, lanceolate, oblong-lanceolate or oblong to ovate, chartaceous to thin-coriaceous, base with three veins not evident, margin revolute, venation camptodromous. Inflorescences axillary racemes, 2–6 cm long (including the peduncle), usually shorter than mature leaves, pubescent, pauciflorous or multiflorous (5–15-flowered), flowers slightly congested, 6–12 mm long. Fruit 13–17 × 8–10 mm.

Nomenclatural and taxonomic notes:—Grear (1970) stated: "the type specimen, presumably a collection of Humboldt, could not be found", but with our detailed search in the herbarium P we could find the holotype of *Glycine rufa* (P 00660114), which is the basionym of *Eriosema rufum*.

There are two described varieties of *Eriosema rufum*; the main differences between the two are the stipules (ovate and free in *E. rufum* var. *rufum* vs. lanceolate and connate in *E. rufum* var. *macrostachyum*) and length of the racemes (up to 3.5 cm long in *E. rufum* var. *rufum* vs. 3.6–6 cm long in *E. rufum* var. *macrostachyum*). In addition, *Eriosema rufum* var. *macrostachyum* is a larger plant with larger stipules and leaflets, and its geographical area of occurrence is more southerly than that of the typical variety (Grear 1970).

28.1 *Eriosema rufum* (Kunth) G. Don var. *rufum*

Reproductive phenological states:—Flowering from January to May; fruiting from January to May, and July.

Distribution and habitat:—This taxon occurs in Central America, Haiti and Trinidad and Tobago and is widely distributed in South America, occurring in Bolivia, Colombia, Guyana, Peru, Suriname, Venezuela and Brazil (Grear 1970). In Brazil it occurs in the Distrito Federal and in the states of Bahia, Goiás, Maranhão, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Pará, São Paulo and Tocantins (Fig. 16). *Eriosema rufum* var. *rufum* grows in cerrado areas, in open pine forests, near streams, along roadsides as well as in degraded environments (Grear 1970).

Representative specimens examined:—BRAZIL. Bahia: Itaête, Paraguaçu, assentamento Baixão, próximo ao rio Una, depois da ponte, 13 April 2001 (fr.), *D.L. Santana et al. 221* (ALCB, CEPEC); São Desidério, Manoel de Souza, 21 July 2007 (fr.), *A. Cotrim et al. 843* (HUEFS). Distrito Federal: Brasília, ca. 30 km N.E. of Brasília, 14 May 1966 (fl./fr.), *H.S. Irwin et al. 15846* (HUEFS, NY); Gama, Embrapa CTZL, 22 May 2014 (fr.), *A.M. Alonso et al. 1288* (CEN). Goiás: Alto Paraíso de Goiás, Chapada dos Veadeiros, ca. 15 km W. of Alto Paraíso de Goiás (formerly Veadeiros), 14 February 1966 (fl./fr.), *H.S. Irwin et al. 12800* (MO, NY, UB, US); Catalão, contraforte Central, Serra do Facão, ca. 50 km N.E. of Catalão, 25 January 1970 (fl./fr.), *H.S. Irwin et al. 25342* (MO, NY, SPF, UB, US). Maranhão: Imperatriz, "Bananal", 15 km S of Imperatriz along Belém-Brasília highway (BR 010), 29 February 1980 (fl./fr.), *T.C. Plowman et al. 9364* (INPA, MO, NY); Loreto, "Ilha de Balsas" region between the Balsas & Parnaíba Rivers, 35 km south of Loreto, east of main house of Fazenda Morros, 15 February 1970 (fl./fr.), *G. Eiten & L.T. Eiten 10623* (MO, NY, SP, UB, US). Mato Grosso: Poconé, Estrada nova para Boqueirão, 03 April 1982 (fl./fr.), *C.N. Cunha & A.L. Prado 479* (UEC); Xavantina-Cachimbo road, km 246, 11 January 1968 (fl.), *D. Philcox & A. Ferreira*

3961 (MO, NY). Mato Grosso do Sul: Bodoquena, a 10km na estrada para o assentamento Canaã, 27 April 2012 (fl./fr.), *W. Vargas et al. 12* (CGMS, MBM). Minas Gerais: Corinto, ca. 12 km W of Corinto, 04 March 1969 (fl./fr.), *H.S. Irwin et al. 26881* (NY, RB, UB, US); Formoso, Parque Nacional Grande Sertão Veredas, Vereda próximo ao riacho Santa Rita, 15 February 1999 (fl.), *A.C. Sevilha et al. 1808* (RB); Itutinga, 28 February 2012 (fl./fr.), *M. Sobral 14795* (HUFSJ, RB); Tiradentes, av. Castelo Branco, 02 February 2011 (fl./fr.), *M. Sobral 13707* (HUFSJ, RB); Pará: Parque Indígena do Tumucumaque, rio Parú de Oeste, 08 March 1970 (fl./fr.), *P.B. Cavalcante 2599* (NY, US); Região dos Tiriós, rio Parú do Oeste, 19 March 1962 (fl./fr.), *E.J. Fittkau*, without number (INPA 12826). São Paulo: Itirapina, 28 February 1920 (fr.), *G. Gehrt*, without number (SP); Mogi Guaçu, Pádua Sales, Fazenda Campininha, 18 April 1955 (fl./fr.), *O. Handro 478* (SP); São Paulo, Jaraguá, 01 February 1907 (fl./fr.), *A. Usteri 86b* (NY, SP). Tocantins: Araguaína, ca. 5 km N. of Araguaína, 14 March 1968 (fl./fr.), *H.S. Irwin et al. 21162* (NY). Filadélfia, fazenda Ressaca, cerca de 6 km da entrada para a fazenda Ressaca, 28 February 2005 (fl./fr.), *G. Pereira-Silva et al. 9707* (CEN); Paranã, área próximo à pedreira principal, canteiro de obras da UHE São Salvador, 24 March 2007 (fl.), *G. Pereira-Silva & G.A. Moreira 11516* (CEN).

28.2 *Eriosema rufum* var. *macrostachyum* (DC.) G. Don, Gen. Hist. 2: 347. 1832.

Rhynchosia rufa var. *macrostachya* DC., Prodr. 2: 388. 1825. Type:— "v.s. ex itin. *Née*".

Reproductive phenological states:—Flowering and fruiting from October to February.

Representative specimens examined:—BRAZIL. Goiás: Caiapônia, ca. 33 km S. of Caiapônia on road to Jataí, 21 October 1964 (fl.), *H.S. Irwin & T.R. Soderstrom 7120* (NY00600917); Jataí, Queixada, without date (fl.), *A. Macedo 1859* (MO, SP). Mato Grosso do Sul: Aquidauana-Campo Grande, 09 November 1977 (fl./fr.), *I.A. Rodrigues et al. 343a* (RB). Minas Gerais: Uberaba, "Prov. Minas Geraes, Uberava", 08 December 1848 (fl./fr.), *A.F.*

Regnell III 461 (S15-34637). Paraná: Laranjeiras do Sul, Rincão Grande, 12 October 1974 (fl.), *G.G. Hatschbach 35206* (MBM); Palmas, rodovia para Ponte Serrada, 12 December 1980 (fl.) *G.G. Hatschbach 43459* (ASU, CEPEC, MBM, MO, NY). Rio Grande do Sul: Bom Jesus, fazenda dos Potreirinhos, 4º distrito, 28 February 1977 (fl.), *O.R. Camargo 5467* (FLOR, FURB, HAS); Erechim, Quatro Irmãos, 15 November 1995 (fl./fr.), *A. Butzke 11383* (HUCS, NY). Santa Catarina: Campos Novos, rodovia BR470, km 337, em frente à entrada da fazenda Bom Retiro, 12 January 2008 (fr.), *L.D. Rogalski 158* (ICN, UPCB); São José do Cerrito, rodovia BR 282 para Lages em frente à fazenda Rincão do Butiá, 22 February 2008 (fr.), *L.D. Rogalski 189* (ICN). São Paulo: Caieiras, 16 January 1946 (fl./fr.), *W. Hoehne*, without number (SPF 00011642, OUPR 26973, ICN 135998); Novo Horizonte, faz. Rio Morto, Setor Figueira Branca, 10 October 1989 (fl./fr.), *H.T. Sujuki 3976* (UEC).

29. *Eriosema simplicifolium* (DC.) G. Don, Gen. Hist. 2: 348. 1832.

Rhynchosia simplicifolia DC., Prodr. 2: 389. 1825. Type:—VENEZUELA. "Crescit prope Atures, ad cataractas Orinoci, floret Majo" *A.J.A. Bonpland & F.W.H.A. von Humboldt*, without number (holotype: P! 00660110).

Prostrate subshrub, 0.4–1 m tall, stems procumbent or decumbent, yellowish pilose or rufous-pilose. Stipules 5–13 mm long, connate, lanceolate to broadly lanceolate, persistent. unifoliolate, persistent when the plant is fertile. Leaflets uniform in size and shape on the same plant, 2.5–10.5×1–3.5 cm, lanceolate to ovate or slightly cordate, chartaceous, base with three veins not evident, margin plane, venation camptodromous. Inflorescences terminal or axillary racemes, 2–5 cm long (including the peduncle), usually shorter than mature leaves, glabrescent, pauciflorous (2–10-flowered), flowers laxly arranged or (rarely) congested, 7–15 mm long. Fruit 10–20×2.5–9 mm.

Nomenclatural and taxonomic notes:—Grear (1970) and Fortunato (1993) erroneously considered *Glycine simplicifolia* Kunth as the basionym of "*Eriosema simplicifolium* (Kunth) G. Don". The name *Glycine simplicifolia* Kunth (in Nov. Gen. Sp. (ed.4) 6: 419. 1823) is

illegitimate under *Glycine simplicifolia* (Walter) Elliott (in Sketch Bot. S. Carolina 2(3): 234. 1822). Therefore, *Rhynchosia simplicifolia* DC. (in Prodr. 2: 389. 1825), although intended as a combination, name should be treated as a replacement name (Turland et al. 2018, Art. 58.1) and should be written *R. simplicifolia* DC. not *R. simplicifolia* (Kunth) DC. Finally, *Rhynchosia simplicifolia* DC. (in Prodr. 2: 389. 1825), with the same type of the illegitimate name, *Glycine simplicifolia* Kunth (in Nov. Gen. Sp. (ed.4) 6: 419. 1823), is the basionym of *Eriosema simplicifolium* (DC.) G. Don (in Gen. Hist. 2: 348. 1832).

Grear (1970) described *Eriosema simplicifolium* var. *micranthum*, and mentioned that his variety is more robust, the habit sometimes erect, the flowers smaller, and the inflorescences longer than the typical variety. Fortunato (1993) synonymized *E. simplicifolium* var. *micranthum* under the typical variety, based on the huge morphological variation of both varieties, making clear separation into two taxa impossible. Future studies focused on this species will be necessary to clearly separate it from morphologically similar specimens of *E. heterophyllum* (see comments under that species).

Reproductive phenological states:—Flowering throughout the year (except July); collected in fruit in January, March to May, and September to December.

Distribution and habitat:—The species is widely distributed throughout Costa Rica, Haiti, Panama and Trinidad and Tobago and in South America (in northwestern Argentina, Bolivia, Brazil, Colombia, French Guiana, Guyana, northern Paraguay and Suriname). It grows in savanna, usually in sandy soils and near streams (Grear 1970, Fortunato 1993). In Brazil it occurs in the Distrito Federal and in the states of Amapá, Amazonas, Goiás, Maranhão, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Pará, Paraíba, Paraná, Pernambuco, Piauí, Rio Grande do Norte, Roraima, Sergipe, São Paulo and Tocantins (Fig. 17).

Representative specimens examined:—BRAZIL. Amapá: Macapá, Campo Experimental do Cerrado, km 45 da rodovia BR 156 (trecho Macapá-Ferreira Gomes), 05 May 1988 (fl./fr.),

J.F.M. Valls et al. 11653 (CEN). Amazonas: Humaitá, Campo III, ao Norte da BR 230, km 6, 24 December 1979 (fl./fr.), *A.S. Janssen & I. Gemtchujnicov 86* (BOTU, INPA). Distrito Federal: Brasília, córrego Jerivá, ca. 10 km E. of Brasília, 15 September 1965 (fl./fr.), *H.S. Irwin et al. 8323* (NY, US). Goiás: Uruaçu, estrada de terra da BR-153, passando pela Vila Água Branca, para a Fazenda Porteira Grande, cerca de 6 km após a sede, 07 February 1996 (fl.), *B.M.T. Walter et al. 3059* (CEN, HUEFS, NY). Maranhão: Balsas, condomínio Kissy, 20 November 1995 (fl./fr.), *G.P. Silva 3232* (CEN). Mato Grosso: Poconé, transpantaneira highway, approx. at km 17, 06 November 1992 (fl./fr.), *M. Schessl 214/1-7* (NY). Mato Grosso do Sul: Corumbá, Fazenda São Gonçalo, Rio Taquari, 1969 (fl./fr.), *E.F. Nienstedt 289* (NY); Campo Grande, RPPN da UFMS, 09 October 2015 (fl./fr.), *E.S. Cândido et al. 1099* (BOTU, UEC). Minas Gerais: Indianópolis, Fazenda Bela Tanda and neighbouring fazendas, nearby the cascade of the Rio Mandaguari, 07 March 1986 (fl.), *G.K. Gottsberger & J. Doring 711-7386* (NY). Pará: Portel, comunidade Santa Rosa, Pacoval, 14 October 2016 (fl.), *C.A.S. da Silva & A.L.K.M. Albernaz 467* (MFS, MG). Paraíba: Bananeiras, Tabuleiro, entre João Pessoa e Goiana, 26 August 1952, (fl.), *D.A. Lima 1174* (IPA). Paraná: Senges, cerrado (scattered scrub) by the road to Jaguariaíva, 19 January 1965 (fl./fr.), *L. Smith et al. 14861-a* (US). Pernambuco: Zona da mata, without date (fl.), *D.S.F. 74* (IPA). Piauí: Ribeiro Gonçalves, Estação Ecológica de Uruçuí-Una, 10 December 1980 (fr.), *M.R. Del' Arco et al.*, without number (TEPB1412). Rio Grande do Norte: Natal, Along drainage ditch between Ponte Velha and Giqui, south of Natal, 18 September 1946 (fl./fr.), *J.J. Wurdack B-175* (NY). Roraima: Amajari, 100m à direita do km 11 da estrada que liga a Vila Brasil à Vila do Tepequém, 24 May 1995 (fl./fr.), *I.S. Miranda 757* (UEC). Sergipe: Itabaiana, Serra de Itabaiana, 02 April 1974 (fl.), *Andrade-Lima 74-7747* (IPA). São Paulo: Cajuru, Fazenda Santa Carlota, 18 March 1990 (fl./fr.), *A. Sciamarelli & J.V. C. Nunes 556* (UEC). Tocantins: Mateiros, Parque Estadual do Jalapão, cachoeira da Formiga, 16 June 2002 (fl.), *T.B. Cavalcanti et al. 2881* (CEN).

30. ***Eriosema stenophyllum*** Harms, Bot. Jahrb. Syst. 33, Beibl. 72: 31. 1904.

Type:—BRAZIL. "Brasilien: Goyaz, Rio Areas; Plateau de Goyaz, Rio Areas, dans le campo pierreux" 28 September 1894 (fl./fr.) *A.F.M. Glaziou 20927* (**lectotype, designated here: P! 00709062**; isolectotypes: K! 000530005; B, destroyed, F negative 2428 photograph!).

Subshrub, 0.5–1 m tall, stems erect or ascending, glabrous, glabrescent. Stipules 8–13 mm long, connate, narrowly lanceolate, caducous. Leaves unifoliolate, persistent when the plant is fertile. Leaflets uniform in size and shape on the same plant, 5–13×1–2 cm, linear to narrowly lanceolate, conspicuously coriaceous and rigid, base with three veins not evident, margin plane, venation camptodromous (midrib conspicuously prominent on the leaflets). Inflorescences axillary, racemes, 2–4 cm long (including the peduncle), usually shorter than the mature leaves, silvery-pubescent, pauciflorous (5–7-flowered), flowers congested, 8–15 mm long. Fruit 11–13×7–8.5 mm.

Nomenclatural and taxonomic notes:—In the protologue of *Eriosema stenophyllum,* Harms (1904) cited the collection *Glaziou 20927*. Grear (1970) only saw a photograph of the type collection (probably the F negative 2418). The original specimen was probably destroyed in Berlin during the Second World War. The specimen at P with barcode 00709062 is the most complete material and most closely matches the description in the protologue, and it is here designated as the lectotype of *E. stenophyllum*.

Eriosema stenophyllum is easily differentiated from the other unifoliolate species in Brazil by its linear to narrowly lanceolate leaves which are conspicuously coriaceous, rigid, glabrous or glabrescent, and have a conspicuously prominent midrib, by its racemes being shorter than mature leaves, silvery-pubescent and pauciflorous.

Reproductive phenological states:—Flowering and fruiting from June, July, September, and October.

Distribution and habitat:—*Eriosema stenophyllum* is endemic to Brazil, occurring in Goiás (mainly in the region of the city of Cristalina) and Minas Gerais (along the border with the state of Goiás) (Fig. 17). The species grows mainly in campos rupestres (rocky fields) at elevations of 1000–1200 m (Grear 1970).

Representative specimens examined:—BRAZIL. Goiás: Cristalina, BR-040, 5 km da cidade em direção à Brasília, 14 July 2013 (fl./fr.), *M.A. da Silva 7981* (RB, UFG); Serra dos Cristais, 23 June 1983 (fl.), *G. Hatschbach & R. Kummrow 46599* (EAC, MBM, R, RB); Luziânia, 28 July 1964 (fl./fr.), *A.P. Duarte & A. Mattos 8206* (NY, RB, UB). Minas Gerais: Paracatu, ramal entrando a NE da BR 040, 30 October 2010 (fl./fr.), *L.P.de Queiroz et al. 15074* (HUEFS).

31. *Eriosema strictum* Benth., Linnaea 22: 520. 1849.

Type:—BRAZIL. "In campis glareosis prope Coca Branca/ Casa Branca", October 1824, (fl./fr.), *L. Riedel 975* (lectotype: K! 000530010, designated by Grear 1970; isolectotype: LE 00002576 digital image!).

Subshrub, 0.25–0.7 m tall, stems erect, densely whitish pubescent. Stipules 10–22 mm long, connate, lanceolate to broadly lanceolate, persistent. Leaves trifoliolate, persistent when the plant is fertile. Leaflets uniform in size and shape on the same plant, 4–14 × 0.3–4.5 cm, lanceolate, rarely linear, chartaceous, base with three veins not evident, margin revolute, venation camptodromous. Inflorescences axillary racemes, 2–4 cm long (including the peduncle), shorter than mature leaves, densely pubescent, pauciflorous or multiflorous (3–15-flowered), flowers congested, 7–11 mm long. Fruit 12–13×6–8 mm.

Nomenclatural and taxonomic notes:—In the protologue of *Eriosema strictum* Bentham (1849) stated: "E. strictum; In campis glareosis ad Coca Branca, *Riedel*; in campis prov. Minas Geraes, *Claussen*". Grear (1970) stated that the "holotype" of the species collected by *Riedel* is deposited in K, and we interpret this as a lectotypification. Therefore, K specimen barcode 000530010 is the lectotype of *Eriosema strictum*.

Eriosema strictum is most similar morphologically to *Eriosema longifolium* (see comments under that species), but can be distinguished by its densely whitish pubescent stems and racemes and in having usually lanceolate leaflets.

Reproductive phenological states:—Flowering from January, February, October, and December; fruiting in January, October, and December.

Distribution and habitat:—*Eriosema strictum* occurs in Bolivia, Paraguay and Brazil, in Distrito Federal and in the states of Goiás, Minas Gerais and Paraná (Fig. 18); it grows in campos and on rocky soils (Grear 1970).

Remaining syntypes:—BRAZIL. "Minas Geraes": 1838 (fl./fr.), *P. Claussen 898* (P! 00709064; P! 00709064); "Caxoeiras do Campo" 1839 (fl.fr.), *P. Claussen & B. Delessert* 79 (K! 000530009).

