



Acta botánica mexicana

ISSN: 0187-7151

ISSN: 2448-7589

Instituto de Ecología A.C., Centro Regional del Bajío

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Acta botánica mexicana, no. 122, 2018, pp. 157-163

Instituto de Ecología A.C., Centro Regional del Bajío

DOI: <https://doi.org/10.21829/abm122.2018.1225>

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The identity of *Senegalia saltilloensis* (Fabaceae)

La identidad de *Senegalia saltilloensis* (Fabaceae)

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Cite as:

Villarreal-Quintanilla, J. A., J. A. Encina-Domínguez and E. Estrada-Castillón. 2018. The identity of *Senegalia saltilloensis* (Fabaceae). Acta Botanica Mexicana 122: 157-163. DOI: <http://dx.doi.org/10.21829/abm122.2018.1225>

Received: March 30, 2017.

Reviewed: May 3, 2017.

Accepted: September 27, 2017.

First online: October 4, 2017.

Published: January 1st 2018.

DOI:

<http://dx.doi.org/10.21829/abm122.2018.1225>

ABSTRACT:

Background and Aims: The mimosoid genera *Senegalia* and *Acacia* are closely related. *Acacia sensu lato* is a polyphyletic group that can be split in the following genera: *Vachellia*, *Senegalia*, *Acaciella* and *Mariosousa*, remaining as *Acacia (sensu stricto)* only the “Australian species” and some others from the Pacific Islands. The American species of *Senegalia* and the new genus *Mariosousa* include the elements of *Acacia* subgenus *Aculeiferum*. We agree with this criterion. *Senegalia saltilloensis* was described by Britton & Rose in 1928, followed by synonymization with *S. roemeriana*, and was later re-evaluated as a valid species, creating a new nomenclatural combination in the genus *Acacia*. The aim of this study was to know the identity of the poorly known plants named as *Senegalia saltilloensis*. **Methods:** A morphometric analysis was carried out. A total of 70 specimens were examined and 21 characters were evaluated to find the similarity between *Senegalia saltilloensis* and *Senegalia roemeriana*.

Key results: The results show no significant morphological difference between the two entities.

Conclusions: The name *Senegalia saltilloensis* should be maintained as synonym of the well-known name of *Senegalia roemeriana*.

Key words: *Acacia roemeriana*, Mimosoideae, morphometric analysis, multivariate analysis.

RESUMEN:

Antecedentes y Objetivos: *Senegalia* y *Acacia* son dos géneros de mimosoideas estrechamente relacionados. *Acacia sensu lato* es un grupo polifilético que puede ser dividido en los siguientes géneros: *Vachellia*, *Senegalia*, *Acaciella* y *Mariosousa*, quedando sólo como *Acacia (sensu stricto)* “las especies australianas” y algunas de las Islas del Pacífico. Las especies americanas de *Senegalia* y las del nuevo género *Mariosousa* incluyen elementos de *Acacia* subgénero *Aculeiferum* y otras combinaciones nuevas. Estamos de acuerdo con este criterio. *Senegalia saltilloensis* fue descrita por Britton & Rose en 1928, luego incluida en la sinonimia de *S. roemeriana* y más tarde considerada como especie válida, creándose una combinación nomenclatural nueva para el género *Acacia*. El objetivo de este estudio fue conocer la identidad de las plantas con el nombre poco conocido de *Senegalia saltilloensis*.

Métodos: Se llevó a cabo un análisis morfométrico de 70 especímenes, con la evaluación de 21 caracteres para encontrar la similitud entre *Senegalia saltilloensis* y *Senegalia roemeriana*.

Resultados clave: Los resultados no muestran diferencias morfológicas significativas entre las dos entidades.

Conclusiones: El nombre *Senegalia saltilloensis* debe mantenerse como parte de la sinonimia del nombre bien conocido de *Senegalia roemeriana*.

Palabras clave: *Acacia roemeriana*, análisis morfométrico, análisis multivariado, Mimosoideae.

INTRODUCTION

A revision of the Coahuila's flora checklist led us to re-evaluate some names in the family Fabaceae. *Senegalia* Raf. is a genus of mimosoids (LPWG, 2017) closely related to *Acacia* Mill. It was described in 1838 by C.S. Rafinesque, as a segregation of *Acacia* “with legumes short stipitate, elliptic, membranaceous, compressed, with 2-3 seeds”

(Rafinesque, 1838). Standley (1922), in the treatment of the Trees and shrubs of Mexico, did not include *Senegalia*. The genus was recognized by Britton & Rose (1928) among others; later Seigler et al. (2006b), transferred some of the species of *Acacia* subgenus *Aculeiferum* Vassal to *Senegalia*, but Rico-Arce (2007) included all in *Acacia*.

