



New records of *Digitaria filiformis* var. *laevigulumis* (Paniceae, Panicoideae, Poaceae) for the Flora del Bajío and Durango, Mexico

Nuevos registros de *Digitaria filiformis* var. *laevigulumis* (Paniceae, Panicoideae, Poaceae) para la Flora del Bajío y Durango, México

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Abstract:

Background and Aims: Since its publication in 1920, *Digitaria filiformis* var. *laevigulumis* had been considered as an endangered taxon endemic to New Hampshire, USA. However, a recent inventory of the grasses of Mexico showed that it also occurs outside its type locality. New findings for the ongoing project Flora del Bajío have yielded additional new records. The objective of this work is to report this taxon from the Mexican states of Michoacán and Durango, increasing the number of known localities of *Digitaria filiformis* var. *laevigulumis*.

Methods: Online databases and herbaria were reviewed. Botanical herbarium specimens were collected in the state of Michoacán.

Key results: *Digitaria filiformis* var. *laevigulumis* is reported as new for the Flora del Bajío in the state of Michoacán, as well as from a herbarium specimen from Durango which has both var. *laevigulumis* and var. *filiformis* mounted on the same sheet and that was misplaced among other specimens.

Conclusions: With the addition of this variety, the number of taxa in the subfamily Panicoideae increases for the Flora del Bajío and the state Durango. With these findings there are more intermediate localities between the northern and southern range for this variety.

Key words: distribution, floristics, grasses, second glume glabrous, sterile lemma glabrous.

Resumen:

Antecedentes y objetivos: Desde su publicación en 1920, *Digitaria filiformis* var. *laevigulumis* fue considerado como un taxon endémico y en peligro en Nueva Hampshire, EUA. Sin embargo, un reciente inventario de las gramíneas de México mostró que también ocurre fuera de su localidad tipo. Nuevos hallazgos dentro del proyecto Flora del Bajío representan nuevas adiciones. El objetivo de este trabajo es reportar registros nuevos recientemente encontrados de Michoacán y Durango, incrementando el número de localidades de *D. filiformis* var. *laevigulumis*.

Métodos: Se revisaron bases de datos en línea y herbarios. Se colectaron especímenes botánicos en el estado de Michoacán.

Resultados clave: Se reporta *Digitaria filiformis* var. *laevigulumis* como nuevo para la Flora del Bajío en Michoacán, además de un ejemplar de Durango que tiene ambas variedades *laevigulumis* y *filiformis* montadas en el mismo ejemplar y que estaba mal colocado entre otros especímenes.

Conclusiones: Con la adición de esta variedad el número de taxa de la subfamilia Panicoideae se incrementa para la Flora del Bajío y el estado de Durango. Con estos hallazgos aumentan el número de localidades intermedias entre el intervalo norte y sur de esta variedad.

Palabras clave: distribución, florística, gramíneas, lema estéril glabra, segunda gluma glabra.

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Introduction

The genus *Digitaria* Haller belongs to the family Poaceae, subfamily Panicoideae, tribe Paniceae, and subtribe Antherorinae. It is the second largest in the Paniceae with 230 to 271 species distributed worldwide (Clayton et al., 2006 onwards; Vega et al., 2009; Sánchez-Ken, 2012, 2018(2019); Soreng et al., 2017). There are 33 species in Mexico, with ten of them reported as weeds (Sánchez-Ken, 2017). *Digitaria filiformis* (L.) Koeler is found throughout Mexico, and two varieties are recognized here, var. *filiformis* and var. *laevigulumis* (Fernald) Wipff. Two other varieties, var. *dolichophylla* (Henrard) Wipff, and var. *villosa* (Walter) Fernald are recognized for the United States of America, although, according to Wipff (2003), the latter might be a synonym of the typical variety.

When *Digitaria laevigulumis* Fernald was published (Fernald, 1920), it was distinguished from *D. filiformis* by its “translucent hyaline glume, and truncate erose-dentate ligule” and considered to be related to two perennial species from Florida. Fernald (1920) also considered the taxon as a part of the distinctive flora of New Hampshire in the New England region. Later, Wipff (1996) reduced the species to a variety of *D. filiformis*, stating that the only differences between the typical variety and *D. laevigulumis* were the glabrous second glume and sterile lemma. This taxon has long been considered as endemic to sandy soils in New Hampshire (Fernald 1920; Wipff, 1996, 2003). More recently, other authors tried to relocate the “rare” variety in in the type locality, but without success (Nichols and Hoy, 2014). Smith (2017) and the Natural Heritage Bureau (NHB, 2018) cited the variety in the list of rare, endangered and threatened grasses of the conterminous United States of America.

