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A new species of *Astragalus* (Fabaceae, Faboideae) from Durango, Mexico

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Abstract

We describe and illustrate *Astragalus spellenbergii*, as a new species from Durango, Mexico, morphologically related to *Astragalus micranthus*.

Key words: Leguminosae, Northwestern Mexico, Sierra Madre Occidental, *Strigulosi*

Introduction

Astragalus L. (1753: 755) is the largest genus of Fabaceae (Barneby 1989), and probably the largest genus among the flowering plants (Lock & Simpson 1991) with up to 2500 species included into 245 sections around the world (Lewis *et al*. 2005). It is mainly distributed in the north hemisphere, especially in central and west Asia, west North America, Mexico and the Andes, South America (Barneby 1989). According to material stored and consulted at ANSM, BCMEX, CAS, CFNL, CIIDIR, MEXU, NY, TEX, and US, of the 368 species and 93 sections recorded for North America (Barneby 1964), 93 species belonging to 18 sections are found in Mexico. The section *Strigulosi* Jones (1923: 184), includes 27 species distributed from Southwestern USA (Arizona, New Mexico, and Colorado), throughout temperate areas in Mexico to Guatemala and Honduras (Barneby 1964). It includes 22 endemic species and they constitute the largest group of native species of this genus in México. Eight of the species have restricted distribution; it is limited to a single state, as *A. guanajuatensis* Rzed. & Calderón (2015: 2), *A. regiomontanus* Barneby (1964: 168), and *A. pennellianus* Barneby (1964: 169), some of them only to the type locality, as *A. lyonnetii* Barneby (1964: 161), *A. mario-sousae* A. E. Estrada, Villarreal & Yen-M. (2005: 315), *A. pueblae* M.E. Jones (1912: 35), and *A. tioides* (Rydb.) Barneby (1964: 171). The most striking morphological characters of section *Strigulosi* include: perennial habit, shallow subterranean root-crown, connate stipules, small to moderate size deflexed flowers with purple or ochroleucous petals, and pods persistent and most often stipitate, dorsoventrally to triquetrously, partially or fully bilocular, compressed and papery texture with primarily apical and downward dehiscence (Barneby, 1964). According to these features, this new species is included into section *Strigulosi*.

Material and methods

Based on morphological characteristics of dry material stored in the CIIDIR herbarium (Durango, Mexico) collections, a new species of *Astragalus* was found. To date, the main contribution to the taxonomy of this genus in Mexico is Barneby's (1964) *Atlas of North American Astragalus*. Material was examined by using a Carl Zeiss StemiDV4 Stereo Microscope with 320x magnifications.

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Taxonomy

Astragalus spellenbergii A. E. Estrada, S. González & Villarreal**,** *sp. nov.* (Fig. 1 A–K)

Morphologically similar to *Astragalus micranthus* Desv., but differs in the longer, spreading to retrorse trichomes, shorter stipules, shorter leaves with fewer and smaller leaflets, shorter peduncles, narrower calyx tube, fewer flowers per raceme, flower color, relatively shorter and narrower banner, and shorter keel blade.

Type:—MEXICO. Durango (Municipio de Pueblo Nuevo): Maíz Gordo, ladera, bosque de *Pinus* y *Quercus*, 23°12'39" N, 104°56'24"W, alt. 3043 m, 23 October 2010, *C. Vázquez R. 40a and N. B. Cabada A.* (holotype CIIDIR!; isotype CFNL!).