The genus *Acacia sensu lato* is considered polyphyletic (Pedley, 1986; Maslin et al., 2003; Seigler et al., (2006a) as supported by molecular studies (Miller and Bayer, 2001; Luckow et al., 2003), including a series of subgroups. According to Maslin et al. (2003), there is a strong evidence suggesting that *Acacia* should be divided in the genera *Vachellia* Wight & Arn., *Senegalia*, *Aca-ciella* Britton & Rose, *Acacia* and *Mariosousa* Seigler & Ebinger, considering that the latter is a polyphyletic group of species (Gómez-Acevedo et al., 2010; 2015). According to this classification, *Acacia sensu stricto* is restricted to the “Australian group of species” (Maslin, 2008) and some others in the Pacific Islands (Pedley, 1978). In America, *Senegalia* includes most of the species of *Acacia* subgenus *Aculeiferum* and some other new nomenclatural combinations for the genus (Seigler et al., 2006b; Glass and Seigler, 2006). Some other species of the subgenus are included in the new genus *Mariosousa* (Seigler et al., 2006a). Currently, we are accepting this segregation.

The plants named as *Senegalia* are distinguished by having prickles and no stipular spines, petioles with glands and absence of phyllodes, pedicellate ovaries with glands at the base, and porate pollen grains (Seigler et al., (2006b) *Senegalia saltilloensis* was described by Britton & Rose (1928) selecting as the type *E. Palmer 169*, from near Saltillo, Coahuila. A Latin diagnosis is not included, neither a “holotype” was designated, and four to five duplicates are currently annotated as isotypes at A, BM, MO, NY, and US. The US herbarium sample has the annotation as holotype made by C. Glass (2003). The NY duplicate has confusing annotations, as an isotype by C. E. Glass in 2003 and as holotype by D. S. Seigler & J. E. Ebinger in 2013. Glass & Seigler (2006) designated this duplicate also as lectotype, which seems more appropriate. These annotations as different “types” is probably due to the fact that

N.L. Britton at NY and J.N. Rose at US published frequently in collaboration (Rzedowski et al., 2009), making it difficult to know which sample is the original “type”.

While many of the species names in *Senegalia* given by Britton & Rose were reduced to synonymy (Seigler et al., 2006b), *S. saltilloensis* was included under *S. roemeriana*. Besides the type material, no other herbarium specimen was found with the name *Senegalia saltilloensis*. The name remained in *Senegalia* for almost 80 years. Then, Seigler et al. (2006b) included it as a synonym of *S. roemeriana* (Scheele) Britton & Rose (1928), but Rico-Arce (2007) considered that *S. saltilloensis* is a different species from *S. roemeriana* and transferred it to *Acacia*, publishing it as a new nomenclatural combination. Tropicos.org from the Missouri Botanical Garden (TROPICOS, 2016) and The Plant List from the Royal Botanical Gardens at Kew (The Plant List, 2016) follow this nomenclature and consider it as a name in current use. To establish the identity of the species, several collections near Saltillo were made. As the type locality of *Senegalia saltilloensis* is not clearly defined, we followed the localities visited by another collector of those times, C.G. Pringle, who used to travel by train around Mexico. From Saltillo he moved southwards into the mountains (Davis, 1936), so we assume that the lower slopes of the Sierra de Zapalinamé are the most probable places where the specimens of *S. saltilloensis* could be found. A detailed observation of its morphology took us to the well-known *Senegalia roemeriana* (Scheele) Britton & Rose (1928), with a wide distribution and morphological variation. On this basis, we decided to compare both species.

MATERIALS AND METHODS

A total of 62 samples of *Senegalia roemeriana* from the herbaria ANSM, ASU, CFNL, DES, ENCB, HIN, MEXU, and USU were examined (Thiers, continuously updated) (Table 1). These collections are a good representation of this species. In addition, eight samples from the Saltillo area, including the annotated “type” material of *Senegalia saltilloensis* were included (ANSM, NY, US). The revision of the herbarium specimens had the purpose