Evidently, the last three authors did not acknowledge the two papers mentioning *D. filiformis* var. *laevigulumis*. First, it was mentioned by Vega and Rúgolo de Agrasar (2005) who identified the variety based on the glabrescent spikelets present in Venezuela. Later, Sánchez-Ken (2012, 2018(2019)), in a synopsis of the genus *Digitaria* and the family Poaceae in Mexico, mentioned the presence of the broadly distributed typical variety in 14 states of Mexico and the presence of var. *laevigulumis* in the state of Oaxaca.

As part of the ongoing taxonomic treatment of the subfamily Panicoideae for the Flora del Bajío y de regiones

adyacentes, several new collections of this group were made in Michoacán and a misplaced herbarium specimen from Durango, that has both varieties *laevigulumis* and *filiformis* mounted on the same sheet, was found. The objective of this paper is to report new records of *D. filiformis* var. *laevigulumis* for the states of Michoacán and Durango, increasing the number of intermediate localities between the northern and southern range of this variety.

Material and Methods

National and foreign online databases were reviewed, as well as the herbaria IEB and MEXU. Fieldwork was carried out to collect botanical specimens in the state of Michoacán. The specimen of *D. filiformis* var. *laevigulumis* from Michoacán (Sánchez-Ken et al. 935 (IEB)) was scanned using the Herbscan equipment (Machine 127, London, UK). The synflorescence and spikelets of this specimen and that from Durango were photographed in close-up with the aid of a stereoscope Carl Zeiss (Stemi 2000, New York, USA), a mobile phone by Apple (iPhone 6, California, USA), and mobile camera lenses (Knguvth, China). All specimens but the one collected in Michoacán were georeferenced using Google Earth (2019).

Results

A plant from a herbarium specimen from Durango that has two taxa mounted on the same sheet and that was misplaced, as well as new collections from Michoacán, were identified as *Digitaria filiformis* var. *laevigulumis*, of which an amended description is presented here.

***Digitaria filiformis* (L.) Koeler var. *laevigulumis* (Fernald) Wipff, Phytologia 80(5): 348. 1996. Fig. 1.**

≡ *Digitaria laevigulumis* Fernald, Rhodora 22(258): 102. 1920. TYPE: UNITED STATES OF AMERICA. New Hampshire, Manchester, 11.IX.1901, F. W. Batchelder s.n. (holotype: GH00023526!, isotype: GH00106486!).

Plants annual, cespitose, 7-25(-70) cm tall, branching at the base, erect or slightly decumbent, nodes yellowish to brownish, glabrous; internodes glabrous; lower sheaths purplish and longer than the internodes, upper



Figure 1: Specimen of *Digitaria filiformis* (L.) Koeler var. *laevigulmis* (Fernald) Wipff from the state of Michoacán, Mexico.

sheaths shorter, the lower ones usually hirtellous, rarely glabrous, the upper ones becoming glabrous, margins membranous, pilose, upper sheaths only distally shortly pilose; ligules 0.5-1.5 mm long, membranous, apex erose, glabrous; blades 1-3(-9) cm long, 1.9-3.5(-6) mm wide, linear lanceolate, glabrous on both surfaces, base rounded, sometimes with a few long hairs on the sides, margins scabrellous; synflorescence 1-3(-4) racemose branches, peduncle trichetrous, glabrous, base of branches hirtellous; racemes 1.5-4(-9) cm long, when 3 on a common axis, the two uppermost digitate, the third one inserted below 0.5-0.8 cm on the axis, axis trichetrous, scabrellous; pedicels 0.3-3 mm long, trichetrous, scabrous, prickles becoming larger towards apex, apex cupuliform; spikelets in triads becoming paired toward apex of the racemes, homomorphic, 1.6-1.9(-2) mm long, 0.7-0.8 mm wide, elliptic; first glume absent; second glume 1.2-1.3 mm long, nearly 2/3 as long as the fertile lemma, glabrous, rarely very few capitate hairs on margins on upper half, 3-veined, lateral veins joining central one below the tip, margins membranous, glabrous; lower floret sterile, 0.1-0.2 mm shorter than the fertile lemma; sterile lemma 7-veined, veins equally spaced, joined at the apex, glabrous; sterile palea ca. 0.2 mm long, papillose; upper floret perfect; fertile lemma 1.6-1.9 mm long, punctulate-striate, dark brown at maturity, apiculate, with a tiny rounded callus, apex pale, margins overlapping fertile palea; stamens 3, anthers ca. 0.3 mm long, purple; caryopsis about half as long as the fertile lemma, embryo about 1/3 as long as the caryopsis, hilum punctiform.