Representative specimens examined:—BRAZIL. Distrito Federal: Brasília, Reserva Ecológica do IBGE, próximo ao córrego Taquara na divisa com a Fazenda Água Limpa (FAL-UnB) e Jardim Botânico de Brasília (área do Cristo), 06 February 2012 (fl.), *M.A. da Silva 7589* (RB). Goiás: Cristalina, Serra dos Cristais, rodovia BR-040, Cristalina-Brasília, próximo ao km 90.5, cerca de 2 km de Cristalina (intersecção com a saída para Unaí), 10 February 2013 (fl.), *L.M. Borges & J.B. Bringel 998* (RB). Minas Gerais: Poços de Caldas, Fazenda da Família Carvalho Dias, Campo da Sapucáia, 11 December 2001 (fl./fr.), *C.N. de Fraga et al. 905* (RB). Paraná: Guarapuava, Rio Coutinho, 07 January 1987 (fl./fr.), *J. Cordeiro & G. Hatschbach 397* (CEPEC, MBM, UPCB).

Additional specimens examined:—BOLIVIA. La Paz: Coripata, Yungas, 18 March 1894 (fl./fr.), *A.M. Bang 2094* (BM, G, GH, K, MO, NY, US). PARAGUAY. Caaguazy: Igatimi, October 1898-99 (fl./fr.), *E. Hassler 4820* (BM, G).

32. *Eriosema tacuaremboense* Arechav., Anales Mus. Montevideo 3: 397.1901. (Fig. 12 J).

Type:—URUGUAY. "En campos de Tacuarembo, cerce de la Gruta de los Cuervas", January 1900 (fl./fr.), *J. Arechavaleta* 19 (photograph of type: B, destroyed, F negative 2431 photograph!).

Subshrub, 0.5–1 m tall, stems erect or rarely ascending, densely whitish sericeous. Stipules 7–20 mm long, connate, lanceolate, persistent. Leaves trifoliolate, persistent when the plant is fertile. Leaflets uniform in size and shape on the same plant, 3.5–10 × 0.8–2.5 cm, elliptical to narrowly-elliptical, chartaceous, base with three veins not evident, margin slightly revolute, venation camptodromous. Inflorescences axillary racemes, 2–7 cm long (including the peduncle), shorter than mature leaves, sericeous to hirsute, pauciflorous (3–10-flowered), flowers conspicuously congested, 7–12 mm long. Fruit 12–16×6–10 mm.

Nomenclatural and taxonomic notes:—Grear (1970) and us only saw a photograph of the type collection (probably the F negative 2431), which was probably destroyed in Berlin during the Second World War. In our detailed research in all herbaria that we visited not found another specimen "*Arechavaleta 19*". However, unfortunately we did not visit the herbarium (MVFA) hosted at Facultad de Agronomia in Montevideo where José Arechavaleta worked and may be his collections. Therefore, additional investigations are required.

Eriosema tacuaremboense frequently has an erect habit, its stems, leaflets and racemes whitish sericeous, its flowers conspicuously congested on the inflorescence and its leaflets elliptic to narrowly-elliptic.

Reproductive phenological states:—Flowering and fruiting from November to February.

Distribution and habitat:—*Eriosema tacuaremboense* occurs in Argentina, Paraguay, Uruguay (Grear 1970) and Brazil, in the states of Mato Grosso do Sul, Minas Gerais, Paraná, Rio Grande do Sul and Santa Catarina (Fig. 18). This species grows in savanna and in grassy fields (Grear 1970).

Representative specimens examined:—BRAZIL. Mato Grosso do Sul: Bonito, 08 December 2002 (fl.), *A. Pott et al. 10486* (HMS). MINAS GERAIS: Belo Horizonte, Estação Ecológica UFMG, 05 February 1991 (fl.), *E.M. Bacariça 118* (BHCB). Paraná: Araucária, 22 November 1963 (fl./fr.), *E. Pereira & G. Hatschbach 8085* (HB, ICN, NY, UPCB); Palmas, rod. p/ Ponte Serrada, 12 December 1980 (fl./fr.), *G. Hatschbach 43454* (CEPEC, MBM). Rio Grande do Sul: Bom Jesus, 16 January 2011 (fl./fr.), *A.P. Fortuna-Perez et al. 1444* (OUPR); Manoel Viana, ca. de 1.3 km do entroncamento de acesso secundário da RS 377 e a Fazenda Berleze (ex Esquina do Silva), 10 December 2008 (fl.), *L.C.P. Lima et al. 467* (HUEFS); Tapes, fazenda São Miguel, 28 November 2011 (fr.), *M.M. Marchi et al. 3277* (ECT). Santa Catarina: Campo Erê, 17 km west of Campo Erê, 07 December 1964 (fl./fr.), *L.B. Smith & R.M. Klein 13815* (HBR, NY, R); Campos Novos, beira da Rodovia, 27 November 2011 (fl./fr.), *L. Meyer et al. 121* (RB).

33. *Eriosema tozziae* Cândido & Fort.-Perez, Phytotaxa 178 (3): 229–232. 2014.

Type :—BRAZIL. Minas Gerais: ca. 15 km W of Corinto Municipality, alt. 600 m, 02 March 1970 (fl./fr.), *H.S. Irwin et al. 26766* (holotype: UB!).

Subshrub, 0.5–1 m tall, stems erect, brownish pubescent or yellowish pubescent. Stipules 8–13 mm long, free, lanceolate to ovate, caducous. Leaves trifoliolate, persistent when the plant is fertile. Leaflets uniform in size and shape on the same plant, 1.5–2.5 × 2–4 cm, obovate, membranaceous, base with three veins not evident, margin plane or slightly revolute, venation camptodromous. Inflorescences terminal or axillary racemes, 10–15 cm long (including the peduncle), longer than mature leaves, pubescent, multiflorous (with up to 22 flowers), flowers laxly arranged, 10–13 mm long. Fruit 9–14 × 6–8 mm.

Taxonomic notes:—*Eriosema tozziae* resembles *E. defoliatum*, but they can be differentiated by the length of the fully developed inflorescences (10–13 cm in *E. tozziae* vs. 15–22 in *E. defoliatum*), by the persistence of the leaves (persistent during the reproductive period in *E.*

tozziae vs. caducous in *E. defoliatum*), and by the persistence of the stipules (caducous in *E. tozziae* vs. persistent in *E. defoliatum*).

Reproductive phenological states:—Flowering and fruiting in March and September.

Distribution and habitat:—The species is endemic to Brazil and is reported only from the state of Minas Gerais; it grows in cerrado (Fig. 19) (Cândido *et al.* 2014b). **Representative specimens examined:**—BRAZIL. Minas Gerais: Lagoa Santa, proximidades da cidade, 24 September 2002 (fl./fr.), *L.S. Kinoshita 02/158* (UEC).

34. *Eriosema venulosum* Benth., Mart. Fl. Bras. 15(1): 211. 1859.

Type:—BRAZIL. "In silvis arenosis Missionis Duro prov. Goyazensis", 1841 (fl./fr.), *G. Gardner 3105* (lectotype, first-step, designated by Grear 1970; **lectotype, second-step, designated here: K! 000530004**; isolectotypes: K! 000530003, P! 00709065).

Subshrub, 0.5–1. m tall, stems erect, glabrescent or sparsely rufous or whitish pubescent. Stipules 4–4.5 mm long, connate, lanceolate, persistent or rarely caducous. Leaves unifoliolate, persistent when the plant is fertile. Leaflets uniform in size and shape on the same plant (sometimes with smaller leaflets near the inflorescence), 3–8 × 1.5–4 cm, cordate-ovate or broadly oblong, coriaceous, base with three veins not evident, margin plane or slightly revolute, venation camptodromous (conspicuously reticulate secondary veins on the on abaxial surface). Inflorescences terminal or axillary racemes, 1.5–5 cm long (including the peduncle), usually shorter than mature leaves, pubescent, pauciflorous (2–7-flowered), flowers laxly arranged, 20–30 mm long. Fruit 20–32 × 10–13 mm.

Nomenclatural and taxonomic notes:— Grear (1970) mentioned that the "holotype" of the species is deposited in K herbarium, but there are two sheets *G. Gardner 3105* in K. Although Grear annotating one as the "holotype" (K 000530004), but did not distinguish them in his publication (Grear 1970). Then, this type designation made by Grear (1970) should be treated as the first-step lectotypification and following Turland et al. (2018: Art. 9.17), a second-step lectotype

is needed, and we have chosen the specimen annotated as “holotype”, the specimen subsequently barcoded K 000530004, to be a second-step lectotype of *Eriosema venulosum*.

Eriosema venulosum resembles *E. benthamianum*, but differs by the length of its flowers (20–30 mm long in *E. venulosum* vs. 12–18 mm long in *E. benthamianum*), the relative length of the inflorescence (usually shorter than mature leaves in *E. venulosum* vs. usually longer than mature leaves in *E. benthamianum*) and the uniformity of its leaflets (uniform in size and shape on the same plant in *E. venulosum* vs. conspicuously variable in size and shape on the same plant in *E. benthamianum*).

Reproductive phenological states:—Flowering in March and from June to November; fruiting March and in August, September, and November.

Distribution and habitat:—This species is endemic to Brazil, occurring in the states of Bahia, Goiás, Pernambuco, Piauí and Tocantins (Fig. 19). *Eriosema venulosum* grows in cerrado (including disturbed areas) and campo rupestre (Grear 1970).

Remaining syntypes:—BRAZIL. “Provinc. Minarum interior, in Chapada do Paranan, inter arbusta, locis siccis apricis” August-September 1818 (fl./fr.), *C.F.P. von Martius 1747* (M 0240821 digital image!; M 0240822 digital image!). Pernambuco. “Pernambuco, Rio Preto, Serra da Batalha September 1839–1841 (fl./fr.), *G. Gardner 2817* (K! 000207333; K!000207336; P! 00758638; NY! 600444).

Representative specimens examined:—BRAZIL. Bahia: Barreiras, BR 020, próximo ao Rio de Ondas, ca. 30 km do Distrito de Luís Eduardo Magalhães em direção à Brasília, 21 July 2000 (fl.), *V.C. Souza et al. 24388* (ESA, HUEFS, OUPR, RB); Chapada Diamantina, Fazendola, Rio de Contas, 16 November 1996 (fl./fr.), *H.P. Bautista et al. 4334* (ALCB); Luís Eduardo Magalhães, Moriçoca, 29 November 2003 (fr.), *A.B. Xavier 210* (ALCB). Goiás: Cristalina, BR 050, ca. 5 km de Cristalina, 30 October 2010 (fl.), *L.P. Queiroz et al. 15127* (HUEFS, RB, UEC). PIAUÍ: Barreiras do Piauí, APA Estadual- Fazenda Fortaleza, Chapada das

Mangabeiras, 23 August 1996 (fl.), *A. Fernandes*, without number (EAC 24255). Tocantins: Mateiros, Parque Estadual do Jalapão, estrada de terra Mateiros-Ponte Alta do Tocantins, a 21 km de Mateiros, 14 June 2002 (fl.), *T.B. Cavalcanti et al. 2777* (CEN); Novo Jardim, estrada para Placas, cerca de 2 km da divisa com a Bahia (Rodovia TO-280), 20 July 2000 (fl.), *V.C. Souza et al. 24242* (ESA, OUPR, RB, UB).

35. *Eriosema violaceum* (Aubl.) G. Don, Gen. Hist. 2:347.1832.

Cytisus violaceous Aubl., Hist. Pl. Guiane 2: 766–767. Tab. 306. 1775. Type:—FRENCH GUIANA. "In pratis aut siccis aut paludosis Macouria-Matoury", *J.B.C.F. Aublet & L.C. Richard*, without number (**lectotype, designated here: P! 00709066**; isolectotypes: BM 000931852 digital image!, LINN-HS 1198-30 digital image!)

Subshrub, 0.8–1.3 m tall, erect or ascending, ferrugineous-villous. Stipules 7–10 mm long, connate, lanceolate, persistent. Leaves trifoliolate, persistent when the plant is fertile. Leaflets conspicuously variable in size and shape on the same plant, 4–10 × 0.5–1 cm, linear-oblong, chartaceous, base with three veins not evident, margin conspicuously revolute, venation camptodromous. Inflorescences axillary (spiciform) racemes, 3–7 cm long (including the peduncle), usually longer than mature leaves, pubescent, multiflorous (10–20-flowered), flowers laxly arranged, 5–7.5 mm long. Fruit 10–15 × 6–7 mm.

Nomenclatural and taxonomic notes:—Aublet (1775) in his protologue of *Cytisus violaceous* stated: "Habitat Guinae in pratis Macouria". The author gave only the collection locality of his new species, but no collector or collection number. There are three collections of Aublet of *Cytisus violaceous* that are probably the same collection from French Guiana. Specimen P 00709066 has the most complete information label and best matches the protologue and we here designate it as the lectotype of *Cytisus violaceous*.

Eriosema violaceum may be recognized by its linear-oblong leaflets with a conspicuously revolute margin, as well as by its stems and leaflets often being ferrugineous-

villous, its axillary racemes spiciform in appearance with small laxly arranged, 5–7.5 mm long flowers.

Reproductive phenological states:—Flowering from January to March and in June and August; fruiting in March, June, and July.

Distribution and habitat:— *Eriosema violaceum* has a wide distribution across the Americas occurring in Mexico, the Antilles, Honduras, Nicaragua, Cuba, Guatemala, Panama, Trinidad and Tobago, Guyana, French Guiana, Surinam, Bolivia, Colombia, Venezuela, Paraguay and Brazil (Grear 1970). In Brazil this species occurs in the states of Pará, Rondônia, Amapá and Roraima (Fig. 19), growing mainly in Amazonian savannas.

Representative specimens examined:—BRAZIL. Amapá: Amapá Territory, 03 June 1944 (fl.), *J.T. Baldwin 4046* (US); Rio Matapi, 12 July 1962 (fr.), *J.M. Pires & P.B. Cavalcante 52106* (NY, SP, US). Pará: Igarapé Munenin., região dos Tiriós, rio Paru do Oeste, 17 March 1962 (fl.), *E.J. Fittkau & D. Coêlho 60* (NY); São Felix do Xingu, Reserva Florestal de Gorotire, (Kayapó-Indian Reservation), surroundings of Gorotire village at Rio Fresco, 17 January 1983 (fl.), *G.K. Gottsberger & D.A. Posey 112-17183* (NY). Rondônia: Rio Guaporé, Bahia do Meio, 15 June 1952 (fl./fr.), *G.A. Black & E. Cordeiro 52-15019* (NY). Roraima: Alto Alegre, Ilha de Maracá, SEMA Estação, campo by base camp, right hand side of estrada down to Rio Urariquera, 12 March 1987 (fl./fr.), *G.P. Lewis 1459* (INPA, K, MIRR, NY); Caracaraí, território do Rio Branco, Campos Gerais da região de Caracarahy, 06 February 1948 (fl.), *R.L. Fróes 23643* (NY); Fazenda União, 85 km N of Boa Vista, 01 February 1969 (fl.), *G.T. Prance et al. 9572* (INPA, NY, US); Rio Branco, Campo bei Serra do Mel, Surumu, August 1909 (fl.), *E.H. Ule 8160* (US).

Final remarks

Of the 41 species of *Eriosema* found on the American continent, 35 (85%) of them occur in Brazil, and 24 of those are endemic to the country. Brazil is thus the country with the highest species diversity and greatest level of endemism of the genus *Eriosema* in the Neotropics.

Only six neotropical species do not occur in Brazil: *Eriosema diffusum* (Kunth) G. Don, *E. grandiflorum* (Schltdl. & Cham.) G. Don, *E. hasslerianum* Chodat, *E. longicalyx* Grear, *E. multiflorum* B.L. Rob. ex Pringle, and *E. palmeri* S. Watson (Grear 1970).

The greatest species diversity is in the cerrado areas of Central Brazil, mainly the highlands of the state of Goiás with 28 species (29 taxa). According to Myers *et al.* (2000) the Brazilian Cerrado is the most diverse tropical savanna in the world and is considered a biodiversity hotspot, with high concentrations of threatened endemic species. The Cerrado has suffered from a notable loss of habitats and is now reduced to less than 12% of its original area. The remaining areas are almost exclusively located within Conservation Units (Ribeiro *et al.* 2009). Other areas of occurrence of *Eriosema* species in Brazil are on quartzite geology in *campos rupestres* (rupestrian fields), mainly in the Espinhaço mountain range which extends from Minas Gerais to Bahia, and is an area threatened by mining and urban expansion. The conservation of the species of *Eriosema* is strongly linked to the conservation of the Cerrado in general and all its various phytophysiognomies. Conservation assessments for each Brazilian species of *Eriosema* are already underway.

Eriosema is a morphologically uniform genus and its infrageneric taxa are thus difficult to correctly identify. The study of Brazilian species presented here, including the first key for all the species occurring in the country, highlights those morphological characters that aid in species recognition. In addition, 15 lectotypes are chosen, and data on geographic distribution, phenology and ecology are updated.

Eriosema simplicifolium and *E. crinitum* are the most widely distributed species of the genus in Brazil and in the Neotropics. Both show a high degree of morphological variation that should be investigated in future studies.

Acknowledgements

The authors thank FAPESP/Brazil - Fundação de Amparo à Pesquisa do Estado de São Paulo (process 2015/13386-0), CNPq/Brazil - Conselho Nacional de Desenvolvimento Científico e Tecnológico (process 457911/2013-1 and process 400567/2016-4) and FAPEMIG/Brazil - Fundação de Amparo à Pesquisa do Estado de Minas Gerais (process APQ-02323-12), for financial support granted to A.P. Fortuna Perez; FAPERJ/Brazil – Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro (process 203.007/2017) for financial support granted to VFM (process 312766/2009-2); CNPq - REFLORA Project (process number 563550/2010-4) for financial support granted to A. Tozzi; CAPES/Brazil - Coordenação de Aperfeiçoamento de Pessoal de Nível Superior and CNPq/Brazil - Conselho Nacional de Desenvolvimento Científico e Tecnológico (process 141628/2016-2) for a PhD scholarship to the first author; the Rupert Barneby Award of The New York Botanical Garden awarded to E.S. Cândido; the Biologia Vegetal post graduate program at UNICAMP (Universidade Estadual de Campinas), the UNESP-Botucatu (Universidade Estadual Paulista), the Instituto de Pesquisas Rio de Janeiro Botanical Garden, the UFOP (Universidade Federal de Ouro Preto) for the support; the UFG (Universidade Federal de Goiás), especially to Professor Dr. Marcos José da Silva and his students for all the support in the field in the state of Goiás. We thank the curators and staff of all herbaria visited for providing access to specimens and photographs of their collections and all the people who helped us in the field in Brazil or contributed photographs of the species.

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Figures and Table

TABLE 1. Morphological characteristics that distinguish species of *Eriosema* and *Rhynchosia* that occur in Brazil.

Character	***Eriosema***	***Rhynchosia***
Habit/Growth form	subshrubs/ erect, ascending, procumbent or prostrate, never twining	subshrubs or lianas/ erect, prostrate or twining
Stipules	free or variably connate	always free
Stipels	often absent	often present
Inflorescence type	raceme	raceme, panicle, corymb or fascicle
Color of seeds	brown or black; never bicolored	brown, black or bicolored red/black or orange/black
Strophiole	always conspicuous flanking the hilum, thick, prominent, thickest at point of funicular attachment	often reduced to a thin membrane covering the hilum or when conspicuous not extensive
Hilum form	linear	elliptical or oblong
Location of the funicular attachment of the seed in relation to the hilum	terminal	terminal, subcentral or apical
Fruits	never constricted between the seeds	sometimes constricted between the seeds

FIGURE 1. Habitat of the *Eriosema* species. A. Grasslands on stony soil in Espinhaço Mountain Range, Minas Gerais state (MG). B. Grasslands with rock outcrops in Espinhaço Mountain Range, MG (A.P. Fortuna-Perez et al. 2013). C. Grasslands with rock outcrops in Chapada dos Veadeiros National Park, Goiás state (GO). D, E. Campo rupestre (rupestrian fields) in Rio Preto State Park, MG. F. Grasslands with seasonal waterlogging in Chapada dos Veadeiros National Park, GO. G. Woodland and wooded grassland in Rio Preto State Park, MG. H. Grasslands and bushy woodland in Chapada dos Veadeiros National Park, GO. I. Woodland after fire in Chapada dos Veadeiros National Park, GO. J. Bushy woodland in the municipality of São João da Aliança, GO. Photographs by A.P. Fortuna-Perez (A, B, D, E, G); E.S. Cândido (C, F, H, J) and M.J. Silva (I).