**Table 1:** List of specimens examined for the similarity analysis.

Specimen	Species	Collector	Number collection	Collection date	Locality	State	Herbarium
1	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	E. Estrada	20881	5.VII.2011	Bustamante	N.L.	CFNL
2	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	E. Estrada	21856	13.V.2012	Iturbide	N.L.	CFNL
3	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	M. González	3969	3.IX.2006	Sierra Mojada	Coah.	CFNL
4	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	E. Estrada	12745	14.VI.2001	Santa Catarina	N.L.	CFNL
5	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	E. Estrada	12172	14.IV.2011	Bustamante	N.L.	CFNL
6	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	E. Estrada	12917	6.VII.2001	Villaldama	N.L.	CFNL
7	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	E. Estrada	2078	31.VI.1991	Castaños	Coah.	ANSM, CFNL
8	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	E. Estrada	12196	15.IV.2001	Villaldama	N.L.	CFNL
9	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	E. Estrada	6915	4.V.1997	Aldama	Chih.	CFNL
10	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	E. Estrada	7515	25.VII.1997	Manuel Benavides	Chih.	ANSM, CFNL
11	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	T. Caldera	s.n.	4.VII.1975	Galeana	N.L.	CFNL
12	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	E. Estrada	11676	26.VII.2000	Lampazos	N.L.	CFNL
13	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	E. Estrada	607	6.VIII.1985	Linares	N.L.	CFNL, MEXU
14	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	N. Reid	s.n.	13.V.2012	Linares	N.L.	CFNL
15	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	B. Treviño	530	5.IX.1985	Linares	N.L.	CFNL
16	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	E. Estrada	1575	5.VII.1989	Iturbide	N.L.	ANSM, CFNL
17	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	J. A. Villarreal	5577	10.III.1990	Ramos Arizpe	Coah.	ANSM
18	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	J. S. Marroquín	3689	8.IV.1978	Ramos Arizpe	Coah.	ANSM
19	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	M. A. Carranza	974	12.X.1991	Ocampo	Coah.	ANSM
20	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	M. A. Carranza	1111	11.IX.1991	Ocampo	Coah.	ANSM
21	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	E. Estrada	637	27.VIII.1986	Linares	N.L.	ANSM, MEXU
22	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	E. Estrada	1121	25.VI.1987	Santiago	N.L.	ANSM
23	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	A. Rodríguez	s.n.	12.V.1989	Ramos Arizpe	Coah.	ANSM
24	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	J. Wehbe	23	19.IV.1986	Múzquiz	Coah.	ANSM
25	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	A. Rodríguez	911	8.VI.1987	Ocampo	Coah.	ANSM
26	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	M. A. Carranza	1310	26.III.1992	Múzquiz	Coah.	ANSM
27	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	O. Mares	760	17.X.2005	Guadalcázar	S.L.P.	ANSM
28	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	A. García	2621	6.VII.1997	Jiménez	Chih.	ANSM
29	<i>Senegalia saltilloensis</i> Britton & Rose	J. A. Encina	4497	19.IV.2015	Saltillo	Coah.	ANSM
30	<i>Senegalia saltilloensis</i> Britton & Rose	J. A. Encina	4575	30.III.2015	Saltillo	Coah.	ANSM
31	<i>Senegalia saltilloensis</i> Britton & Rose	J. A. Encina	5465	09.VI.2016	Saltillo	Coah.	ANSM
32	<i>Senegalia saltilloensis</i> Britton & Rose	E. Palmer	169	1.V.1898	Saltillo	Coah.	NY
33	<i>Senegalia saltilloensis</i> Britton & Rose	E. Palmer	169	1.V.1898	Saltillo	Coah.	US

Table 1: Continuation.