Plant caulescent perennial, dwarf, with a shallow subterranean root-crown. **Stems** 10–15 cm long, branched from the base, procumbent or suberect; stems, leaves, petioles, rachis of leaves, peduncles and racemes loosely to densely (especially in young structures) pilose to pilose-hispidulous, the trichomes 0.7–1 mm long, spreading or retrorsely spreading, straight o sligthly sinuous, white; stems subglabrate to glabrate with age, peduncles less densely so to subglabrate with age; leaflets loosely pilose to pilose-hispidulous in both surfaces; **stipules** dimorphic, the lower ones 2–2.6 mm long, in leafless nodes, connate-amplexicaul, fused through 0.1–0.2 mm, free apically, the middle and upper ones 3–8 mm long, semi-amplexicaul or free, ovate to triangular, gradually or abruptly acute in the apex, green, reflexed with age, scarcely pilose adaxially, hispid to pilose abaxially, becoming ochre or stramineous with age. **Leaves** 1.1–5.5 cm long, subsessile, odd-pinnate, petiole 0.5–6 mm long; **leaflets** 5–15, 3–9 x 1–5 mm, elliptic to oblong-elliptic, apex rounded, petiolule 0.1–0.3 mm long, pilose in both surfaces, slightly denser abaxially. **Inflorescences** in axillary racemes, 5.5–10 cm long, peduncles 3.5–7 cm long, erect or curved-ascending, pilose-hispidulous, trichomes black and white mixed; floriferous axis compact and dense, 2–3 cm long, 9–15 flowered, the flowers early deflexed; bracts 4.3–5 mm long, oblong, elliptic to lanceolate-elliptic, acute at the apex, green or white, hispidulous with trichomes white and black mixed; pedicels 1–1.2 mm long, early deflexed downward, slightly thickened, in fruit, caducous; bracteoles absent. **Flowers** 6.5–7 mm long, calyx 4.3–4.7 x 1.4–1.7 mm, campanulate, the tube 1.3–1.7 mm long, inequilaterous or slighlty oblique, pilose-hispidulous with black hairs, rarely some few white trichomes, the teeth 1.7–3 mm long, triangular; petals yellow to ochroleucous, the banner sessile, 6.5–7.2 x 2.8–3 mm, elliptic, elliptic-obovate to rhombic-elliptic, obtuse or retuse at the apex, the notch 0.4–0.7 mm deep, folded near the middle, its margins then folded backward, abruptly bent backward from the keel, recurved through 55°–60° from the vertical; wings 5.2–5.3 mm long, the claw 2.2–2.3 mm long, the blade 2.9–3.1 x 1.3–1.8 mm, obliquely oblong, apex rounded, auriculate; the keel 4–4.2 mm long, the claw 2 mm long, the blade (2–)2.1–2.2 x 1.6–1.8 mm, half-obovate, incurved, apex rounded, auriculate. Stamens 10-merous, diadelphous, 9 fused by their filaments into a white red striped sheath 2.7–2.8 mm long, the free part 1.2–1.3 mm long, enfolding the ovary, the vexilar stamen 3.8–4 mm long, standing free; anthers round, 0.2 mm diameter. Ovary unilocular, 6–7 ovulate, shortly stipitate, stipe 0.2–0.3 mm long, the body 1.2–2 x 0.5–1 mm, densely pilose-strigose, trichomes white and black, style 1.5–1.7 mm long, glabrate, incurved, stigma terminal, minute, glabrous. **Pod** reflexed, short stipitate, stipe 0.2–0.3 mm long, the body 7–8 x 2–3 mm, oblong in profile, straight or slightly incurved, triquetrous, sulcate dorsally, keeled ventrally by the concave suture, rounded or slightly obtuse at the base, apiculate at the apex, the valves yellow-green, becoming stramineous to dark brown with age, densely hirsute-hispidulous, with only black trichomes when young, black or white and black mixed along the ventral suture and white trichomes in the rest of body, turning subglabrate to spread-hispidulous with age, imperceptibly reticulate, fully bilocular, inflexed as a complete septum 0.8–1 mm wide, dehiscence apical and downward through the ventral suture; seeds 2–2.2 mm long, light brown to olivaceous, shiny, mitten-shaped, style persistent, incurved.

Distribution and habitat:—As far as we know, *Astragalus spellenbergii* is known only from the type locality, in the municipality of Pueblo Nuevo, Durango, inhabiting oak-pine forest, on mountain slopes and roadsides, at 3043 m elevation. This species distributes on the higher parts of the Sierra Madre Occidental, on igneous substrate. This site is similar to those of Mexico, where the other species of sect. *Strigulosi* occur, mainly in mountains, sheltering under oak and oak-pine forest.