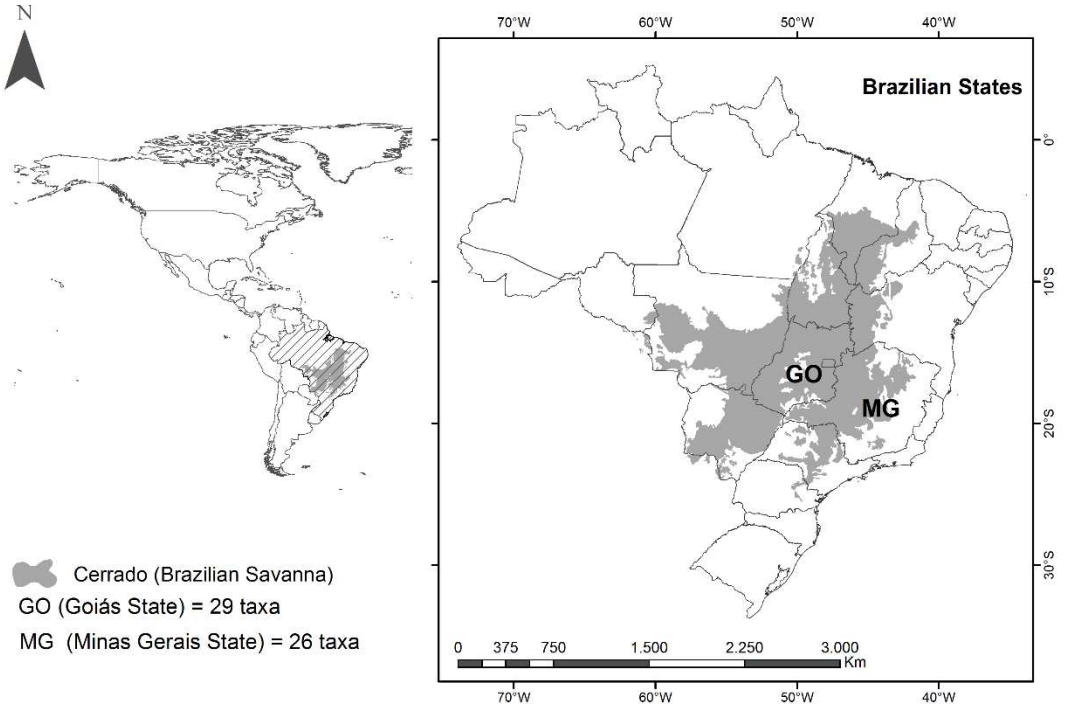

FIGURE 2. Geographical location of Brazil in the American continent, highlighting the cerrado vegetation (Brazilian Savanna) and the two main diversity centers of *Eriosema* species in the country, Goiás (with 29 taxa) and Minas Gerais (with 26 taxa) (Brazilian Savanna: Ecoregions of the world modified from Olson *et al.* 2001).

FIGURE 3. Photographs of *Eriosema* species. A, B. *E. campestre* var. *campestre*. C, D. *E. benthamianum*. E, F. *E. congestum*. G–I. *E. brevipes*. J, K. *E. crinitum*. L, M. *E. heterophyllum*. Photographs by E.S. Cândido (A–D, G–I); A.P. Fortuna-Perez (E, F, K); A. Soldevila (J); M.F. Simon (L) and G.H. Shimizu (M). F and K: A.P. Fortuna-Perez et al. 2018.

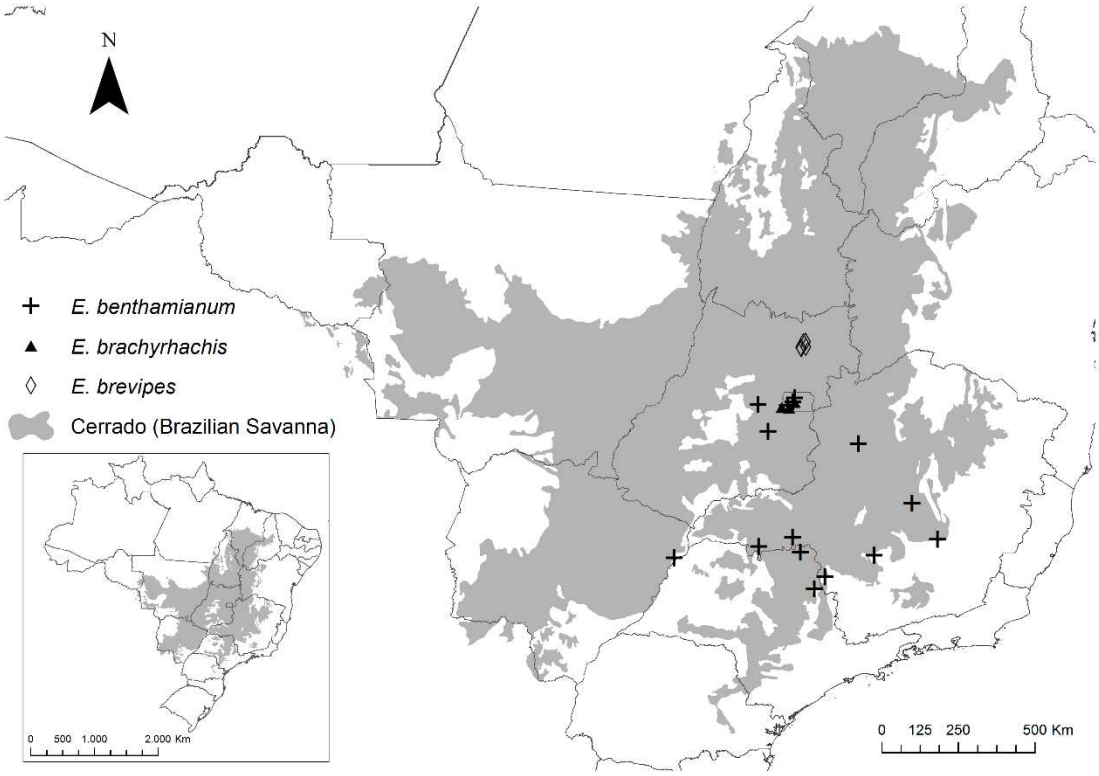

FIGURE 4. Geographical distribution of *Eriosema benthamianum*, *E. brachyrhachis* (endemic to Goiás state), and *E. brevipes* (endemic to Chapada dos Veadeiros National Park in Goiás state) (Brazilian Savanna: Ecoregions of the world modified from Olson *et al.* 2001).

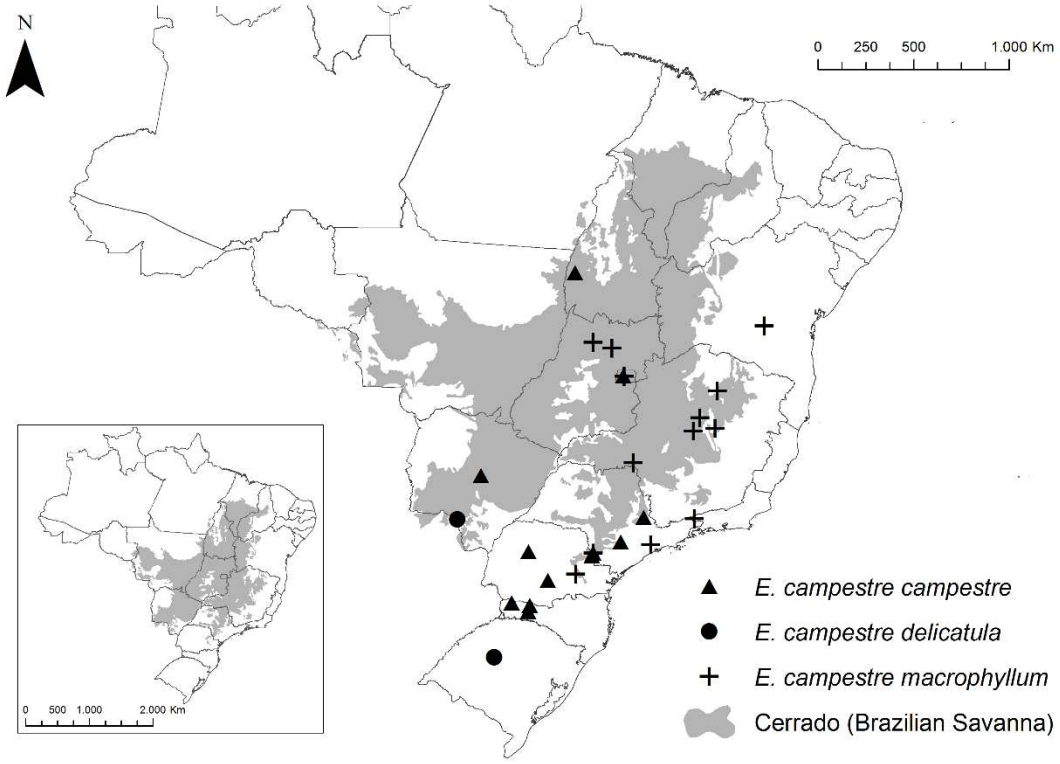

FIGURE 5. Geographical distribution of *Eriosema campestre* in Brazil. *E. campestre* var. *campestre*, *E. campestre* var. *delicatula* and *E. campestre* var. *macrophyllum* (Brazilian Savanna: Ecoregions of the world modified from Olson *et al.* 2001).

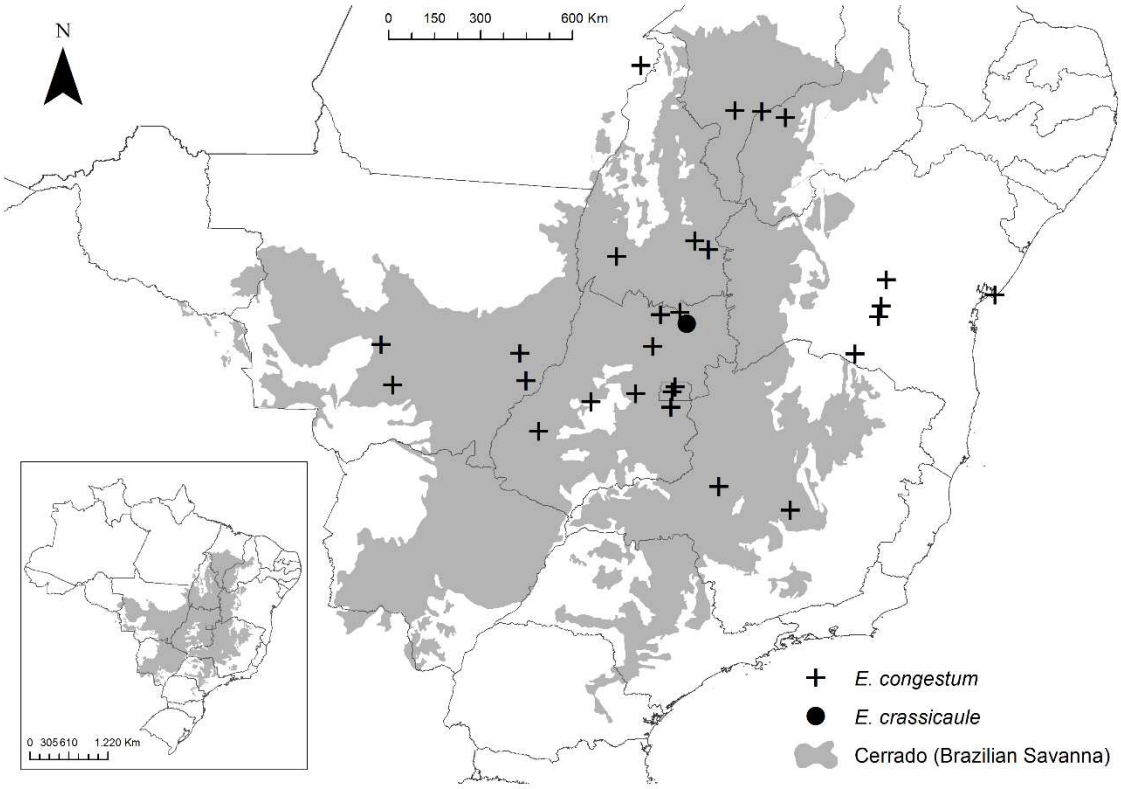

FIGURE 6. Geographical distribution of *Eriosema congestum* and *E. crassicaule* (endemic to Goiás state) (Brazilian Savanna: Ecoregions of the world modified from Olson *et al.* 2001).

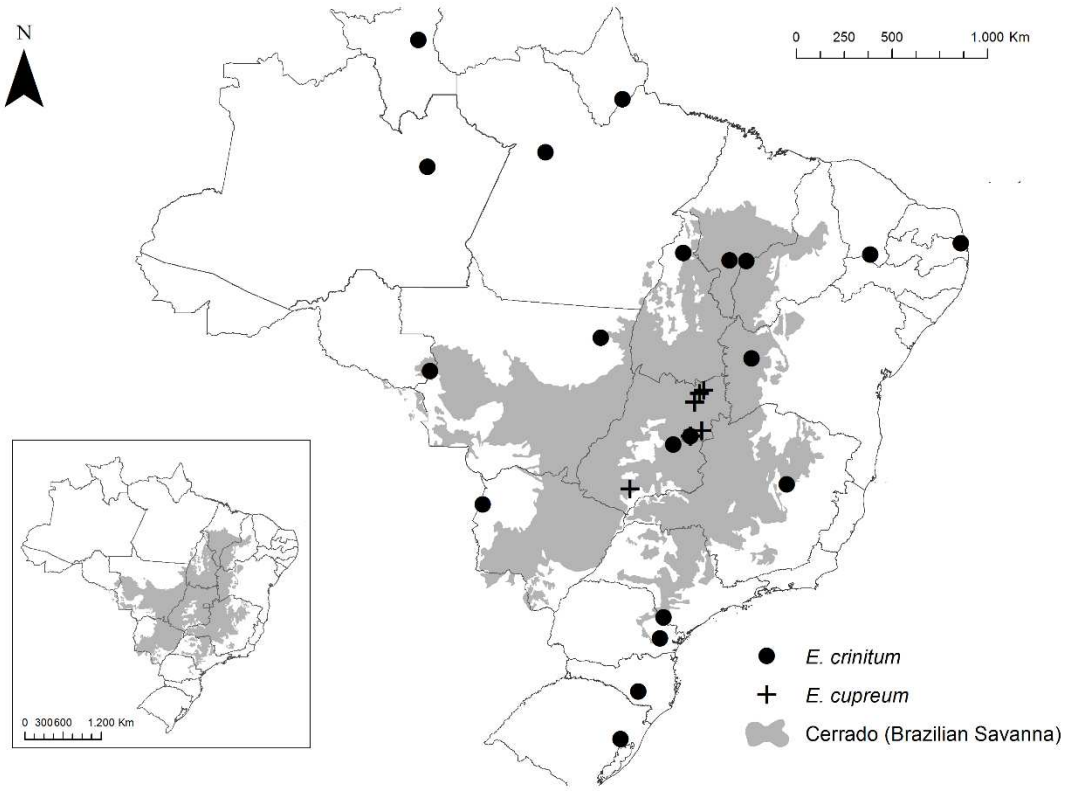

FIGURE 7. Geographical distribution of *Eriosema crinitum* and *E. cupreum* (endemic to Goiás state) (Brazilian Savanna: Ecoregions of the world modified from Olson *et al.* 2001).

FIGURE 8. Photographs of *Eriosema* species. A, B. *E. defoliatum*. C, D. *E. glabrum*. E. *E. elegans*. F, G. *E. floribundum*. H–J. *E. hatschbachii*. (A, B, E by E.S. Cândido); (C, D, H by A.P. Fortuna-Perez); (F, G, I, J by A. Soldevila).

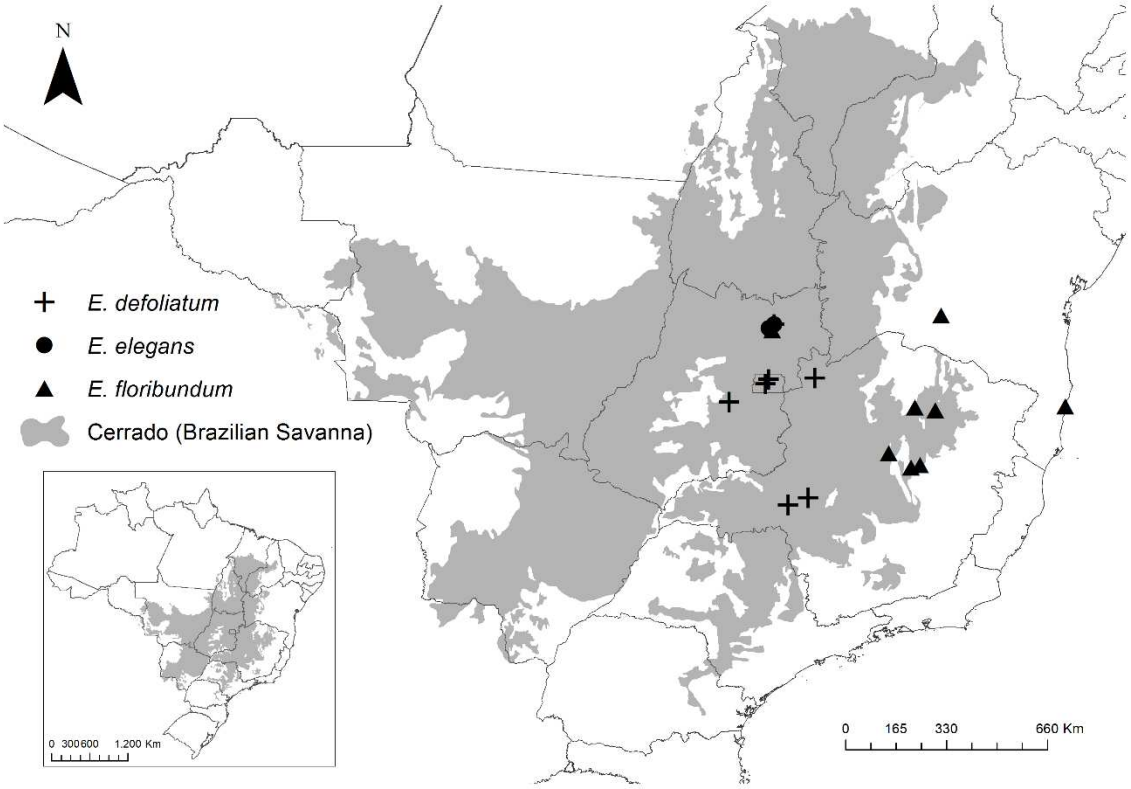

FIGURE 9. Geographical distribution of *Eriosema defoliatum*, *E. elegans* (endemic to Chapada dos Veadeiros National Park in Goiás state) and *E. floribundum* (Brazilian Savanna: Ecoregions of the world modified from Olson *et al.* 2001).