Habitat: this taxon grows on gravel and sandy soils among other grasses. The surrounding vegetation is a disturbed pine-oak or oak forest. Elevation between 80-2013 m.

Phenology: flowering and fruiting between August and October.

Distribution: *Digitaria filiformis* var. *laeviglumis* has been collected in the northeast of the United States of America, western and southern Mexico, and northern Venezuela (Fig. 2).

Additional specimens examined: MEXICO. Durango, municipality Canatlán, Agua Blanca, 11 km al N de Benjamín Aranda, 2025 m, 24°29'06"N, 104°29'06"W, 25.IX.1983, *Y. Herrera 303* (IEB, mixed with the typical variety). Michoacán, municipality Tzintzuntzan, cerros pasando las pirámides de Ihuatzio, 2103 m, 19°34'47"N, 101°37'02"W, 04.X.2018, *J. G. Sánchez-Ken et al. 935* (IEB, MEXU). Oaxaca, district Tlacolula, municipality San Pedro Totolapa, about 66 mi NW of Tehuantepec, 1430 m, 19°32'23"N, 95°56'45"W, 29.VIII.1953, *J. R. Reeder and C. G. Reeder 2171* (MEXU, mixed with the typical variety). UNITED STATES OF AMERICA. New Hampshire, Hillsboro Co. Rock Rimmon, West Manchester, 80 m, 43°00'16"N, 71°28'49"W, 27.VIII.1931, *M. L. Fernald and L. Griscom 516* (GH00354531, NEBC00354529, NO0028299, PBRU00013069). VENEZUELA. Aragua, municipality Tovar, Placib(v)el, vía Colonia Tovar por La Victoria, sector Loma Briza, 1350 m, 10°20'N, 67°19'W, 17.IX.2003, *O. Morrone et al. 4666* (SI). Distrito Capital, municipality Bolivariano Libertador, Los Castillitos, 1423 m, 10°32'N, 66°57'W, 27.IX.1958, *Wiszniewski s.n.* (VEN304281).

Discussion

It is evident that the three varieties of *Digitaria filiformis* are very similar, although several vegetative and reproductive characters help to separate them effectively (Table 1). The two most similar varieties are the typical and var. *laeviglumis* as can be seen in Figure 3, being the only difference the lack of pubescence on the second glume and sterile lemma.

Digitaria filiformis var. *laeviglumis* was considered a rare taxon since its publication, and it seemed that it was rarely collected again (Fernald, 1920; Wipff, 1996, 2003). In the past four years, the taxon was enlisted as rare and endangered or threatened (Nichols and Hoy, 2014; Smith, 2017; NHB, 2018). These authors never saw it cited from Mexico and Venezuela in other papers (Vega and Rúgolo de Agrasar, 2005; Sánchez-Ken, 2012, 2018(2019)). The variety has a much broader distribution than assumed, resulting in a disjunct pattern (Fig. 2). It is obvious that more collecting is needed, and it is necessary to verify in the field whether this variety is also found in the same distribution range of the typical variety. Given that both the typical variety and var. *laeviglumis* are present in the same areas as shown by some mixed-up specimens, the latter seems to be absent