Etymology:—The species epithet name honors to Dr. Richard W. Spellenberg, professor at New Mexico State University (1968–2000) and former curator of the NMC Herbarium, collector and expert on the flora of northern Mexico. *Astragalus* is one of the many groups in which Dr. Spellenberg is a specialist.

Phenology:—Flowering occurs from October to November and fruiting from October to November, presumably also to early December.

FIGURE 1. *Astragalus spellenbergii* showing its morphology. **A** complete plant; **B** upper stipules; **C** pubescence in young (upper drawing) and old (lower drawing) leaves; **D** inflorescence; **E** calyx, flower and bract (lateral view); **F** banner petal; **G** wing petal; **H** keel petals; **I** stamens, lateral (left, showing the vexilar stamen) and frontal (right, not showing the vexilar stamen) view; **J** fruit; **K** seed. **A–K** *C. Vázquez R. 40a and N. B. Cabada A*. Drawn by Albino Luna Sánchez.

Additional specimen examined (paratypes):—Herbarium collections at ANSM, BCMEX, CAS, CFNL, CIIDIR, JEPS, NY, TEX, and US, were reviewed and there is no record of another collection of this species to date.

Discussion:—Physognomically, the most striking characters to recognize the new species as member of sect. *Strigulosi* are its connate stipules, deflexed flowers, emmenoloboid, and triquetrous small pod. *Astragalus spellenbergii* is quite similar to *A. purpusii* M.E. Jones (1912: 34) and *A. micranthus* with purple or purple tinged flowers, but it can be easily distinguished from both, by its ochroleucous to yellow flowers. It should be noted that sometimes the flowers of *A. micranthus* turn yellow when dry; however, *A. spellenbergii* can be distinguished by the longer, divergent or retrorse pubescence, shorter leaves, with fewer and shorter leaflets, shorter peduncles, fewer flowers per raceme, relatively longer but narrower banner, and larger seeds. Regarding to the carpological characters, *A. spellenbergii* is more akin to *A. purpusii*, since both species have fully bilocular pod, but a wider (1.5–2.3 mm) septum is found in *A. purpusii*, which is easily distinguished from *A. spellenbergii* by its shorter and adpressed pubescence, longer stipules, shorter calyx and calyx tooth size, purple flowers, wider banner, smaller wing claw, fewer ovules (2–5), and sessile pod. Ecologically, *A. spellenbergii* distributes in mountains at high elevations in similar way to *A. purpusii* (northeastern Mexico) and *A. micranthus* (central and southern Mexico), the three of them associated to alpine meadow or oak and pine forest, reaching 2800–3650 m elevation.