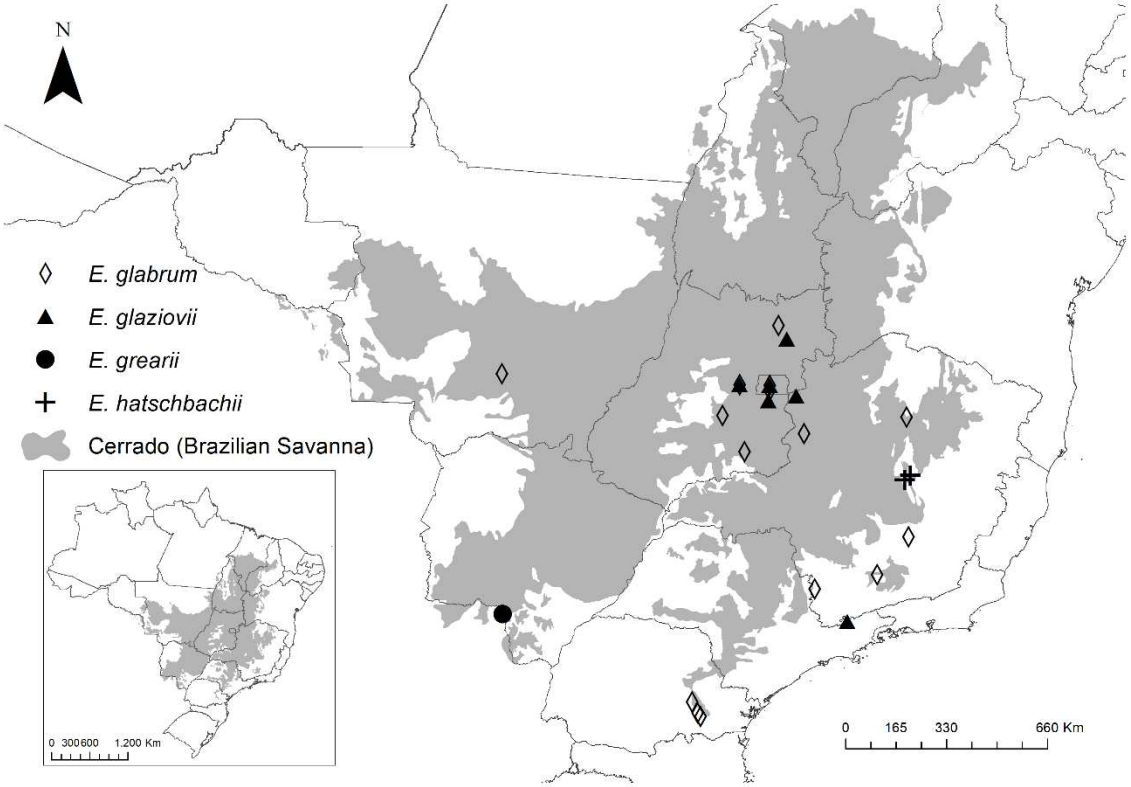

FIGURE 10. Geographical distribution of *Eriosema glabrum*, *E. glaziovii*, *E. grearii* (endemic to Mato Grosso do Sul state) and *E. hatschbachii* (endemic to Minas Gerais state) (Brazilian Savanna: Ecoregions of the world modified from Olson *et al.* 2001).

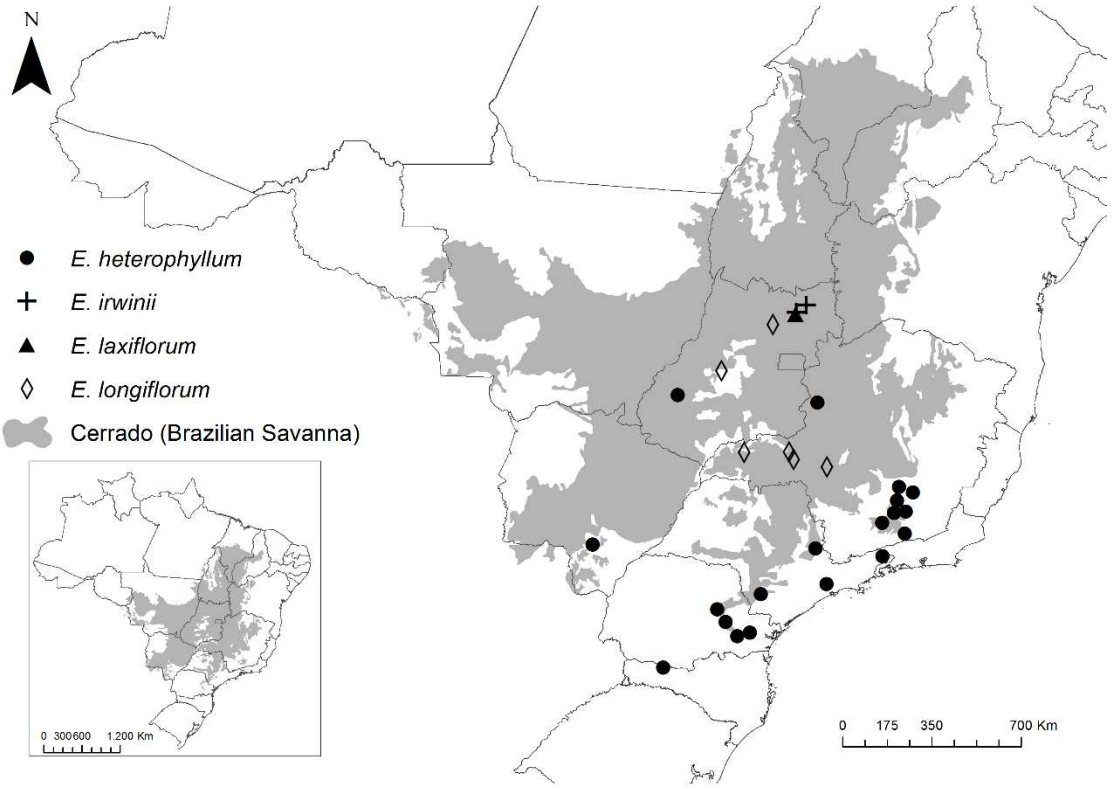

FIGURE 11. Geographical distribution of *Eriosema heterophyllum*, *E. irwinii* (endemic to Goiás state), *E. laxiflorum* (endemic to Goiás state), and *E. longiflorum* (Brazilian Savanna: Ecoregions of the world modified from Olson *et al.* 2001).

FIGURE 12. Photographs of *Eriosema* species. A, B. *E. irwinii*. C–E. *E. laxiflorum*. F, G. *E. macrostipulatum* G. H, I. *E. prorepens*. J. *E. tacuaremboense*. (A, B, by E.S. Cândido); (C–E, G by M.J. Silva); (F by A.P. Fortuna-Perez); (H, I by M.F. Simon); (J by W. Vargas). D and G: A.P. Fortuna-Perez et al. 2018.

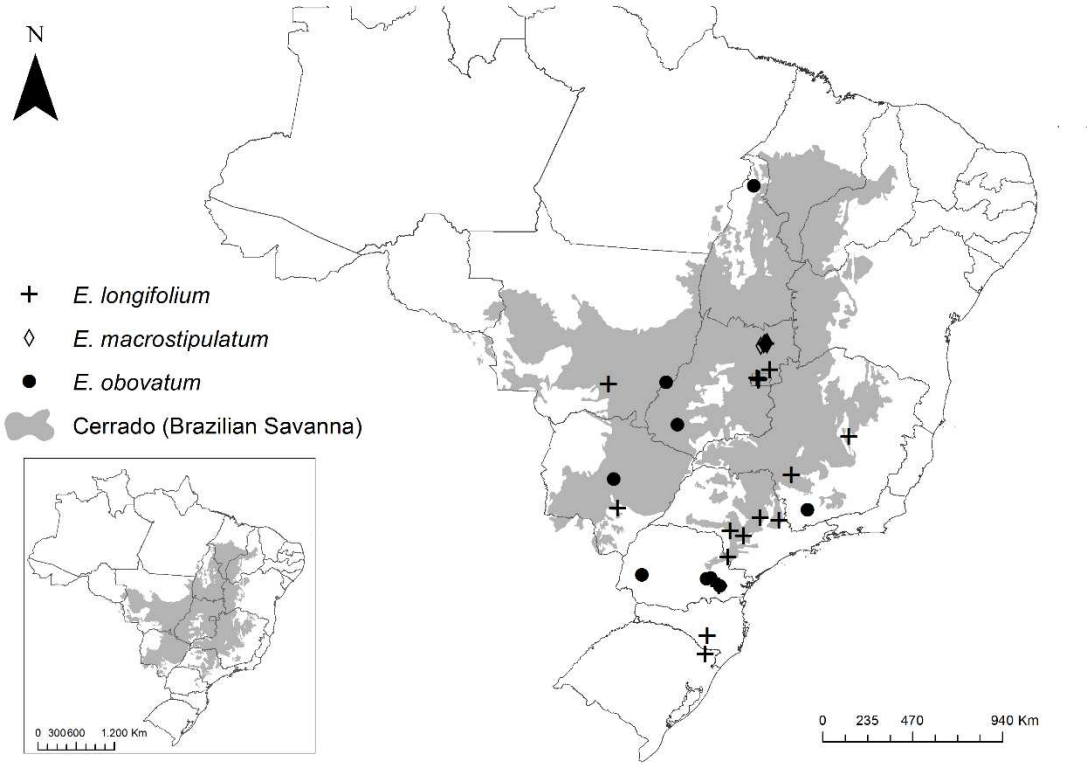

FIGURE 13. Geographical distribution of *Eriosema longifolium*, *E. macrostipulatum* (endemic to Chapada dos Veadeiros National Park in Goiás state) and *E. obovatum* (Brazilian Savanna: Ecoregions of the world modified from Olson *et al.* 2001).

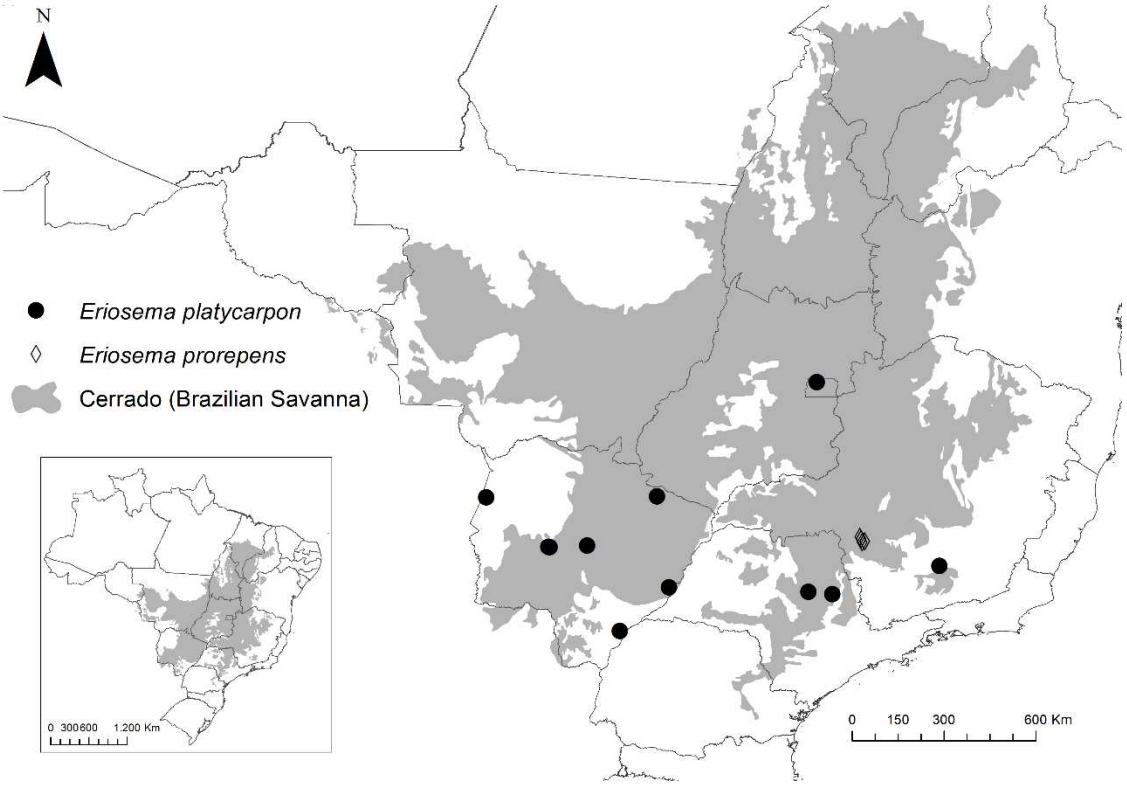

FIGURE 14. Geographical distribution of *Eriosema platycarpon* and *E. prorepens* (endemic to Serra da Canastra National Park in Minas Gerais state) (Brazilian Savanna: Ecoregions of the world modified from Olson *et al.* 2001).

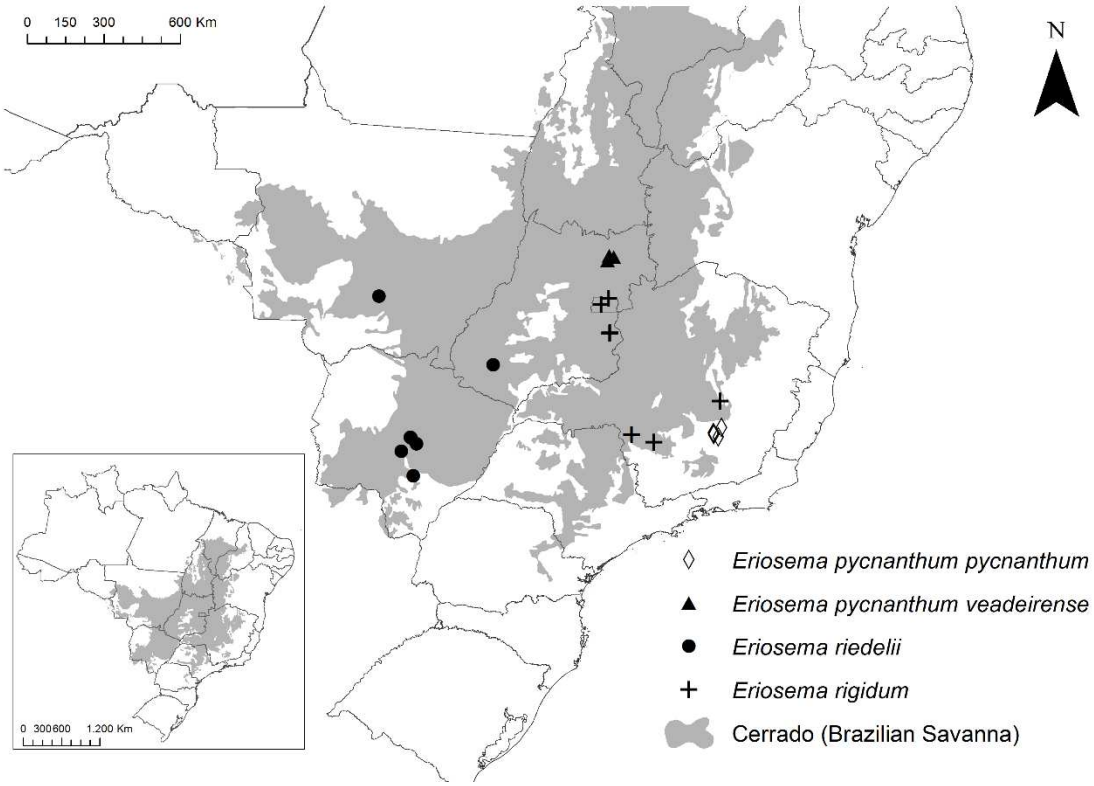

FIGURE 15. Geographical distribution of *Eriosema pycnanthum* var. *pycnanthum* (endemic to the Iron Quadrangle Region in Minas Gerais state), *E. pycnanthum* var. *veadeirense* (endemic to the Chapada dos Veadeiros National Park in Goiás state), *E. riedelii* and *E. rigidum* (Brazilian Savanna: Ecoregions of the world modified from Olson *et al.* 2001).

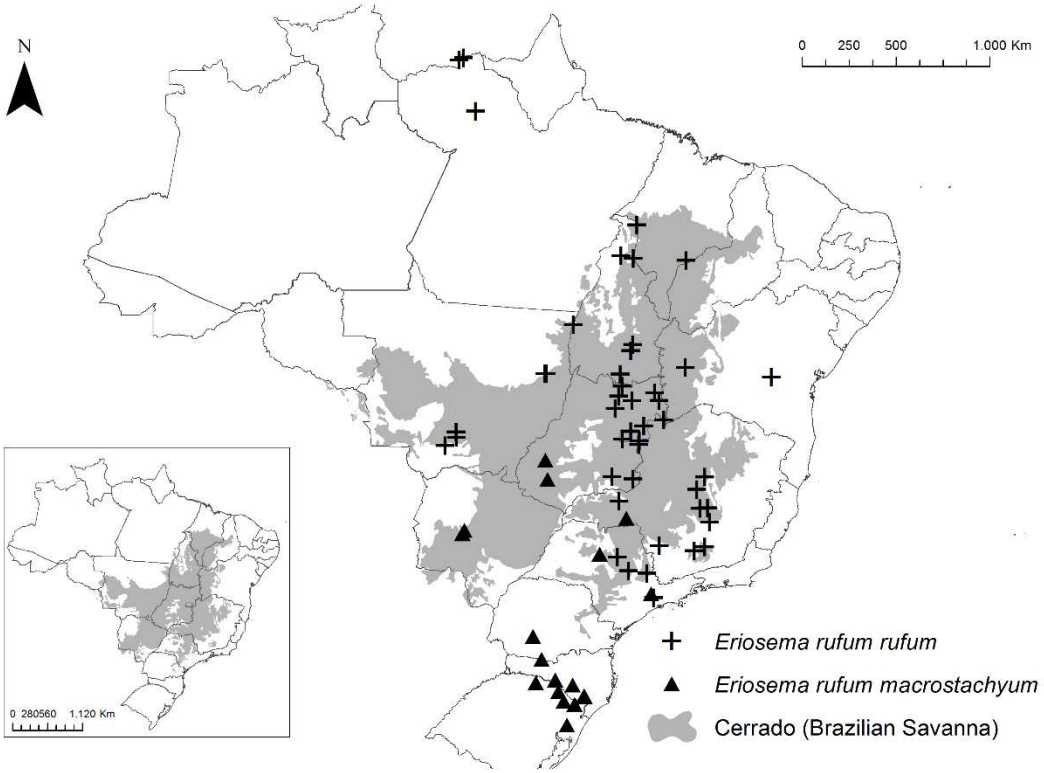

FIGURE 16. Geographical distribution of *Eriosema rufum* var. *rufum* and *E. rufum* var. *macrostachyum* (Brazilian Savanna: Ecoregions of the world modified from Olson *et al.* 2001).

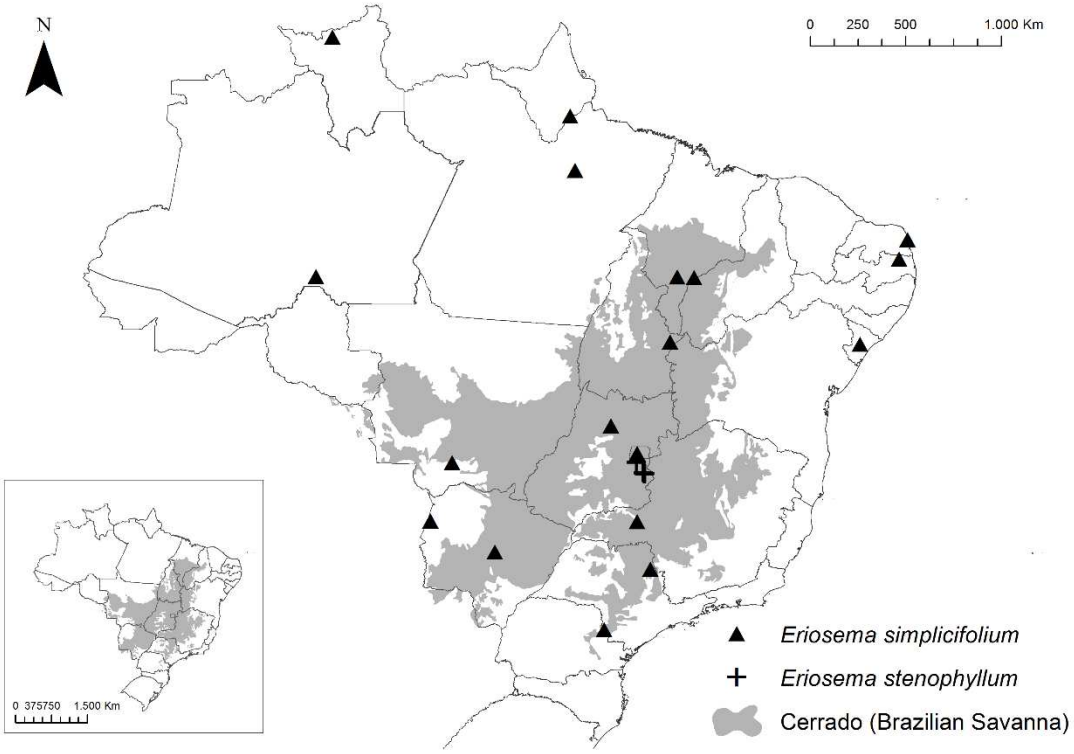

FIGURE 17. Geographical distribution of *Eriosema simplicifolium* and *E. stenophyllum* (Brazilian Savanna: Ecoregions of the world modified from Olson *et al.* 2001).