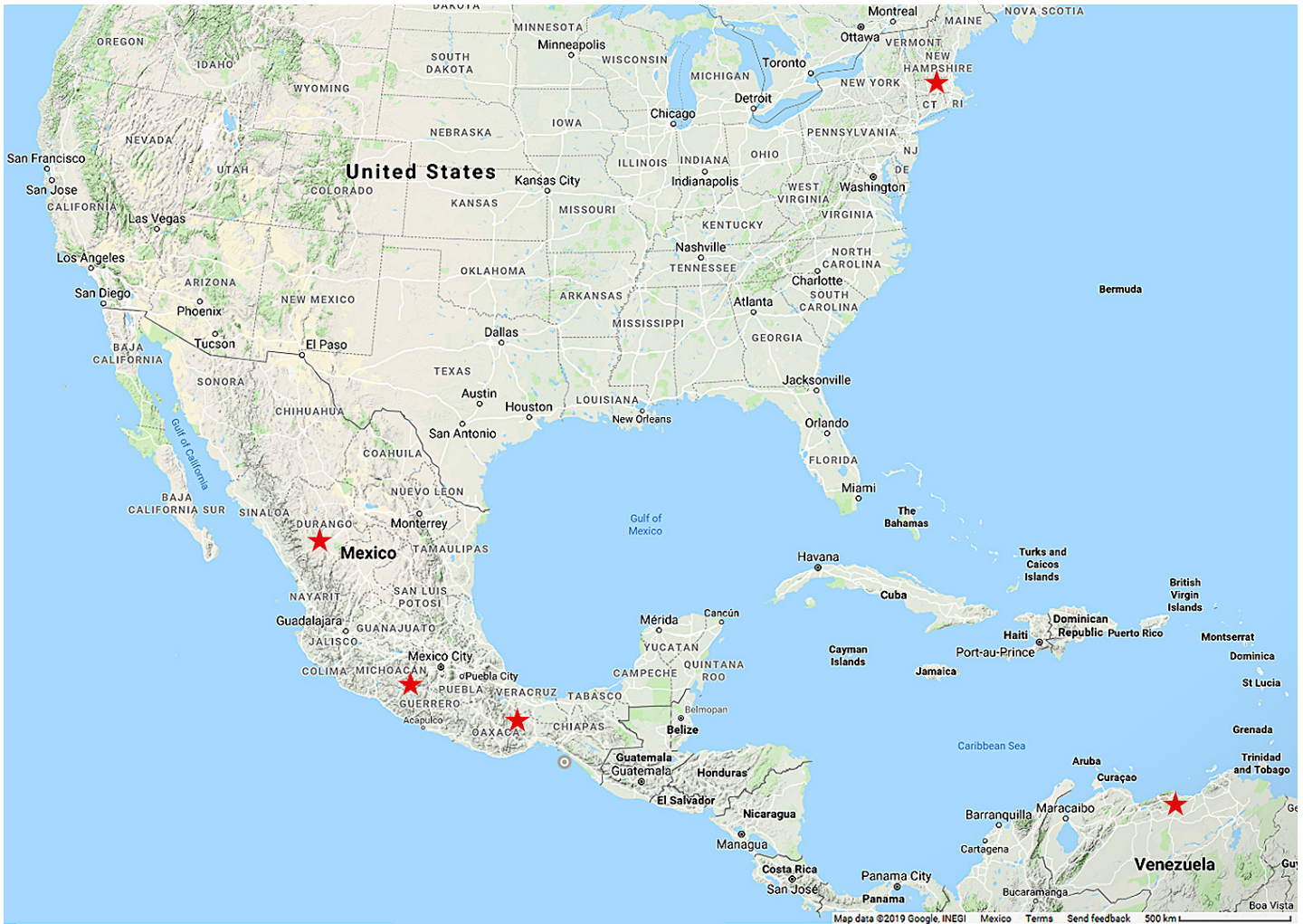


Figure 2: General distribution of *Digitaria filiformis* (L.) Koeler var. *laevigulum* (Fernald) Wipff.

Table 1: Vegetative and reproductive differences between three varieties of *Digitaria* Haller.

	<i>Digitaria filiformis</i> (L.) Koeler var. <i>dolichophylla</i> (Henrard) Wipff	<i>Digitaria filiformis</i> (L.) Koeler var. <i>filiformis</i>	<i>Digitaria filiformis</i> (L.) Koeler var. <i>laevigulum</i> (Fernald) Wipff
Height (cm)	50-115	10-80	7-25(-70)
Basal sheaths	glabrous	papillose-pilose	papillose-pilose
Blade surface	involute	flat	flat
Blade width (mm)	<1(-2)	1-6	1.9-3.5(-6)
Raceme number	1-4	2-4	1-3(-4)
Raceme length (cm)	7-19	3-13	1.5-4(-9)
Spikelet length (mm)	1-4.1.6	1.3-1.9	1.6-1.9(-2)
Second glume pubescence	pilose	pilose	glabrous
Sterile lemma pubescence	pilose	pilose	glabrous