A distinctive feature of this new species, not found in any other species of this section is the type of pubescence, pilose to pilose-hispidulous, its trichomes are straight o slightly sinuous but spreading or retrorsely spreading as in *A. greggii* S. Watson (1882: 343), a species in sect. *Greggiani* (Barneby 1964: 1087). This can be considered a case of convergent evolution among species of two sections as occurs also with species possessing dolabriform trichomes included into different sections of *Astragalus* such as *A. amphioxys* A. Gray (1878: 366) (sect. *Argophylli* A. Gray (1864: 209)), *A. arizonicus* A. Gray (1868: 398) (sect. *Leptocarpi* M.E. Jones (1923: 266)), *A. hypoleucus* S. Schauer (1847: 747) (sect. *Hypoleuci* Barneby (1964: 1099)) and *A. humistratus* A. Gray (1853: 43) (sect. *Humistrati* (M.E. Jones) Barneby (1964: 383)), among others. Or, even the spreading or retrorsely spreading pubescence could be considered to be present only into sect. *Strigulosi*, if sect. *Greggiani* including *A. greggii, A. pomphocalyx* Villarreal & Carranza (1994: 336), and *A. rupertii* Villarreal & Carranza (1994: 335) would be transferred into *Strigulosi*. Such consideration may be based not only in their type of pubescence, but also in their strong morphological affinities. The sect. *Greggiani* and sect. *Strigulosi* are characterized by subterranean root-crown, connate lower stipules, and persistent pod (most of the species); Barneby (1964: 1088) recognized the relationship between both sections *Greggiani* and *Strigulosi*, but also related them to sect. *Leptocarpi*; however, the species of this last section lack the lower connate stipules and buried crown. The recognition of sect. *Greggiani* with only one species (*A. greggii*) was essentially based on two distinctive characteristics, the horizontal or retrorse hispidulous pubescence and the lanceolate-oblong, glabrous, bilocular, triquetrous and sessile pod (Barneby 1964: 1087–1088); however, these features, with exception of the type of pubescence on leaves, stems, and sometimes in the fruit, as well as the size of calyx teeth and number of flowers per raceme are present also in *A. esperanzae* M. E. Jones (1923: 227) (sect. *Strigulosi*), and the other morphological characters of both species overlap. Additionally to the horizontal or retrorsely-hispidulous pubescence, the sessile pod has been considered as characteristic of the sect. *Greggiani*. However, specimens collected in other areas of central Coahuila (*Villarreal et al. 2216*, ANSM; *Arce*, not numbered, ANSM), and northern and central Nuevo Leon (*Villarreal et al. 3007,* ANSM; *E. Estrada 12002,* CFNL; *E. Estrada 12356,* CFNL) show stipitate pods, the stipe ranging from 0.2–3 mm long, and also ochroleucous flowers. The presence of stipitate (almost all species) to sessile (*A. esperanzae*), triquetrous and bilocular pods are characteristic into sect. *Strigulosi*. Along with the vestiture of spreading or retrorsely spreading trichomes, a small stipe above the receptacle holding the pod is also present in *A. rupertii* and *A. pomphocalyx*. Both of them along with *A. spellenbergii* share the same type of dense white and black mixed pubescence on pods. In summary, sections *Strigulosi* and *Greggiani* share species with subterranean root-crown, connate stipules, appressed to spreading or retrorsely spreading pubescence, deflexed flowers, and sessile to stipitate, glabrous to hirsute, emmenoloboid (rarely piptoloboid), triquetrous pods. With these obvious morphological characteristics, sect. *Greggiani* could be included within *Strigulosi*, and the last may be subdivided into smaller and natural groups (subsections), based on the type of pubescence, size and curvature of flowers, shape and position of the pod in the receptacle (sessile or stipitate) and type of dehiscence. That approach would need a revision of the species of both sections, which is beyond the scope of this work.

Astragalus spellenbergii, A. micranthus, and *A. purpusii* are closely related by their morphological affinities. They include short petals, the banner shorter than 8 mm long and the keel shorter than 6 mm long, ovary and pod pubescent, the pod 5–8 x 2–3 mm. The three species can be distinguished by the characters noted in the following key (adapted from Barneby, 1964):

1. Pod sessile, fully bilocular, the septum 1.5–2.3 mm wide; pubescence appressed with ascending hairs; flowers pale purple; Nuevo León, Coahuila and Zacatecas ..... *A. purpusii*
1. Pod stipitate, the stipe short, 0.6 mm long or shorter, but always present, fully to semi-bilocular, the septum 0.4–1.5 mm wide; pubescence appressed with ascending hairs or pilose-hispidulous with spreading or retrorse hairs; flowers pale purple, light yellow to ochroleucous; Durango to southern Mexico..... 2
2. Pubescence pilose-hispidulous with spreading or retrorse hairs; leaves up to 5.5 cm long with 5–15 leaflets 3–9 mm long; racemes with 5–15 pale yellow flowers to ochroleucous; pod fully bilocular, the septum 0.8–1 mm wide; endemic of Durango ..... *A. spellenbergii*
2. Pubescence appressed with ascending hairs; leaves commonly 8–10.5 cm long, with 21–31 leaflets commonly 8–20 mm long; racemes with (15–)30–60 purple to yellowish flowers; pod semi-bilocular, the septum 0.4–1.5 mm wide; central and southern Mexico (San Luis Potosí, Hidalgo, Veracruz, Puebla, Morelos, Estado de México, Ciudad de México, and Oaxaca..... *A. micranthus*

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