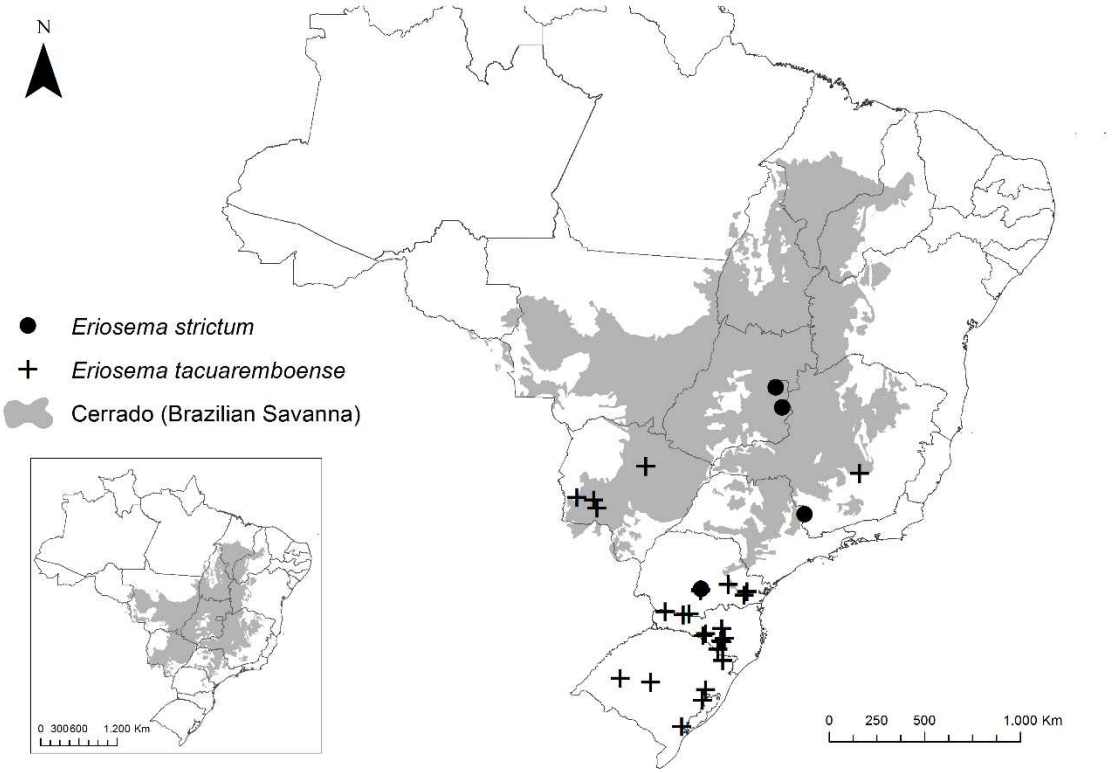

FIGURE 18. Geographical distribution of *Eriosema strictum* and *E. tacuaremboense* (Brazilian Savanna: Ecoregions of the world modified from Olson *et al.* 2001).

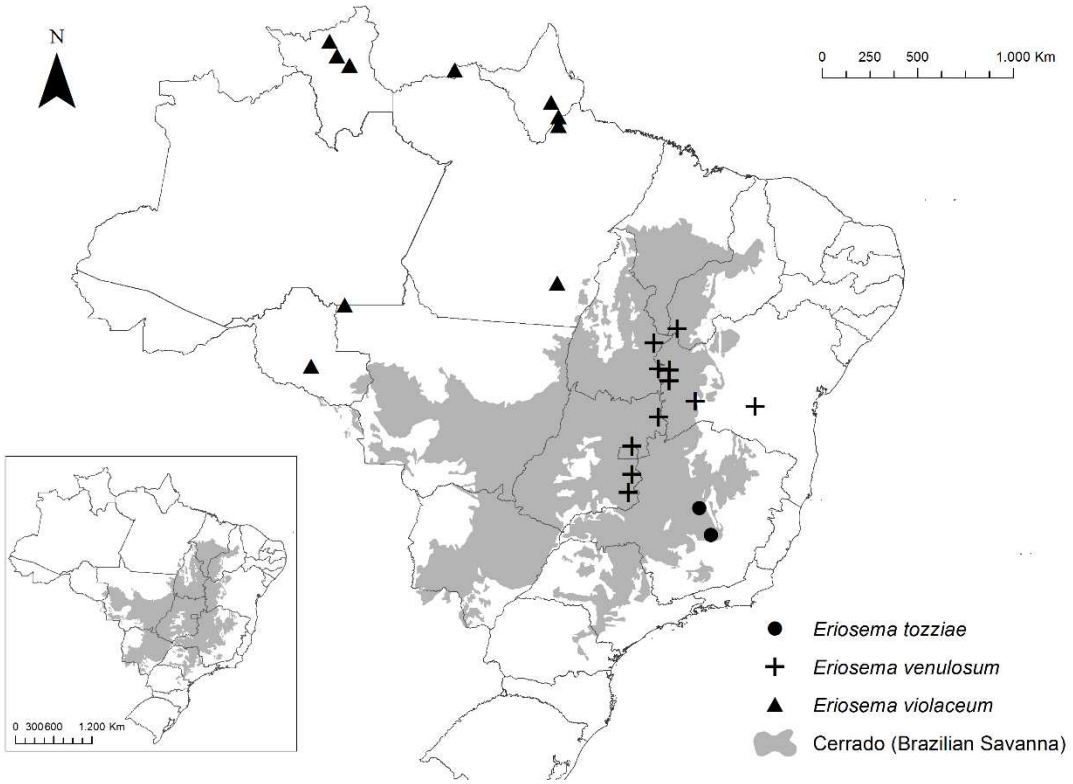

FIGURE 19. Geographical distribution of *Eriosema tozziae* (endemic to Minas Gerais state), *E. venulosum* and *E. violaceum* (Brazilian Savanna: Ecoregions of the world modified from Olson *et al.* 2001).

Chapter II

Phylogeny of the genus *Eriosema* (Leguminosae, Papilionoideae, Phaseoleae)

ELISA S. CÂNDIDO[1*], MOHAMMAD VATANPARAST[3], WANDERLEIA DE VARGAS[2], LUÍSA M.P.A. BEZERRA[2], GWILYM P. LEWIS[4], VIDAL F. MANSANO[5], ANDRÉ OLMOS SIMÕES[1], MARCOS J. SILVA[6], CHARLES STIRTON[7], & ANA PAULA FORTUNA-PEREZ[1,2*]

[1] *Departamento de Biologia Vegetal, Programa de Pós-Graduação em Biologia Vegetal, Instituto de Biologia, Universidade Estadual de Campinas, 13083–862, Campinas, São Paulo, Brasil.*

[2] *Departamento de Botânica, Instituto de Biociências, Programa de Pós-Graduação em Ciências Biológicas (Botânica), Instituto de Biociências, Universidade Estadual Paulista, 18618-000, Botucatu, São Paulo, Brasil.*

[3] *US National Herbarium (US), Department of Botany, Smithsonian Institution-NMNH, MRC 166, 10th and Constitution Ave, Washington, D.C., 20560, USA.*

[4] *Comparative Plant and Fungal Biology Department, Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AB, U.K.*

[5] *Instituto de Pesquisas do Jardim Botânico do Rio de Janeiro, DIPEQ, Rua Pacheco Leão, 915, Jardim Botânico, Rio de Janeiro, 22460–030, RJ, Brasil.*

[6] *Departamento de Botânica, Instituto de Ciências Biológicas, Universidade Federal de Goiás, CP 131, 74001–970, Goiânia, GO, Brasil.*

[7] *University of Cape Town, Department of Biological Sciences, Bolus Herbarium,105 Rondebosch, South Africa.*

*Authors for correspondence: *Elisa Silva Cândido, elisasilvacandido@gmail.com; Ana Paula Fortuna Perez, bio.fortuna@gmail.com*

ABSTRACT

The genus *Eriosema* is the second largest genus of the monophyletic subtribe Cajaninae and comprises c. 150 species, with pantropical distribution and two centers of diversity, Africa (110 spp.) and America (40 spp.). The species occur typically in tropical savanna regions and present peculiar morphological adaptations to these environments, such as an underground specialized system (woody rootstock, often called xylopodium), and abundance of trichomes throughout the plant. *Eriosema* is most morphologically and phylogenetically related to *Rhynchosia* and there is no specific molecular study for two genera, as well as any other of the subtribe Cajaninae. We carried out a phylogeny of the genus sampling 94 species of *Eriosema* from its entire geographic range, based on ITS, *rpl*32 and *trn*Q sequence data. It is the first and most comprehensive molecular phylogeny for the genus and also for the subtribe. Our results show that *Eriosema* is a monophyletic genus but its interspecific relationships have not yet been elucidated. *Rhynchosia* emerges in distinct lineages and one of them is sister to *Eriosema*. The subtribe Cajaninae emerged as monophyletic, as reported in previous studies. The studies to explain biogeographic history, to determine divergence time estimation and ancestral area inference are being carried out to improve our understanding of the evolution, biogeography, and systematics of the *Eriosema* and Cajaninae.

Keywords: Cajaninae, Fabaceae, *Rhynchosia*, systematics, tropical savanna.

1. INTRODUCTION

Eriosema (DC.) Desv. is the second largest genus of the subtribe Cajaninae (Leguminosae, Phaseoleae) of the tribe Phaseoleae (Figs. 1, 2, 3 and 4), It comprises approximately 150 species, with two centers of diversity, one in Africa (including Madagascar) with about 110 species, and another in the New World (from México to northern Argentina with exception of Chile) with about 40 species. In addition, one or two species are recorded in Southeast Asia and Australia (Schrire, 2005; van der Maesen, 2003; Grear, 1970). In some regions species of *Eriosema* are widely used for medicinal purposes such as the Zulu people of South Africa that use the roots as a medicine for the treatment of erectile dysfunction and/or impotence (Ojewole, 2007).

Representatives of this genus occur typically in savanna regions, mainly tropical savannas in Africa, South America (named "cerrado" in Brazil) (Fig. 5), Southeast Asia and northern Australia. In Central America and the Caribbean, the genus can be found in pine savannas such as the Isle of Pines in the southwest coast of Cuba (Grear, 1970). Tropical savannas are defined mainly by a continuous C4 herbaceous layer, with a discontinuous stratum of disturbance-tolerant woody species (especially fire tolerance and shade intolerance) (Ratnam et al., 2011; Lehmann et al., 2014).

Eriosema species grow in a diverse array of habitats: woodland, wooded grassland, bushed grassland and grassland (terms recommended by Lock, 2006). These habitats form a gradient of woody vegetation ranging from a canopy cover of up to 40%, such as woodland, until open vegetation with limited occurrence of shrubs, such as grassland (Lock, 2006; White, 1983; Pennington et al., 2000). The climate, e environment and structure of these habitats include: a single dry season lasting more than four months, grasses narrow-leaved, tussock-

forming and xeromorphic, tree with canopy cover not more than 40%, one shrub or grass layer, often with regular fire, natural grasslands in sites with seasonal waterlogging, shallow soil, high metallic ion concentration (Lock, 2006). In the upper elevations of the Savanna Vegetation a vegetational mosaic of mountaintop "islands" dominated by seasonal drought and rocky or sandy soils occurs with low fertility. In the Neotropics they are referred to as “campo rupestre” (rocky fields), and among them is the Espinhaço Range in eastern Brazil, where many species of *Eriosema* are found (Grear, 1970; Fortuna-Perez et al., 2013, 2017, 2018; Cândido et al., 2014a, 2014b). In the tropical African mountains rather similar vegetation to the Espinhaço Range is found in the Chimanimani mountains on the Zimbabwe-Mozambique border (Lock, 2006) where one of the most abundant shrubs are individuals of *E. montanum* Baker f. (Phipps & Goodier, 1962).

Most species of *Eriosema* presents a peculiar adaptive morphology as a response to the adversity of the environments mentioned above, such as: herbs, subshrub or shrub habit, frequently with an underground specialized system (woody rootstock, often called xylopodium), and abundance of trichomes throughout the plant, including secretory structures that are peculiar of the subtribe Cajaninae (such as bulbous-based trichomes, vesicular glands and secretory-base trichomes) (Grear, 1970; Lackey, 1978; Cândido, 2016). This subtribe is monophyletic according to molecular phylogenetic studies that have included only few members of subtribe (Bruneau et al., 1995; Kajita et al., 2001; Egan et al., 2016; LPWG, 2017).

Eriosema is most morphologically and phylogenetically related to *Rhynchosia* Lour. and except for these two genera, all other members of the Cajaninae subtribe are exclusively from the Old World and Oceania. The existing phylogenetic studies so far include a small number of samples of *Eriosema* and *Rhynchosia* (Doyle & Doyle, 1993; Kajita et al., 2001; Egan et al., 2016; LPWG, 2017) and the genus *Eriosema* was resolved as monophyletic by

Egan et al. (2016) and LPWG (2017). However, there is no specific molecular study for these genera, as well as for other of the subtribe Cajaninae.

In this paper, we present a comprehensive molecular phylogeny of *Eriosema* covering its entire geographical distribution and morphological variation. The aims of the current study are: to test the monophyly, and to examine infrageneric relationships of *Eriosema* and its relationships with the other genera of Cajaninae.

2. MATERIAL AND METHODS

2.1 Taxon Sampling

Relationships between *Eriosema* and the other genera of the subtribe Cajaninae are still unclear, so we sampled for this study other genera of the Cajaninae: *Adenodolichos*, *Bolusafra*, *Cajanus*, *Chrysoscias*, *Dunbaria*, *Flemingia*, *Paracalyx*, besides the genus *Rhynchosia*. The analysis presented here includes 94 species of *Eriosema* (represented by 98 accessions): 1 species from Asia, 59 species from Africa including Madagascar, and 34 species from America; representing 62.6% of total species of the genus. We chose *Galactia striata* (Jacq.) Urb. and *Camptosema grandiflorum* Benth. from the subtribe Diocleinae for rooting purposes and 47 species as outgroups (Table 1) belonging to the following genera of Cajaninae: *Adenodolichos* (2), *Bolusafra* (1), *Cajanus* (3), *Chrysoscias* (1), *Dunbaria* (3), *Flemingia* (3), *Paracalyx* (2), and *Rhynchosia* (32). The species sampled were chosen to cover the entire geographic and ecological range of the genus. Only one genus of the subtribe Cajaninae was not included in this study, *Carrissoa*, due to lack of available material for sequencing. *Carrissoa* is a monotypic genus represented by *Carrissoa angolense* Baker f., which has just the type specimen, housed in the herbarium of Coimbra (COI) (Herbarium acronym from Index Herbariorum; Thiers,

continuously updated). Most of the samples for DNA extraction was obtained from herbarium collections. Samples of species that occur in Brazil were collected in the field and stored in silica gel, as well as some African samples. Accessions with taxon names, voucher specimens, locations, and markers used are listed in Table 1.

2.2 DNA extraction, amplification, and sequencing

Total DNA was extracted from herbarium specimens or silica gel dried leaves, using the NucleoSpin plant II kit (Macherey-Nagel, Düren, Germany), according to the manufacturer's protocols with a modified protocol in the beginning of the procedure, adding 4 μL RNAse A stock solution and for herbarium materials we left on the heater for about three hours. About 1 cm^2 of dried leaf of each sample was grinded with a pestle in a mortar using liquid nitrogen or in a Geno/Grinder® 2010 machine (SPEX® SamplePrep LLC; for 2 minutes on speed 2). To amplify the ITS region (including ITS1 and ITS2 spacer regions and the 5.8S ribosomal subunit) of nuclear ribosomal DNA (nrDNA), primer pairs 17SE and 26SE (Sun et al., 1994) were used. The PCR reactions were prepared in 25 μL solution containing 2 μL of 10 × PCR buffer, 1.5 μL of 50 mM $MgCl^2$, 1 μL of 2.5 mM dNTPs, 1 μL of KB Extender (Invitrogen), 1 μL of DMSO 5%, 0.5 μL of bovine serum albumin, 0.5 μL of betaine, 2 μL of each primer (5 pM), 0.2 μL of Platinum Taq DNA polymerase (Invitrogen), and 1.5 μL of DNA template, adjusted with de-ionized water.

The ITS region was amplified according to the following conditions: 11 cycles using the touchdown strategy: 94°C for 3 min, 94°C for 1 min; −1°C per cycle as from 65°C; 72°C for 1 min; 15 cycles back to step 2, 94°C for 1 min; 50°C for 1 min; 72°C for 4 min; 21 cycles back to step 2; 72°C for 1 min and 15°C constant at the end of the reaction. The rpl32-trnL and trnQ-5'rps16 intergenic spacers of the chloroplast DNA (cpDNA) were amplified using

trnL(UAG)/rpL32-F and trnQ(UUG)/rpS16x1 primers, respectively (Shaw et al., 2007). The rpl32-trnL and trnQ-5'rps16 intergenic spacers were amplified according to the following conditions: 35 cycles: 95°C for 1 min; 55°C for 1 min; 72°C for 1 min; final extension 72°C for 7min and 10°C constant at the end of the reaction. After the PCR, 2 µl of the PCR solution were run on 1% agarose gel to select the successful amplification. The amplified PCR products were purified using the NucleoSpin gel and PCR clean-up kit (Macherey-Nagel, Düren, Germany) and sent to sequencing with the same primers used in the amplifications. DNA sequencing reactions were performed in an automatic sequencer ABI 3730xl (Macrogen Inc., Seoul, South Korea).

2.3 Alignment and phylogenetic analysis

Forward and reverse sequences were edited and aligned into contigs with Geneious version 8.1.9 (http://www.geneious.com, Kearse et al., 2012). All sequences generated in this study will be deposited in GenBank (Table 1). A BLAST search (http://blast.ncbi.nlm.nih.gov/) was conducted for all sequences to check for possible contaminant DNA. DNA regions were aligned using MAFFT v7.369b (Katoh & Standley, 2013) under default setting. Alignments were corrected and edited by eye in AliView (Larsson, 2014). Our phylogenetic analysis are based on Maximum likelihood (ML) and Bayesian inference (BI) approaches. ML analyses were performed using Randomized Accelerated Maximum Likelihood (RAxML), version 8.0.14 (Stamatakis, 2014). BI was done using a Markov chain Monte Carlo (MCMC) method, as implemented in MrBayes, version 3.2.2 (Ronquist et al., 2012).

3. RESULTS

3.1 Data matrices

In total, our analyses included 146 taxa and 393 new DNA sequences (123 of ITS, 142 of *rpl*32, 128 of *trn*Q), all accessions were produced in this study, and that will be deposited in GenBank (Table 1).

3.2 Phylogenetic analysis

Bayesian and Maximum Likelihood analyses for all markers (ITS, *rpl*32 and *trn*Q) were run using both individual and combined datasets. In all analyses *Eriosema* emerged as monophyletic with robust supports (BS 100%; PP 1.00; Figs. 6-8). However, the interspecific relationships within *Eriosema* were not resolved yet. *Rhynchosia* appeared in distinct lineages and one of them is sister to *Eriosema* (Figs. 6-8).

The model GTR-GAMMA was the model selected for ITS to Maximum Likelihood, RAxML v. 8.0.14 (Stamatakis, 2014) analyses, and for combined, ITS, *trn*Q and *rpl*32, RAxML and Bayesian Inference analysis. Rapid bootstrapping was done with 1000 replications with the GTRCAT estimation to assess branch support (Stamatakis, 2006).

In the ML analysis of the ITS/5.8S dataset *Eriosema* and the subtribe Cajaninae emerged as monophyletic (both with 100% BT; Fig. 6). However, the relationships within *Eriosema* were not resolved. The genera *Adenodolichos*, *Flemingia* and *Dunbaria* are monophyletic (100% BT; Fig. 6). One group of African species of *Rhynchosia* (BS 93%; Fig. 6) has emerged as sister to *Eriosema*. *Paracalyx* appeared as paraphyletic nested within the African species of

Rhynchosia (Fig. 6). *Cajanus* appeared as monophyletic (100%; Fig.6), with *Rhynchosia volubilis* as its sister group.