Specimen	Species	Collector	Number collection	Collection date	Locality	State	Herbarium
34	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	J. A. Encina	5131	27.III.2015	Múzquiz	Coah.	ANSM
35	<i>Senegalia saltilloensis</i> Britton & Rose	J. A. Encina	4932	21.VII.2015	Saltillo	Coah.	ANSM
36	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	S. I. Vielma	s.n.	3.III.1979	Ocampo	Coah.	ANSM
37	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	J. A. Villarreal	3223	25.X.85	Nadadores	Coah.	ANSM
38	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	A. Rodríguez	272 ^a	11.VI.1981	Parras	Coah.	ANSM
39	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	M. A. Carranza	342	27.III.1992	Ocampo	Coah.	ANSM
40	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	G. B. Hinton	24178	19.V.1994	Linares	N.L.	ANSM
41	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	M. A. Carranza	2095	20.VIII.1994	Ocampo	Coah.	ANSM
42	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	G. B. Hinton	24179	19.V.1994	Linares	N.L.	ANSM
43	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	S. L. Hatch	5405	22.IV.1988	San Angelo	Tex.	ANSM
44	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	O. L. Briones	1459	6.XII.1984	San Miguel	Tamps.	ANSM, ENCB
45	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	E. Estrada	1519	15.VI.1989	Iturbide	N.L.	ANSM
46	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	J. S. Marroquín	3689	8.IV.1979	Ramos Arizpe	Coah.	ANSM
47	<i>Senegalia saltilloensis</i> Britton & Rose	J. A. Encina	4575	30.IV.2015	Saltillo	Coah.	ANSM
48	<i>Senegalia saltilloensis</i> Britton & Rose	J. A. Encina	4497	19.IV.2015	Saltillo	Coah.	ANSM, MEXU
49	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	A. Rodríguez	1081	31.III.1989	Múzquiz	Coah.	ANSM
50	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	G. B. Hinton	21230	21.IV.1991	Iturbide	N.L.	HIN
51	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	G. B. Hinton	21474	13.IX.1991	Iturbide	N.L.	HIN
52	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	G. B. Hinton	22170	24.VII.1972	Galeana	N.L.	HIN
53	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	S. Walker	s.n.	29.IV.1976	Val Verde	Tex.	USU
54	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	D. J. Pinkava	5468	12.VI.1968	Cuatro Ciénegas	Coah.	ASU
55	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	W. Hodgson	9049	8.IV.1995	Brewster	Tex.	DES
56	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	J. Orozco	10154	2.III.1993	Tolimán	Qro.	ENCB
57	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	J. Orozco	10171	2.III.1993	Tolimán	Qro.	ENCB
58	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	E. Ramírez	263	16.III.1980	Monterrey	N.L.	ENCB
59	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	J. Orozco	10727	23.VIII.1994	Cadereyta	Qro.	ENCB
60	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	G. Borja	227	05.IV.1961	Sierra Mojada	Coah.	ENCB
61	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	R. Grether	636	22.IV.1977	Monclova	Coah.	MEXU
62	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	T. Wendt	1423	05.IV.1974	Acuña	Coah.	MEXU
63	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	M. Carranza	976	12.X.1991	Ocampo	Coah.	MEXU
64	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	M. Carranza	2141	21.VIII.1994	Ocampo	Coah.	MEXU
65	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	J. Henrickson	15210	8.VIII.1976	Ocampo	Coah.	MEXU
66	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	J. Henrickson	23102	15.X.2002	Ocampo	Coah.	MEXU
67	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	A. Uzzell	29	22.VI.1941	Hidalgo	Tex.	ENCB



Table 1: Continuation.

Specimen	Species	Collector	Number collection	Collection date	Locality	State	Herbarium
68	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	E. Juárez	s.n.	2.X.1976	Jiménez	Chih.	ENCB
69	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	A. Yen	13352.	23.III.2002	Santiago	N.L.	MEXU
70	<i>Senegalia roemeriana</i> (Scheele) Britton & Rose	J. Henrickson	16202	16.V.1977	Monclova	Coah.	MEXU

of comparing and analyzing the morphological variation of the two related taxa. A series of selected characters that can be evaluated from herbarium samples were taken from each specimen.

A total of 70 samples were evaluated as representative of the morphological diversity of both species and *Senegalia saltilloensis* and *S. roemeriana* were considered as OTUs (Operational Taxonomic Units). A number of 21 characters were selected as elements of informative value (Table 2). A stereomicroscope Labomed model CSM2 (U.S.A.) and a vernier Mitutoyo series 1505 (Japan) were used to observe details and take measurements. The data were analyzed by the Detrended Correspondence Analysis (DCA), using the CANOCO version 4.5 software (ter-Braak and Šmilauer, 2002).

RESULTS AND DISCUSSION

We graphically presented axis I (eigenvalue of 0.085 and a cumulative percentage of variance of 29.2%) and axis II (eigenvalue of 0.051 and a cumulative percentage of variance of 46.6%) of the DCA. The ordination diagram shows that the specimens analyzed are positively correlated with axis I (Figure 1), most samples of *Senegalia saltilloensis* and *S. roemeriana* are mixed and placed close to the center of the ordination diagram. The group located at the extreme of both axes indicates morphological variation proper of the species. Some of the numbers at the upper right (19, 49, 59, 47, 48, 39, 46) are specimens without fruits and the ones on the right (68, 57, 38, 25, 43, 41, 16, 33) have no flowers.

Additionally, Figure 1 shows all the elements grouping in one aggregate, including the samples from

the Saltillo area. The detailed examination of the lectotype (sample 32) and isolectotype (33), as well as the original description of *Senegalia saltilloensis* led us to consider the presence of prickles on the stem and the

Table 2: Characters used in the Detrended Correspondence Analysis (DCA).