Figure 3: Morphology of the synflorescence and a close-up of the spikelets. A-D. *Digitaria filiformis* (L.) Koeler var. *laevigulumis* (Fernald) Wipff (Sánchez-Ken et al. 935 (IEB, MEXU)); E-G. *Digitaria filiformis* (L.) Koeler var. *filiformis* (Guanajuato, municipality Comonfort, Rancho Rinconcillo de los Remedios, 27.VII.1994. J. C. Castañeda L. 194 (MEXU)). A. synflorescence; B. raceme; C. view of the sterile lemma; D. view of the second glume; E. raceme; F. view of the pubescent sterile lemma; G. view of the pubescent second glume. Photographs by J. G. Sánchez-Ken. ch=capitulate hairs.

from the Caribbean as suggested by a recent study by Vega et al. (2018) and previous works (Hitchcock and Chase, 1917; Hitchcock, 1936; Catasús, 2002; Vega et al., 2018). This kind of broad disjunct distribution is not rare in the grass family as shown by some examples, like the taxa *Pappostipa* (Speg.) Romasch., P.M. Peterson & Soreng (Cenzano et al., 2013) and *Digitaria californica* (Benth.) Henrard var. *californica* (Rúgolo de Agrasar, 1974) found in northern Mexico, the USA, and southern South America. Whether the distribution pattern of *D. filiformis* var. *laevigulumis* is

the result of a long dispersal or that it has not been collected in between is unknown.

There are some minor variations between the Mexican and Venezuelan collections compared to the type collection. These differences may not be considered strong enough to warrant their recognition as different species. There can be several causes for these differences such as lack of fieldwork, convergences, or dispersion, although this can only be confirmed by a molecular study. Similar variations are observed in other species of the genus with

a broad distribution such as *Digitaria ciliaris* (Retz.) Koeler and *D. ternata* (Hochst. ex A. Rich.) Stapf.

Table 2 shows the differences found between the types (holotype and isotype), the Mexican collections and the Venezuelan report. The first difference is the elevation, there are three ranges, the lowest at the type locality, the intermediate in Venezuela and the highest in the states of Michoacán and Durango. The broad distribution range may explain the plants can grow in elevations from 80 to 2025 m.

Other variable characters (Table 2) refer to the actual height of the plants, leaf blade length and the size of the spikelets. Fernald (1920) mentioned that the height of var. *laevigulumis* is the same as the typical variety, but Wipff (1996, 2003) reported taller plants, whereas in the illustration by Vega and Rúgolo de Agrasar (2005) the height of the plant is similar to that of Fernald (1920). It is unknown where Wipff (1996, 2003) did find those measurements, since only the holotype and isotypes are known from the type locality. The same thing happens with the length of the spikelets; Fernald (1920) reported one range but Wipff (2003) mentioned larger spikelets. The characteristics of the synflorescence of both types and the measurements of the spikelets of Vega and Rúgolo de Agrasar (2005) are very similar to those found in the plants collected in Mexico (Fig. 3), except for those mentioned by Wipff (2003). Finally, in the same illustration the plants look more pubescent and the leaf blades are longer. Whether these variations reflect the broad and disjunct distribution, unknown intermediate populations, convergences or dispersal events, we cannot be sure until a genotypic or a morphometric analysis is done.

Table 2: Differences of some characters of *Digitaria filiformis* (L.) Koeler var. *laevigulumis* (Fernald) Wipff between the three distant localities. ¹Wipff (2003), ²Type specimen, ³Vega and Rúgolo de Agrasar (2005).

	United States of America	Mexico	Venezuela ³
Elevation (m)	80	1430-2025	1350-1423
Height (cm)	10-60 (75-150 ¹)	7-25	~68
Leaf blade length (cm)	1.5-9	1-3	~6-20
Raceme number	2-3(-4 ²)	1-3	4
Raceme length (cm)	2-9	1-4	~7.8
Spikelets	1.8-2 (1.8-2.5 ¹)	1.6-1.9	1.8-2

It is important to notice that in both specimens from Durango and Oaxaca the typical variety and var. *laevigulumis* are mixed on the same sheets. This suggests that both varieties are sympatric. A different case is the one collected in Michoacán, where the population visited consisted only of *D. filiformis* var. *laevigulumis*.

Author contributions

Authorship of the whole paper is by JGSK.

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