The Bayesian and ML analyses of combined dataset (ITS, *rpl*32 and *trn*Q; Fig. 7, 8) also showed the monophyly of *Eriosema*, as well as of *Adenodolichos, Dunbaria* and *Flemingia* (BS 100%, PP 1.00; Fig. 7, 8), and again one African group of species of *Rhynchosia* emerged in weakly supported clade as sister to *Eriosema* (Fig. 7, 8). *Chrysoscias* and *Bolusafra* formed a clade (100%, 1.00 PP; Fig. 7, 8) that is sister to a group of *Rhynchosia* species (*R. adenodes*, *R. flecki*, *R. aureovillosa* var. *humbertii*, *R. sublobata*, and *R. nyasica*). *Paracalyx* also was resolved as paraphyletic and nested within the African species of *Rhynchosia* (Figs. 7, 8). *Cajanus* appeared as monophyletic (100%; 1.00 PP; Fig. 7, 8). BA analysis combined showed *Rhynchosia volubilis* as sister to the genus *Cajanus* (Fig. 7).

4. DISCUSSION

Analysis of both nuclear and chloroplast sequences and combined data resulted in the strongly supported monophyly of *Eriosema*, although the infrageneric relationships were not clarified. The Cajaninae clade obtained here (Figs. 6-8) was already found in previous work, but here this group has a much larger sampling (Doyle & Doyle, 1993; Bruneau et al., 1995; Schrire 2005; Egan et al., 2016). The subtribe Cajaninae is included in the core Phaseoleae *sensu* Schrire (2005) together to Psoraleeae, Glycininae, Erythrininae, Cajaninae, and *Butea* (Egan et al., 2016). Our results resolved *Adenodolichos* as monophyletic with strong support (100% BS; 1.00 PP – Fig. 6-8), and Bruneau et al. (1995) stated *Adenodolichos* as sister to all other representatives of Cajaninae, but in our study this has not been resolved. *Adenodolichos* is the only genus that possesses canavanin and bracteoles in the subtribe, and Lackey (1977, 1981) considered it as an anomalous genus inside Cajaninae. However, *Adenodolichos* shares

vesicular glands, which are the only secretory structures considered as a unifying character to this subtribe (Vargas et al., in press).

Our combined analysis resolved *Cajanus*, *Dunbaria* and *Flemingia* as monophyletic, despite the fact that in the ITS analysis (Fig. 6) *Rhynchosia volubilis*, an Asian species, type of the genus, was nested in *Cajanus* (although with weak support). The genus *Rhynchosia* is the largest of the subtribe Cajaninae, comprising about 240 species with pantropical distribution (Schrire, 2005) and studies focusing this big genus are needed to better understand its infrageneric relationships. Our results showed *Rhynchosia* as polyphyletic and *Paracalyx* emerged nested within a group of African species of *Rhynchosia*. Egan et al.'s (2016) study identified *Paracalyx* as sister to *Rhynchosia*. The species belonging to *Paracalyx* were originally included in *Cylista* Aiton and the type species of this genus is included in *Rhynchosia* (Egan et al., 2016).

Further phylogenetic studies of *Rhynchosia* are being carried out to clarify the intergeneric relationships and to propose a new classification for this big genus.

Eriosema is the only genus of the subtribe Cajaninae with geographic distribution restricted to tropical savannas and appears to be the most recent lineage of the subtribe. Studies in the "cerrado" (savanna of South America), the most diverse tropical savanna in the world, and in the African savanna have shown evidence supporting the late Miocene/Pliocene origin of the savanna biome worldwide (Beerling & Osborne, 2006; Simon et. al, 2009; Edwards et al., 2010; Maurin et al., 2014). The rapid evolution of plants that occur in savanna environments and possesses fire adaptations is congruent with a savanna biome origin (mostly during the past 4–5 Myr) and were observed in groups of plants that grow in this type of vegetation such as *Mimosa* and *Chamaecrista* (Simon et. al, 2009; Rando et al. 2016).

In this current study, no groups were formed to explain the interspecific relationships within the clade *Eriosema*. Studies with different markers are needed to obtain better resolution inside the genus, although the low resolution found among species may probably be related to the rapid diversification of the genus. *Eriosema* is morphologically characterized by its inflorescences in axillary or terminal racemes with flowers usually congested, seeds with a linear hilum and an apical funicle embedded at its extremity.

This study presents the first and comprehensive major molecular phylogeny for the tropical savanna endemic genus *Eriosema*. Further studies are being carried out to explain biogeographic history, to determine divergence time estimation and ancestral area inference of the genus and related genera in Cajaninae subtribe.

ACKNOWLEDGMENTS

This article is one of the results from the project “Estudos taxonômicos, filogenéticos e biogeográficos no gênero *Eriosema* (DC.) Desv. (Leguminosae, Papilionoideae, Phaseoleae)” which is funded by FAPESP/Brazil - Fundação de Amparo à Pesquisa do Estado de São Paulo (process 2015/13386-0) and CNPq/Brazil - Conselho Nacional de Desenvolvimento Científico e Tecnológico (process 400567/2016-4), both granted to A.P. Fortuna Perez. The authors also thank CNPq/Brazil - Conselho Nacional de Desenvolvimento Científico e Tecnológico (400567/2016-4) and FAPEMIG/Brazil - Fundação de Amparo à Pesquisa do Estado de Minas Gerais (process APQ-02323-12), for financial support granted to A.P. Fortuna Perez; FAPERJ/Brazil – Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro (process 203.007/2017) for financial support granted to VFM (process 312766/2009-2; CNPq - REFLORA Project (process number 563550/2010-4) for financial support granted to A. Tozzi; CAPES/Brazil - Coordenação de Aperfeiçoamento de Pessoal de Nível Superior and

CNPq/Brazil - Conselho Nacional de Desenvolvimento Científico e Tecnológico (process 141628/2016-2) for a PhD scholarship to the first author; the Rupert Barneby Award of The New York Botanical Garden awarded to E.S. Cândido; the Biologia Vegetal post graduate program at UNICAMP (Universidade Estadual de Campinas), the UNESP-Botucatu (Universidade Estadual Paulista), the Instituto de Pesquisas Rio de Janeiro Botanical Garden, the UFOP (Universidade Federal de Ouro Preto) for the support; the UFG (Universidade Federal de Goiás), especially to Professor Dr. Marcos José da Silva and his students for all the support in the field in the state of Goiás. We thank the curators and staff of all herbaria visited for providing access to specimens and photographs of their collections and all the people who helped us in the field in Brazil.

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Appendix

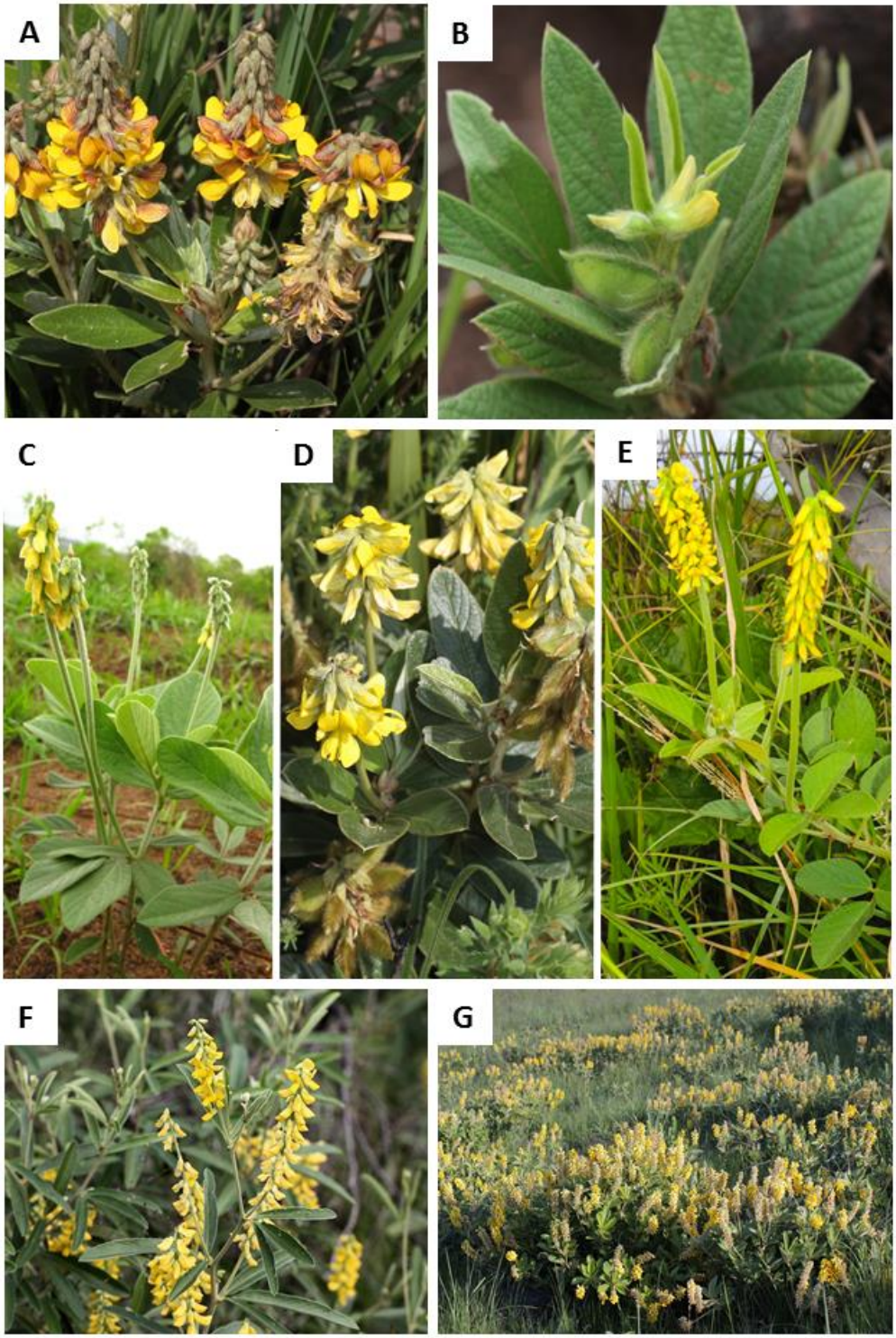

FIGURE 1. Photographs of African *Eriosema* species. A. *E. umtamvunense*. B. *E. ellipticifolium*. C. *E. naviculare*. D. *E. dregei*. E. *E. parviflorum*. F. *E. psoraleoides*. G. *E. luteopetalum*. Photographs by D. Styles (A–G).

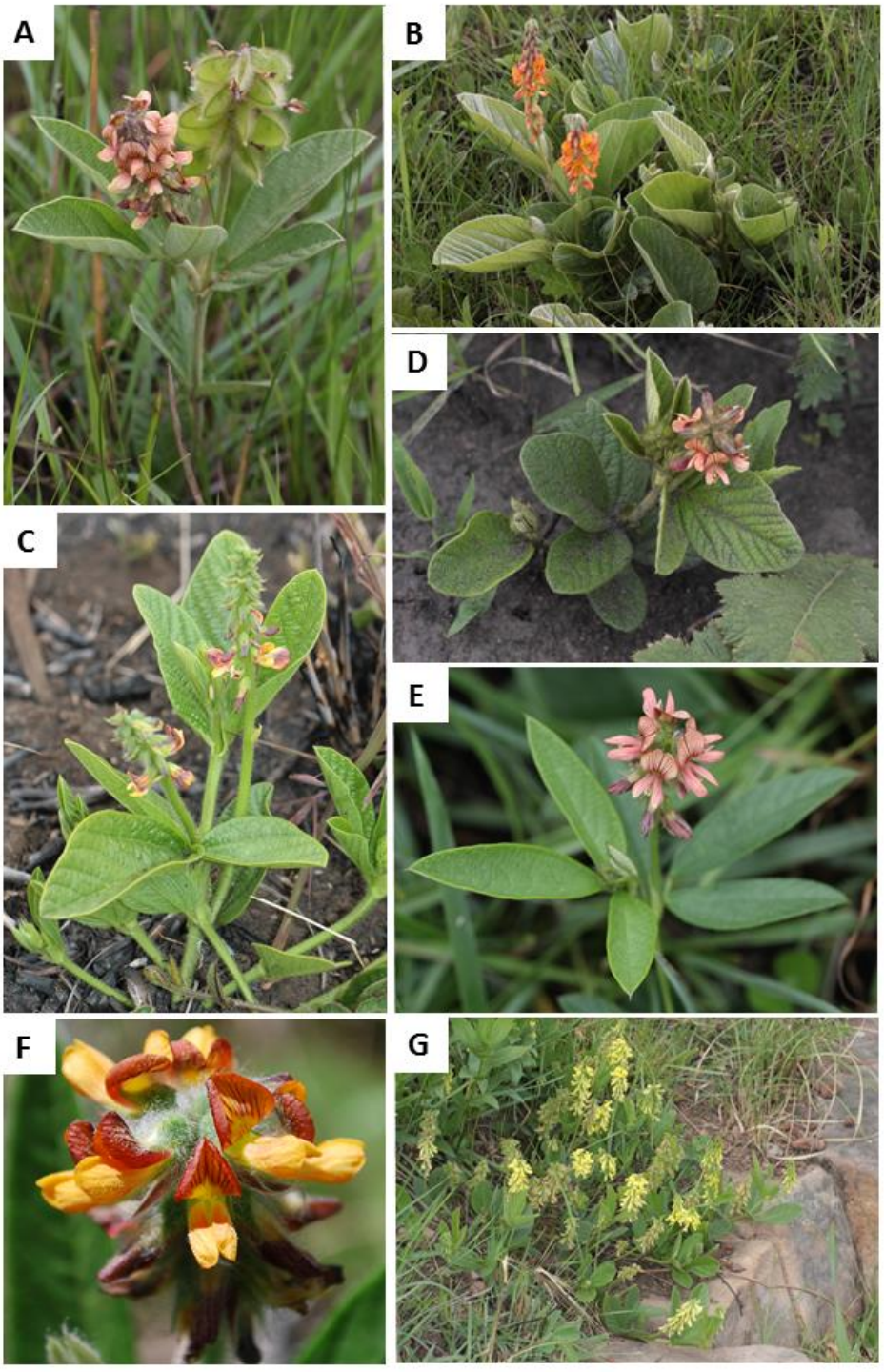

FIGURE 2. Photographs of African *Eriosema* species. A. *E. preptum*. B. *E. populifolium*. C. *E. lucipetalum*. D. *E. rossii*. E. *E. squarrosum*. F. *E. salignum*. G. *E. guenzii*. Photographs by D. Styles (A–G).

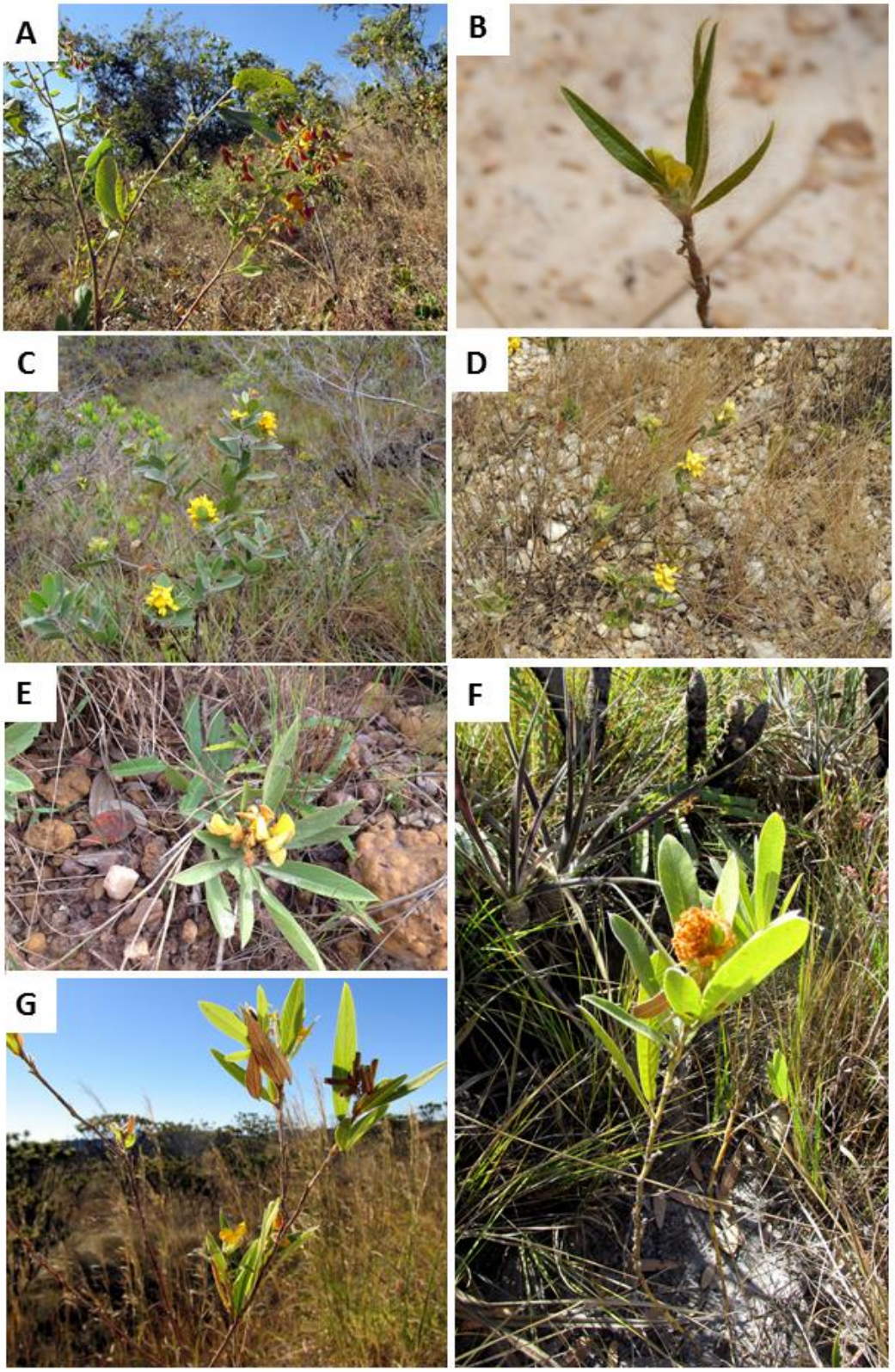

FIGURE 3. Photographs of American *Eriosema* species. A. *E. benthamianum*. B. *E. crinitum*. C. *E. floribundum*. D. *E. hatschbachii*. E. *E. macrostipulatum*. F. *E. irwinii*. G. *E. brevipes*. Photographs by E.S. Cândido (A, F, G); A. Soldevila (B); A.P. Fortuna-Perez (C–E).