1	Stem pubescence: 0=glabrous to slightly pubescent, 1=densely pubescent.
2	Stem: 0=no prickly, 1=prickly.
3	Petiole length.
4	Leaf pubescence: 0=absent, 1=present.
5	Leaf rachis: 0=no prickly, 1=prickly.
6	Number of pinnae.
7	Number of leaflets per pinna.
8	Leaflet shape: 0=elliptic, 1=oblong.
9	Leaflet length.
10	Leaflet width.
11	Leaflet midrib: 0=centric, 1=excentric.
12	Number of capitula per raceme: 0=1, 1=2 or more.
13	Flower pubescence: 0=absent, 1=present.
14	Flower length.
15	Peduncle length.
16	Legume shape: 0=straight, 1=curved.
17	Legume length.
18	Legume width.
19	Legume base: 0=rounded, 1=cuneate.
20	Legume pubescence: 0=absent, 1=present.
21	Altitude: 0=300-1000 m, 1=1001-1800 m.

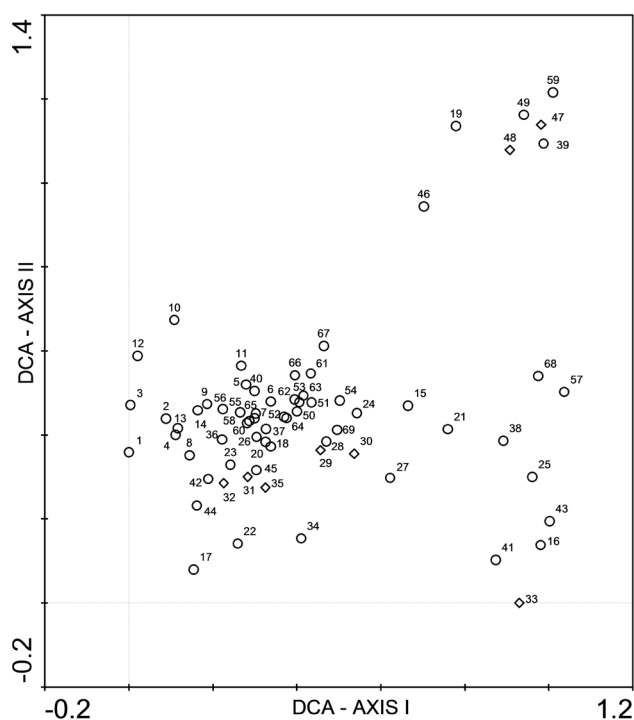


Figure 1: DCA showing the grouping results of *Senegalia roemeriana* (Scheele) Britton & Rose (black circle) and *Senegalia saltilloensis* Britton & Rose (blue diamond), following a similarity analysis.

fruit slightly curved, flat and with the cuneate base as the key characters to separate this taxon from *S. roemeriana*. The revision of the herbarium specimens of *S. roemeriana* showed that the abovementioned characters are part of the morphoplasticity of the species. The plants range from having branches armed with sparse very small fine prickles to abundant stronger prickles. Additionally, the leaf rachis can also be prickly, the leaflets glabrous to pubescent, the legume 2-4 cm wide, glabrous to puberulent, with the base cuneate to rounded.

CONCLUSIONS

The results support the synonymy published by Seigler et al. (2006b), considering the names *Senegalia saltilloensis* and the combination *Acacia saltilloensis* published by Rico-Arce (2007) as synonyms of the previous name *Senegalia roemeriana*.

As a consequence, the nomenclature of the species should be:

Senegalia roemeriana (Scheele) Britton & Rose, N. Amer. Fl. 23(2): 115. 1928 \equiv *Acacia roemeriana* Scheele, Linnaea 21(4): 456. 1848. TYPE: UNITED STATES OF AMERICA. Texas, western Texas, Austin, Römer s.n. (holotype: B, probably destroyed).

\equiv *Senegalia saltilloensis* Britton & Rose, N. Amer. Fl. 23(2): 115. 1928. TYPE: MEXICO. Coahuila, near Saltillo, E. Palmer 169 (lectotype: NY, designated by Glass & Seigler (2006); isolectotypes: BM, MO, US) \equiv *Acacia saltilloensis* (Britton & Rose) L. Rico, Amer. Sp. *Acacia* 166. 2007.

AUTHORS CONTRIBUTIONS

JAVQ y EEC designed the study. JAV y JAED made the analysis. All the authors contributed to the revision and discussion of the manuscript.

FINANCIAL SUPPORT

The study was supported by the Universidad Autónoma Agraria Antonio Narro (project 40012100/Plantas endémicas y raras de Coahuila).

ACKNOWLEDGEMENTS

To the reviewers and the editor for improving the manuscript presentation.

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