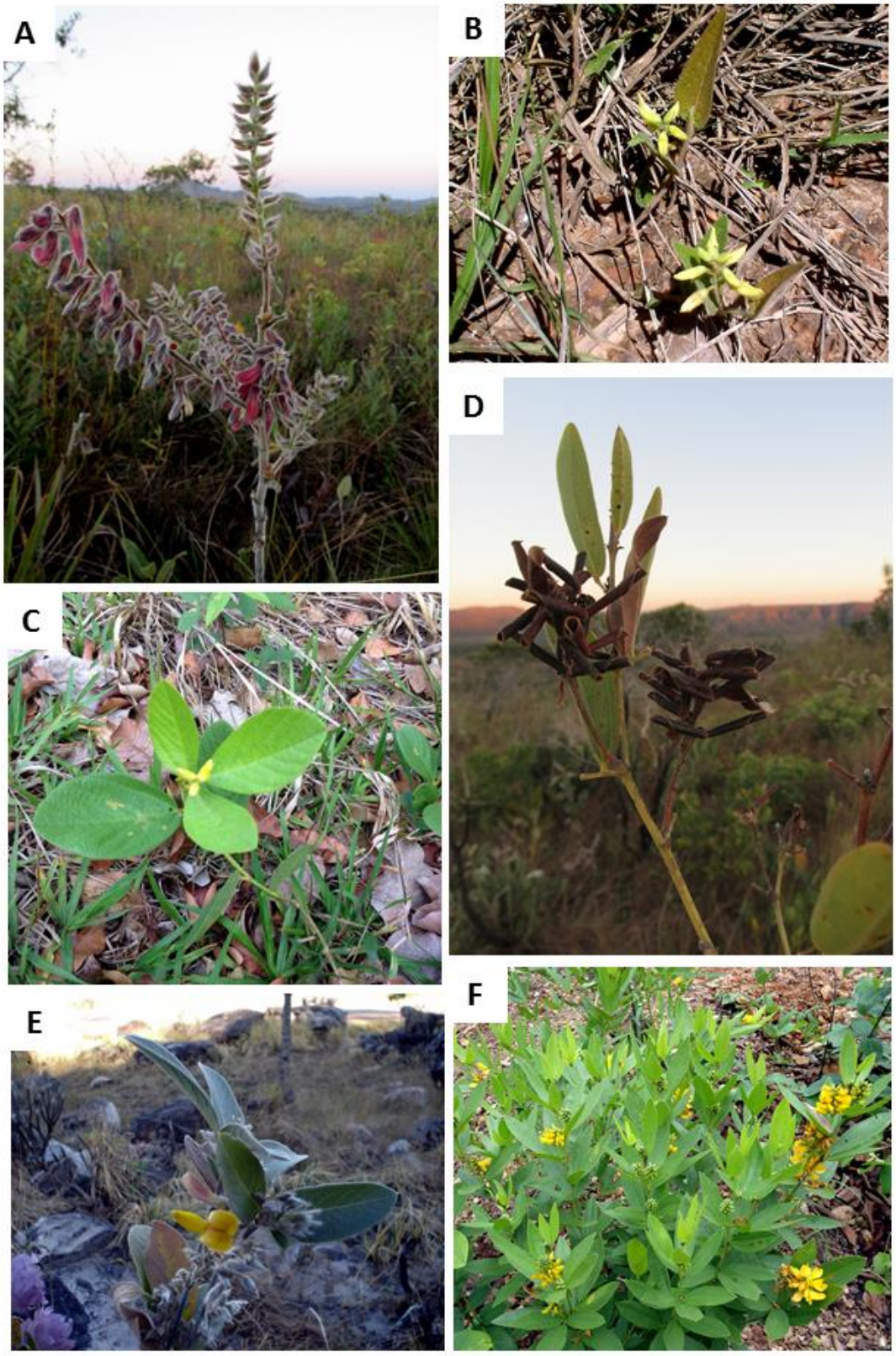

FIGURE 4. Photographs of American *Eriosema* species. A. *E. defoliatum*. B. *E. heterophyllum*. C. *E. campestre* var. *campestre*. D. *E. elegans*. E. *E. congestum*. F. *E. glabrum*. Photographs by E.S. Cândido (A, C, D); A.P. Fortuna-Perez (B, E, F).

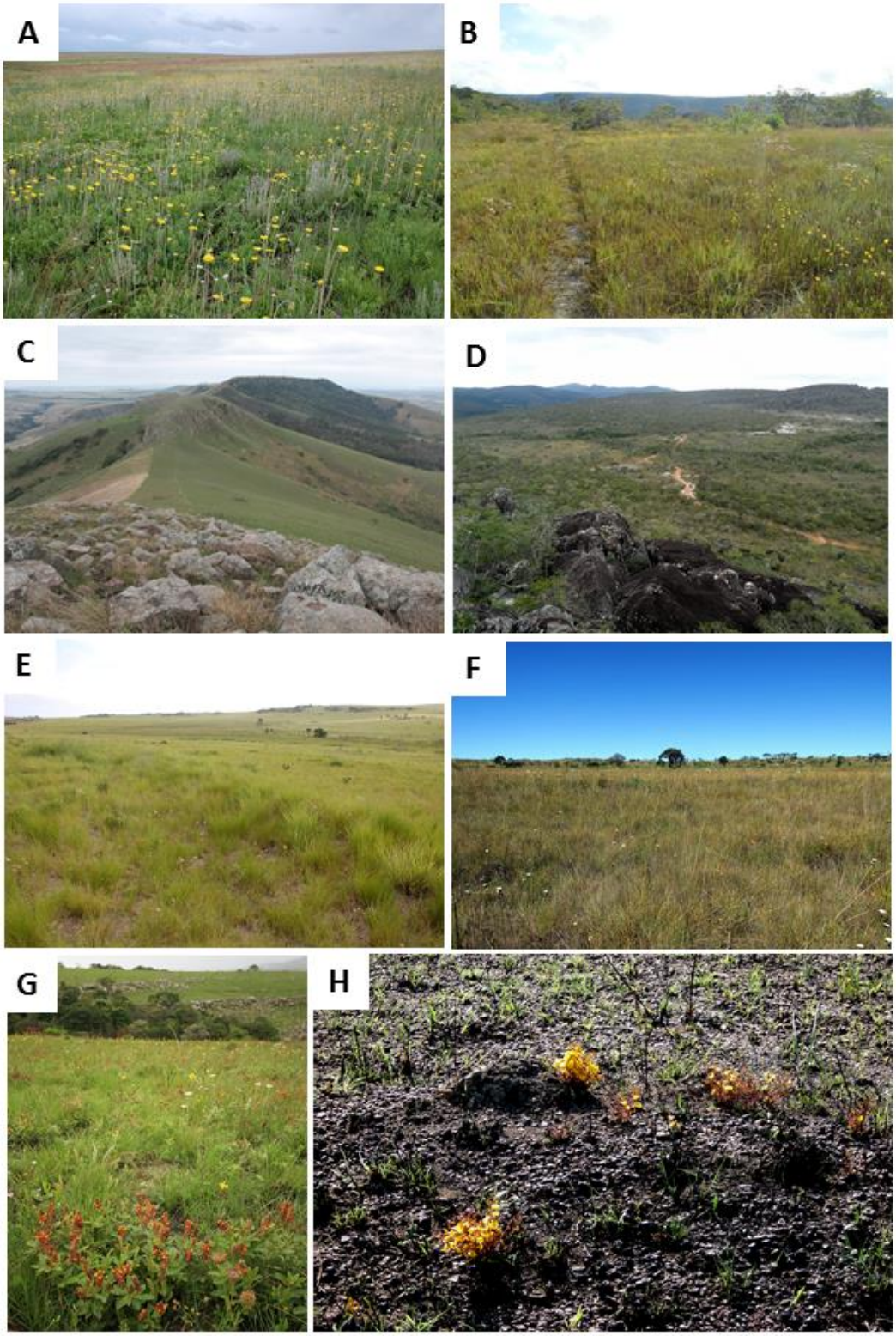

FIGURE 5. Tropical Savannas in Africa and South America, habitat of the *Eriosema* species. A. Bergville (KwaZulu-Natal), South Africa. B, D. Rio Preto State Park (Minas Gerais), Brazil. C. Ingomankulu (KwaZulu-Natal), South Africa. E, G. Umtamvuna Nature Reserve (KwaZulu-Natal), South Africa. F, H. Chapada dos Veadeiros National Park (Goiás), Brazil. Photographs by D. Styles (A, C, E); B.V. Wyk (G); L.M.P.A. Bezerra (B); A.P. Fortuna-Perez (D); E.S. Cândido (F) and M.J. Silva (H).

Table 1.

Taxa studied with voucher information, locations, and markers.

Taxa	Voucher	Continent	Country	ITS	rpl32	trnQ
Adenodolichos baumii Harms	JP Laveridge 403 (PRE)	African	South Africa	x	x	x
Adenodolichos punctatus (Micheli) Harms	J Pawek 9896 (PRE)	African	Malawi	x	x	x
Bolusafra bituminosa (L.) Kuntze	A Hafström (SI - S13-6630)	African	South Africa	x	x	x
Cajanus cajanifolia (Haines) Maesen	LJG van der Maesen 2739 (K)	Asian	India	x	x	x
Cajanus cinerea (F. Muell. ex Benth.) F. Muell.	MJS Sands (K)	Oceania	Australia	x	x	-
Cajanus scarabaeoides (L.) Thouars	AN Egan 13-0733 (K)	Asian	Thailand	x	x	x
Camptosema grandiflorum Benth.	LB Santos & FLS Ferreira 199 (BOTU)	American	Brazil	x	x	-
Chrysoscias calycina E. Mey.	SL Williams 841 (K)	African	South Africa	x	x	x
Dunbaria fusca (Wall.) Kurz	AN Egan 13-0808 (K)	Asian	Thailand	x	x	x
Dunbaria glandulosa Prain	K Larsen & S Supee (K149)	Asian	Thailand	x	x	x
Dunbaria villosa (Thunb.) Makino	BR Yinger et al. 2634 (K)	Asian	South Korea	x	x	x
Eriosema acuminatum (Eckl. & Zeyh.) C.H. Stirt.	KW Grieve 967 (PRE)	African	South Africa	x	x	x
Eriosema affine De Wild.	LJ Brass 17426 (NY)	African	Malawi	-	x	x
Eriosema afzelii Baker	N Diarra 1391 (SI)	African		-	x	x
Eriosema albo-griseum Baker f.	Anzancot de Menezes 1100 (P)	African	Angola	x	x	x
Eriosema andohii Milne-Redh.	R Demange 2670 (P)	African	Mali	x	x	x
Eriosema angolense Baker f.	M Reekmans 6308 (K)	African	Burundi	x	x	x
Eriosema angustifolium Burtt Davy	KW Grieve 990 (PRE)	African	South Africa	x	x	x
Eriosema arachnoideum Verdc.	S Bidgood & I Darbyshire 5279 (P)	African	Tanzania	-	x	x
Eriosema bauchiense Hutch. & Dalziel	HM Richards 20643 (SI)	African	Democratic Republic of the Congo	-	x	x
Eriosema benthamianum Mart. ex Benth.	ES Cândido 1101 (BOTU)	American	Brazil	x	x	x
Eriosema buchananii Baker f.	HG Troupin 7480 (NY)	African	Rwanda	x	x	x
Eriosema campestre Benth. var. *campestre*	ES Cândido et al. 1098	American	Brazil	x	x	x
Eriosema campestre var. *delicatula* Fortunato	W Vargas 6 (CGMS)	American	Brazil	x	x	x
Eriosema campestre var. macrophyllum (Grear) Fortunato	AP Fortuna-Perez 1436 (OUPR)	American	Brazil	x	x	x

Eriosema campestre var. *pubescens* (Chodat & Hassl.) Grear	A Flores & RS Rodrigues 711 (UEC)	American	Brazil	x	x	x
Eriosema chinense Vogel	ED Merrill 878 (SI)	Asian	Philippines	x	-	-
Eriosema chrysadenium Taub.	FJ Breteler 11638 (SI)	African	Tanzania	x	x	x
Eriosema congestum Benth.	MJ Silva 7396 (UFG)	American	Brazil	x	x	x
Eriosema cordatum E. Mey.	KW Grieve 987 (PRE)	African	South Africa	x	x	x
Eriosema cordifolium Hochst. ex A. Rich.	I Friis & K Vollescen 433 (K)	African	South Sudan	x	x	x
Eriosema crinitum (Kunth) G. Don var. *crinitum*	ES Cândido et al. 1075 (OUPR)	American	Brazil	x	x	x
Eriosema cupreum Harms	A Glaziou 20888 (SI)	American	Brazil	x	-	-
Eriosema defoliatum Benth.	ES Cândido 1109 (BOTU)	American	Brazil	x	x	x
Eriosema diffusum (Kunth) G. Don	J Bustamante 202 (SI)	American	Costa Rica	x	x	x
Eriosema distinctum N.E. Br.	KW Grieve 1039 (PRE)	African	South Africa	x	x	-
Eriosema dregei E. Mey.	A Albott 9272 (K)	African	South Africa	x	x	x
Eriosema elegans Fort.-Perez & M.J. Silva	MJ Silva 7228 (UFG)	American	Brazil	x	x	x
Eriosema ellipticifolium Schinz	CH Stirton 1441 (K)	African	South Africa	x	x	-
Eriosema ellipticum Welw. ex Baker	AR Torre 265 (SI)	African	Mozambique	-	x	x
Eriosema englerianum Harms	RD Bayliss 10499 (SI)	African	Zimbabwe	x	x	x
Eriosema erectum Baker f.	HM Richards 15782 (SI)	African	Democratic Republic of the Congo	x	x	x
Eriosema flemingioides Baker	A Fournier 145 (NY)	African	Ivory Coast	x	x	x
Eriosema flexuosum Staner	E Milne-Redhead & P Taylor 8920 (SI)	African	Democratic Republic of the Congo	x	x	x
Eriosema floribundum Benth.	ES Cândido et al. 1090 (OUPR)	American	Brazil	x	x	x
Eriosema glabrum Mart. ex Benth.	ES Cândido et al. 1067 (OUPR)	American	Brazil	x	x	x
Eriosema glaziovii Harms	AP Fortuna-Perez et al. 1457 (OUPR)	American	Brazil	x	x	x
Eriosema glomeratum (Guill. & Perr.) Hook. f.	O Flock 356 (SI)	African	Tanzania	-	x	x
Eriosema grandiflorum (Schltdl. & Cham.) G. Don	HS Gentry 1837 (SI)	American	Mexico	x	x	x
Eriosema gunniae C.H. Stirt.	CH Stirton & Gernishuizen 6938 (K)	African	South Africa	x	x	x

Eriosema harmsianum Dinter	K Dinter 5750 (SI)	African	South Africa	x	x	x
Eriosema hatschbachii Fort.-Perez & G. P. Lewis	AP Fortuna-Perez et al. 1401 (OUPR)	American	Brazil	x	x	x
Eriosema heterophyllum Benth.	ES Cândido et al. 1068 (OUPR)	American	Brazil	x	x	x
Eriosema humbertii Staner & de Craene	JB Gillett 14464 (SI)	African	Ethiopia	x	x	x
Eriosema humile Hauman	DJ Goyder 6273 (K)	African	Angola	-	x	x
Eriosema irwinii Grear	ES Cândido 1106 (BOTU)	American	Brazil	x	x	x
Eriosema jurionianum Staner & De Craene	I Ambijorn 372 (SI)	African	Ethiopia	-	x	x
Eriosema kraussianum Meisn.	KW Grieve 942 (PRE)	African	South Africa	x	x	x
Eriosema latifolium (Benth. ex Harv.) C.H. Stirt.	CH Stirton 5599 (K)	African	South Africa		x	-
Eriosema laurentii De Wild.	KA Lye (K)	African	Uganda	x	x	x
Eriosema laxiflorum Harms	MJ Silva 4407 (UFG)	American	Brazil	x	x	x
Eriosema lebrunii Staner & De Craene	M Reekmans 8784 (SI)	African	Burundi	-	x	x
Eriosema longiflorum Benth.	M Silva 4025 (UFG)	American	Brazil	x	x	x
Eriosema longifolium Benth.	AP Fortuna-Perez et al. 1442 (OUPR)	American	Brazil	x	x	x
Eriosema macrostipulatum Fort.-Perez, Cândido & M.J. Silva	MJ Silva 4696 (UFG)	American	Brazil	x	x	x
Eriosema macrostipulum Baker f. var. *macrostipulum*	M Reekmans 4134 (K)	African	Burundi	-	x	-
Eriosema mirabilis R.E. Fr.	RGN Young 1107 (NY)	African	Angola	-	x	x
Eriosema molle Hutch. ex Milne-Redh.	H Ern et al. 119 (SI)	African	Togo	x	x	x
Eriosema monticola Taub.	JM Lock 84/94 (SI)	African	Togo	x	x	x
Eriosema multiflorum B.L. Rob.	M Hahn 386 (P)	American	Mexico	x	x	x
Eriosema naviculare C.H. Stirt.	CH Stirton 9839 (K)	African	South Africa	x	x	x
Eriosema nutans Schinz	BD Schrire 2422 (K)	African	South Africa	x	x	x
Eriosema oblongum Benth. ex Harv.	RF Rand 590 (NY)	African	South Africa	x	x	x
Eriosema opisenum	L Liben 3673 (NY)	African	Democratic Republic of the Congo	-	x	x
Eriosema palmeri S. Watson var. *palmeri*	HS Gentry 2536 (SI)	American	Mexico	x	x	x

Eriosema parviflorum E. Mey.	JG Adam 20593 (P)	African	Liberia	x	x	x
Eriosema pauciflorum Klotzsch	A Hafstrom & JPH Acock 579 (SI)	African	South Africa	-	x	x
Eriosema pentaphyllum Harms	HM Richards 8193 (K)	African	Zambia	x	x	x
Eriosema platycarpon Micheli	TM Pedersen 4372 (SI)	American	Paraguay	-	x	x
Eriosema populifolium Benth. ex Harv.	CH Stirton 1200 (SI)	African	South Africa	-	x	x
Eriosema preptum C.H. Stirt.	HJ Venter & A Venter 10237 (SI)	African	South Africa	x	x	x
Eriosema prorepens Benth.	R Romero et al. 4653 (VIC)	American	Brazil	x	x	x
Eriosema prunelloides Welw. ex Baker f.	DB Fanshame 8910 (K)	African	Zambia	-	x	x
Eriosema psoraleoides (Lam.) G. Don	A Burkart 24522 (SI)	African	South Africa	x	-	-
Eriosema pulchellum (Kunth) G. Don	CG Pringle 9748 (SI)	American	Mexico	x	x	x
Eriosema pycnanthum Benth. var. *pycnanthum*	SG Rezende & MS Medens 2088 (BHCB)	American	Brazil	x	x	x
Eriosema pynanthum var. *veadeirense* Grear	HS Irwin et al. 12885 (NY)	American	Brazil	x	x	x
Eriosema robustum Baker	JB Gillett 14595 (SI)	African	Ethiopia	x	x	x
Eriosema rossii C.H. Stirt.	KW Grieve 946 (PRE)	African	South Africa	x	x	-
Eriosema rufum (Kunth) G. Don var. *rufum*	W Vargas 12 (CGMS)	American	Brazil	x	x	x
Eriosema shirense var. *adamii* Baker f.	Adam 14687 (SI)	African	Guinea	x	x	x
Eriosema simplicifolium var. *micranthum* Grear	RS Rodrigues et al. 1386 (UEC)	American	Brazil	x	x	x
Eriosema simplicifolium (DC.) G. Don var. *simplicifolium*	ES Cândido et al. 1099	American	Brazil	x	x	x
Eriosema sparsiflorum Baker f.	A Borgdan 3680 (SI)	African	Tanzania	x	x	x
Eriosema speciosum Welw. ex Baker	B Fritzsche 101 (SI)	African	Angola	-	x	x
Eriosema spicatum Hook. f.	JM Lock 84/49 (K)	African	Togo	x	x	x
Eriosema squarrosum (Thunb.) Walp.	A Hafstrom & JPH Acock 616 (SI)	African	South Africa	-	x	x
Eriosema stenophyllum Harms	LP Queiroz 15074 (HUEFS)	American	Brazil	x	x	x
Eriosema strictum Benth.	G Hatschbach 8643 (HB)	American	Brazil	x	-	-
Eriosema tacuaremboense Arechav.	AP Fortuna-Perez et al. 1443 (OUPR)	American	Brazil	x	x	x
Eriosema tozziae Cândido & Fort.-Perez	LS Kinoshita et al. 02/158 (UEC)	American	Brazil	x	x	x

Eriosema triformum Burgt	X M van der Burgt et al. 1240 (NY)	African	Guinea	-	x	x
Eriosema tuberosum A. Rich.	Schimper 1202 (SI)	African	Ethiopia	-	x	x
Eriosema vanderystii (De Wild.) Hauman	SM Chisumpa SMC3 (K)	African	Zambia	x	x	x
Eriosema velutinum Baker f. & Haydon	AA Bullock 2844 (SI)	African	Democratic Republic of the Congo	-	x	x
Eriosema verdickii De Wild.	J Louve 2699 (K)	African	Niger	x	x	x
Eriosema violaceum (Aubl.) G. Don	Ule 8160 (K)	American	Brazil	x	-	-
Flemingia congesta Roxb. ex W.T. Aiton	P Remanandan 4698 (K)	Asian	India	x	x	x
Flemingia ferruginea Wall.	K Larsen 9152 (K)	Asian	India	x	x	x
Flemingia sericea	J Cowie & KG Brennam 9083 (K)	Oceania	Australia	x	x	-
Galactia striata (Jacq.) Urb.	W Vargas & ES Cândido 72 (BOTU)	American	Brazil	x	x	-
Paracalyx microphyllus Ali	M Thulin et al. 10558 (K)	African	Somalia	x	x	x
Paracalyx schweinfurthii Ali	O Cronk 3 (K)	Oceania	Australia	x	x	x
Rhynchosia acuminatissima Miq.	W Takeuchi 9284 (NY)	African	Papua New Guinea	x	x	x
Rhynchosia adenodes Eckl. & Zeyh.	RDA Bayliss 6409 (NY)	African	South Africa	x	x	x
Rhynchosia albae-paulii Berhaut	Berhaut 7495 (P)	African	Senegal	x	x	x
Rhynchosia ambacensis (Hiern) K. Schum.	J Raynal 12914 (P)	African	Cameroon	x	x	x
Rhynchosia androyensis Du Puy & Labat	L Alorge 2295 (P)	African	Madagascar	x	x	x
Rhynchosia aureovillosa var. *humbertii* Hauman	HG Troupin 5686 (NY)	African	Rwanda	-	x	x
Rhynchosia buchananii Harms	K Kaunda & RB Kwatha 632 (NY)	African	Malawi	x	x	-
Rhynchosia buettneri Harms	P de Fabrègues 3473 (P)	African	Ivory Coast	x	x	x
Rhynchosia caaguazuensis Hassl.	E Hassler 11067 (NY)	American	Paraguay	x	x	x
Rhynchosia cliffordii Hutch. & E.A. Bruce	JB Gillett 4864 (P)	African	Somalia	x	x	x
Rhynchosia corylifolia Mart. ex Benth.	AP Fortuna-Perez 1531 (UEC)	American	Brazil	x	x	x
Rhynchosia cytisoides (Bertol.) Wilbur	Rk Godfrey 84172 (NY)	American	United States	x	x	x
Rhynchosia discolor M. Martens & Galeotti	JJ Castillo & J.M. Vargas 2741 (NY)	American	Guatemala	x	x	x
Rhynchosia diversifolia Micheli	M Bonifacino et al. 1803 (SI)	American	Uruguay	x	x	x

Rhynchosia elisae O. Téllez	O Tellez 12583 (NY)	American	Mexico	x	x	x
Rhynchosia fleckii Schinz	R Seydel 1806 (NY)	African	Namibia	x	x	x
Rhynchosia hauthalii (Kuntze) Grear	TM Pedersen 2982 (NY)	American	Argentina	-	x	x
Rhynchosia leucophylla (Benth.) Benth.	W Vargas 10 (CGMS)	American	Brazil	x	x	x
Rhynchosia malacophylla (Spreng.) Bojer	R Spellenberg 7535 (NY)	Asian	Yemen	x	x	x
Rhynchosia mantaroensis J.F. Macbr.	A Sagástegui et al. 15255 (NY)	American	Peru	x	x	x
Rhynchosia melanocarpa Grear	AP Fortuna-Perez (BOTU)	American	Brazil	x	x	-
Rhynchosia minima (L.) DC.	VC Lima 46 (IPA)	American	Brazil	x	x	x
Rhynchosia naineckensis Fortunato	M Nee 50484 (NY)	American	Bolivia	x	x	x
Rhynchosia nyasica Baker	RDA Bayliss 10129 (NY)	African	Zimbabwe	x	x	x
Rhynchosia phaseoloides (Sw.) DC.	RB Pinto 500 (UEC)	American	Brazil	x	x	x
Rhynchosia pycnostachya (DC.) Meikle	H Ern 2562 (P)	African	Togo	x	x	x
Rhynchosia pyramidalis (Lam.) Urb.	S Palma 346 (NY)	American	Honduras	x	x	-
Rhynchosia quercetorum Standl.	WA Haber 3674 (NY)	American	Costa Rica	x	x	-
Rhynchosia resinosa Hochst. ex Baker	CCH Jongkind 8035 (P)	African	Guinea	x	x	x
Rhynchosia sublobata (Schumach. & Thonn.) Meikle	S Bidgood et al. 6418 (P)	African	Tanzania	x	x	-
Rhynchosia viscosa (Roth) DC.	J Bosser 21902 (P)	African	Madagascar	x	x	x
Rhynchosia volubilis Lour.	G Murata 13831 (NY)	Asian	Japan	x	x	x

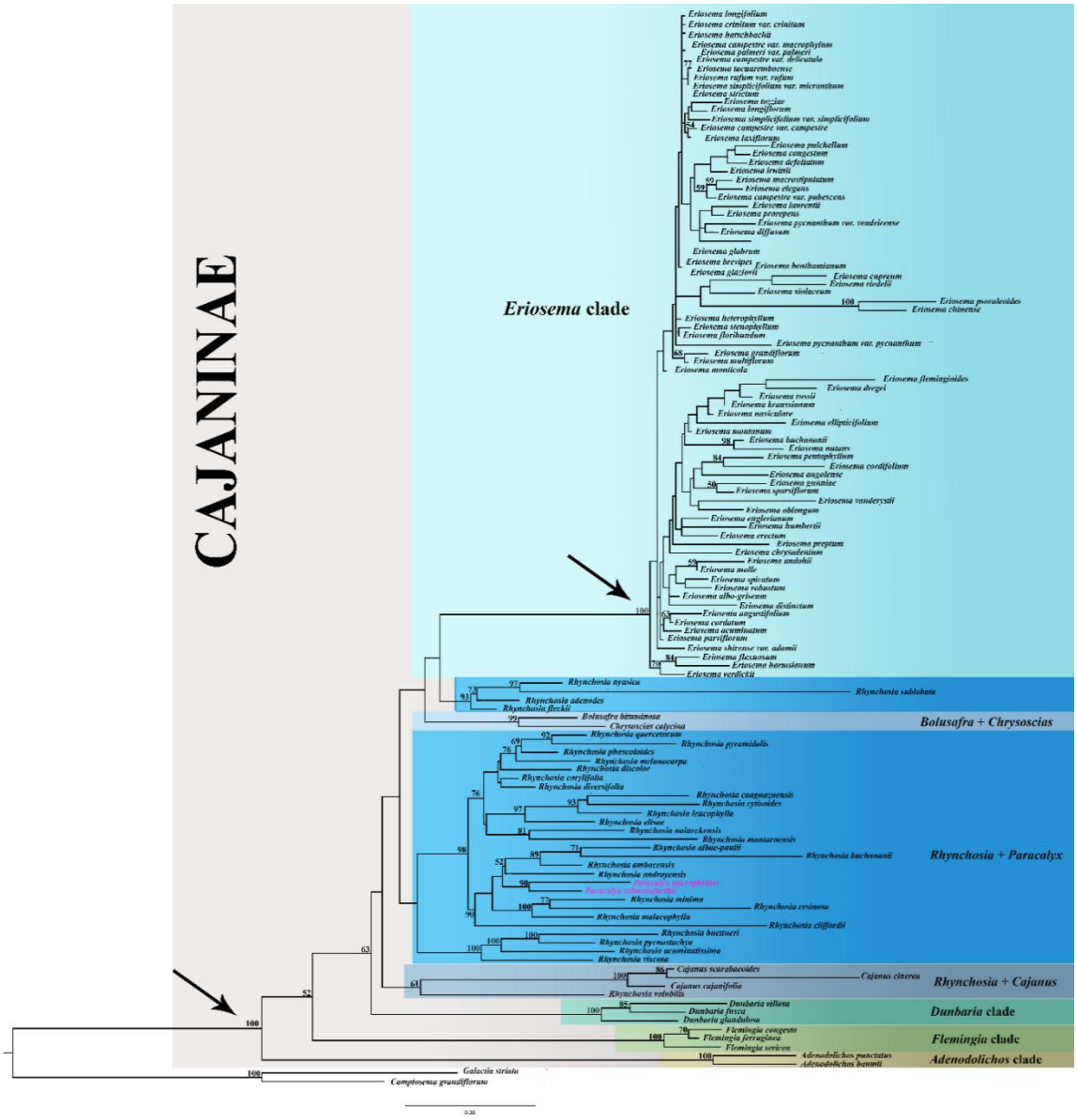

FIGURE 6. Phylogenetic tree of the genus *Eriosema* from Maximum Likelihood analysis of the ITS/5.8S. Numbers along branches are bootstrap values.

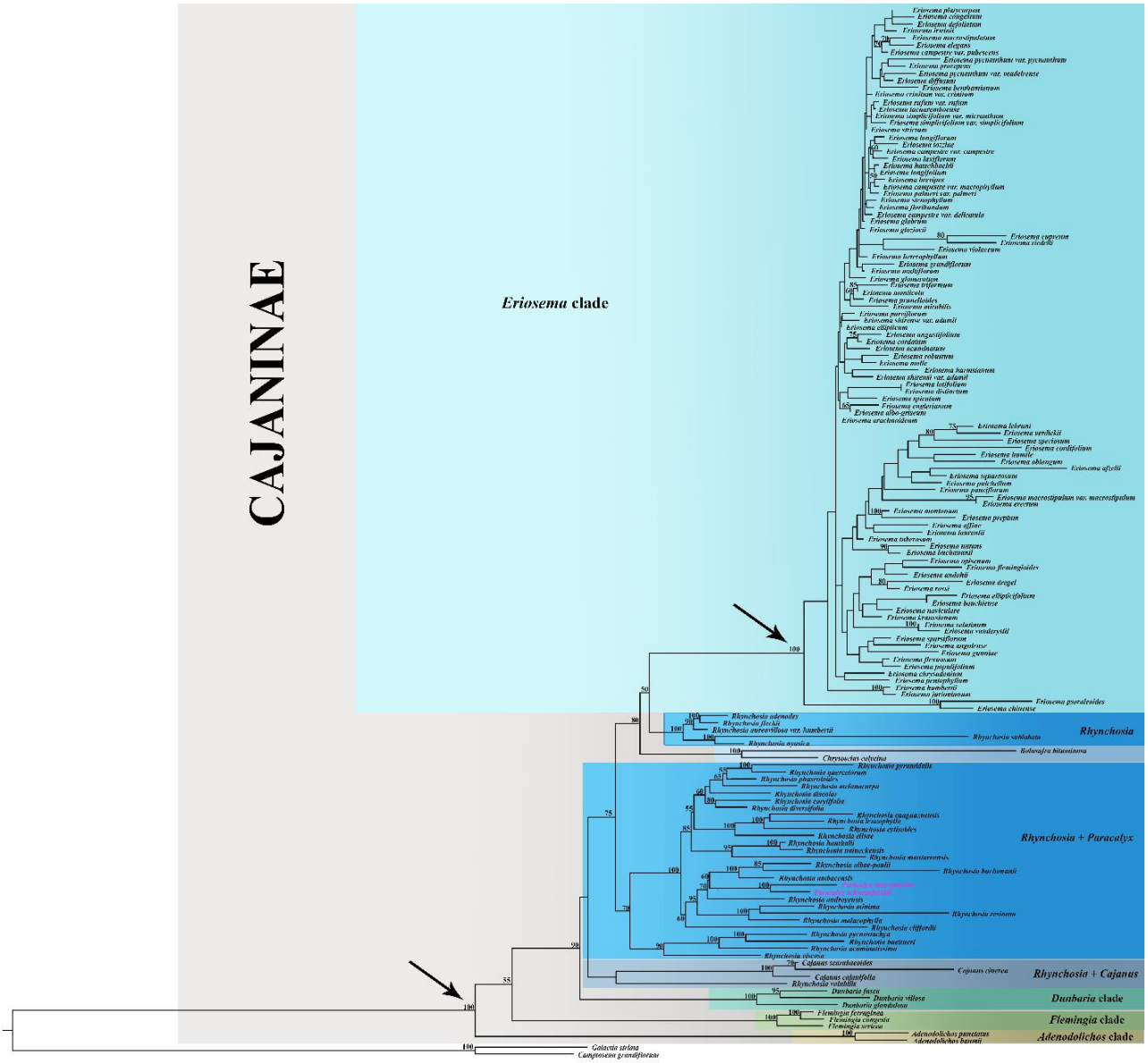

FIGURE 7. Phylogenetic tree of the genus *Eriosema* from Maximum Likelihood analysis of the ITS/5.8S and cpDNA dataset (rpl32-trnL and trnQ-5'rps16). Numbers along branches are bootstrap values.

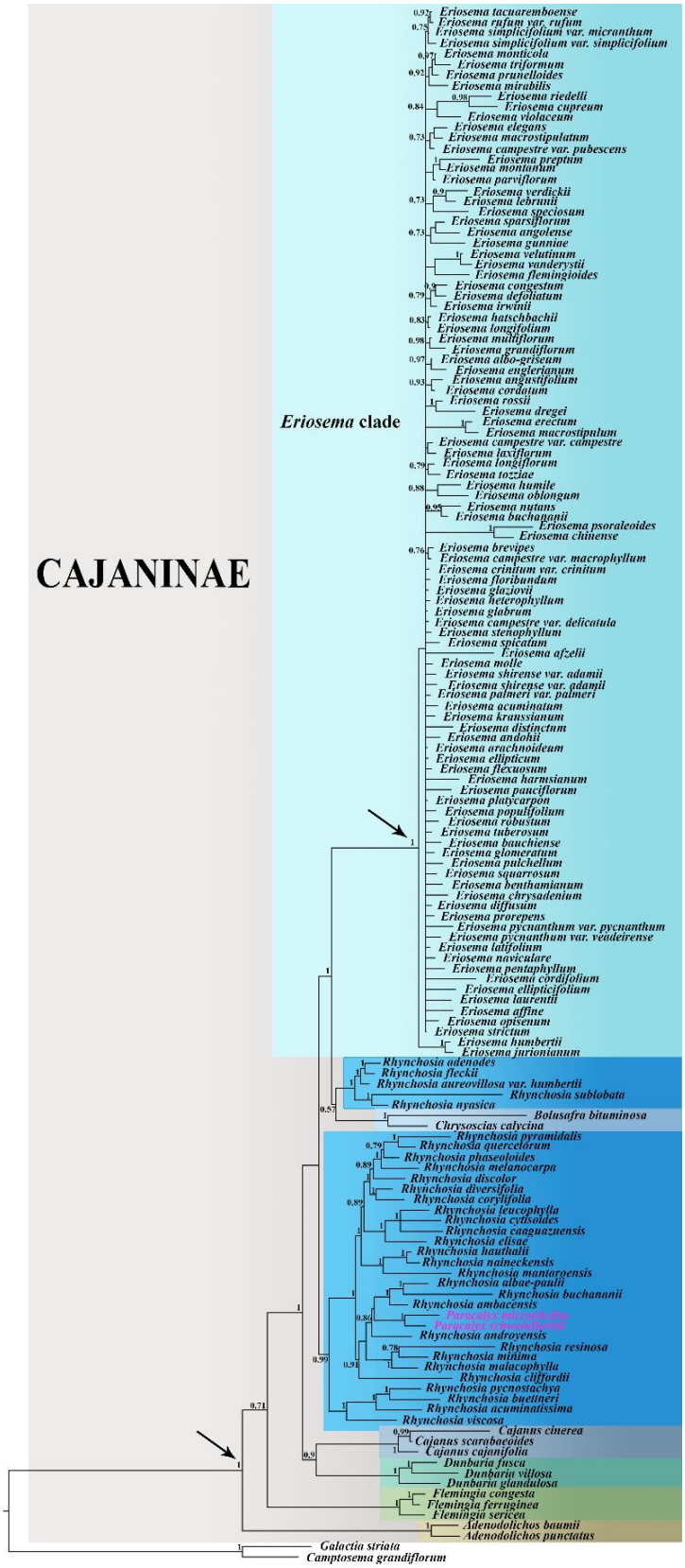

FIGURE 8. Phylogenetic tree of the genus *Eriosema* from Bayesian analysis of the ITS/5.8S and cpDNA dataset (rpl32-trnL and trnQ-5'rps16). Numbers along branches are posterior probabilities values.

CONSIDERAÇÕES FINAIS

Este trabalho inclui o mais completo e recente estudo taxonômico das espécies de *Eriosema* ocorrentes no Brasil, assim como a primeira e abrangente filogenia molecular do gênero. *Eriosema* é um gênero pantropical com 150 espécies e está incluído na subtribo Cajaninae da maior subfamília das leguminosas, Papilionoideae. As espécies ocorrem em ambientes savânicos tropicais, sendo 73% delas no continente africano.

Foram feitas visitas a diferentes herbários, coletas de material botânico em campo, consultas bibliográficas, além de uma otimização de protocolo para extração, amplificação e purificação do DNA de representantes principalmente herborizados de *Eriosema*, bem como do grupo externo.

Ao final deste estudo, foi possível concluir que no Brasil o gênero está representado por 39 táxons e 35 espécies, sendo o país mais rico em espécies de *Eriosema* nos Neotrópicos. Três novas espécies para a ciência foram descobertas e descritas e foram feitas 15 lectotipificações. A grande diversidade do gênero nos Neotrópicos se encontra nas savanas do Brasil Central, especificamente no estado de Goiás. Este ecossistema está relacionado com adaptações morfológicas encontradas no gênero, como por exemplo, os sistemas subterrâneos especializados e os diferentes tricomas encontrados nas espécies. Vale ressaltar que a conservação das espécies de *Eriosema* depende da conservação das diferentes fitofisionomias das savanas Neotropicais, ambiente que é considerado muito diverso e que ainda continua extremamente ameaçado.

Além disto, a filogenia molecular apontou *Eriosema* como monofilético em todas as análises, com um grupo africano de espécies de *Rhynchosia* como seu grupo irmão. Entretanto, não foi possível elucidar as relações infragenéricas. Estudos com diferentes marcadores são necessários para obter uma melhor resolução dentro do gênero, embora a baixa resolução

encontrada entre as espécies possa estar provavelmente relacionada à rápida diversificação do gênero nas savanas tropicais. *Rhynchosia*, o maior gênero de Cajaninae, aparece como polifilético. Estudos de datação molecular, anatômicos e morfológicos adicionais estão sendo realizados para melhor compreensão da sistemática de *Eriosema* e das relações entre os outros gêneros de Cajaninae, e assim propor uma nova classificação para a subtribo.

Finalmente, o gênero *Eriosema*, pela sua intrínseca relação de endemismo nas savanas tropicais, pode ser usado como um grupo modelo para estudos ecológicos, relacionados à biologia da polinização, conservação, biogeografia e evolução desse notável ecossistema.

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CHAPTER I

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ANEXO I

COORDENADORIA DE PÓS-GRADUAÇÃO
INSTITUTO DE BIOLOGIA
Universidade Estadual de Campinas
Caixa Postal 6109, 13083-970, Campinas, SP, Brasil
Fone (19) 3521-6378, email: cpgib@unicamp.br

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DECLARAÇÃO

Em observância ao **§5º do Artigo 1º da Informação CCPG-UNICAMP/001/15**, referente a Bioética e Biossegurança, declaro que o conteúdo de minha Tese de Doutorado, intitulada "***Systematics of Eriosema (Leguminosae: Papilionoideae, Phaseoleae): Taxonomic Synopsis of Eriosema in Brazil and Phylogeny***", desenvolvida no Programa de Pós-Graduação em Biologia Vegetal do Instituto de Biologia da Unicamp, não versa sobre pesquisa envolvendo seres humanos, animais ou temas afetos a Biossegurança.

Assinatura: _____
Nome do(a) aluno(a): Elisa Silva Cândido

Assinatura: _____
Nome do(a) orientador(a): Vidal de Freitas Mansano

Data: 13 de novembro de 2018.

ANEXO II

Declaração

As cópias de artigos de minha autoria ou de minha co-autoria, já publicados ou submetidos para publicação em revistas científicas ou anais de congressos sujeitos a arbitragem, que constam da minha Dissertação/Tese de Mestrado/Doutorado, intitulada **Systematics of Eriosema (Leguminosae: Papilionoideae, Phaseoleae): Taxonomic Synopsis of Eriosema in Brazil and Phylogeny**, não infringem os dispositivos da Lei n.° 9.610/98, nem o direito autoral de qualquer editora.

Campinas, 13 de novembro de 2018.

Assinatura : Elisa Silva Cândido
Nome do(a) autor(a): **Elisa Silva Cândido**
RG n.° 14351396

Assinatura :
Nome do(a) orientador(a): **Vidal de Freitas Mansano**
RG n.° 19630609