Phaseolus texensis (Leguminosae: Phaseolinae): A New Species from the Edwards Plateau of Central Texas

Authors: Delgado-Salinas, Alfonso, and Carr, William R.

Source: Lundellia, 2007(10) : 11-17

Published By: The Plant Resources Center, The University of Texas at Austin

URL: https://doi.org/10.25224/1097-993X-10.1.11

PHASEOLUS TEXENSIS (LEGUMINOSAE: PHASEOLINAE): A NEW SPECIES FROM THE EDWARDS PLATEAU OF CENTRAL TEXAS

Alfonso Delgado-Salinas[1] and William R. Carr[2]

[1]Departamento de Botánica, Instituto de Biología, Universidad Nacional Autónoma de México, Apartado Postal 70-233, 04510 México, D. F. MEXICO

[2]The Nature Conservancy of Texas, P.O. Box 1440, San Antonio, Texas 78295-1440

Abstract: Phaseolus texensis is a new species known only from rocky canyons of the eastern and southern Edwards Plateau of central Texas. Morphological examination and field observations, in conjunction with current molecular phylogenetic analyses based on nuclear ribosomal and chloroplast DNA sequences and a discrete and limited geographical range, support the taxonomic recognition of this species, which is accordingly described and illustrated here.

Resumen: La especie **Phaseolus texensis** es dada a conocer como restringida a cañones pedregosos de las partes orientales y meridionales de la región conocida como Edwards Plateau, de la porción central del estado de Texas, Estados Unidos de América. Un examen morfológico y observaciones en campo, aunados a estudios filogenéticos moleculares basados en secuencias de ADN nuclear ribosomal y de cloroplastos y a una restringida distribución garantizan el reconocimiento de esta especie y por lo tanto, aquí se describe e ilustra.

Keywords: Leguminosae, Phaseolinae, *Phaseolus*, Edwards Plateau, Texas.

During the course of a taxonomic revision of *Phaseolus* for the *Flora of North America* (Delgado-Salinas, in prep.), it became evident that plants from the botanically relatively well-known central part of Texas represent taxonomically problematic populations meriting further study. One herbarium specimen from this area (*V. L. Cory 52444* CAS-DH) was annotated in the first half of the last century by Oliver W. Norvell as *Phaseolus pedicellatus* var. *scabrellus* ined. (Section *Pedicellati* Freytag). Subsequently, Delgado-Salinas (1985) hypothesized these plants to be atypical forms of *P. polystachios* (L.) Britton, Sterns & Poggenb., a species of the eastern U.S.A. Recently, Freytag and Debouck (2002) identified two herbarium specimens from this area as *P. polystachios* subsp. *smilacifolius* (Pollard) Freytag (Section *Paniculati* Freytag), pointing out, however, that the plants concerned were anomalous in this taxonomic placement. Apparently, Debouck (in Freytag & Debouck, 2002) was of the opinion that these plants would be better referred to another species. This has lead to consternation, particularly for workers not conversant with this group.

Examination of more herbarium material and of populations in the field reveals that these plants are morphologically closer to those of section *Pedicellati* Freytag, and that they appear to represent a morphologically distinct taxon allopatric to all other species of *Phaseolus*. In addition, in a phylogenetic analysis of *Phaseolus* (Delgado-Salinas et al., 2006) based on combined sequence data of nrDNA (ITS) and cpDNA (*trnK*/*matK*), two accessions of *P. texensis* were established in a clade with 100% bootstrap support as sisters to a larger group of species (Fig. 1). This clade, named the Pedicellatus group, comprises all species of sections *Pedicellati* and *Digitati* Freytag, along with a species of section *Paniculati* (Delgado-Salinas et al., 2006; Mercado-Ruaro et al., in press). Conversely, there was no support for the placement of *P. texensis* within the clade that comprises species of section *Paniculati* (i.e., *Phaseolus polystachios*), included in this analysis in the Lunatus and Polystachios phylogenetic

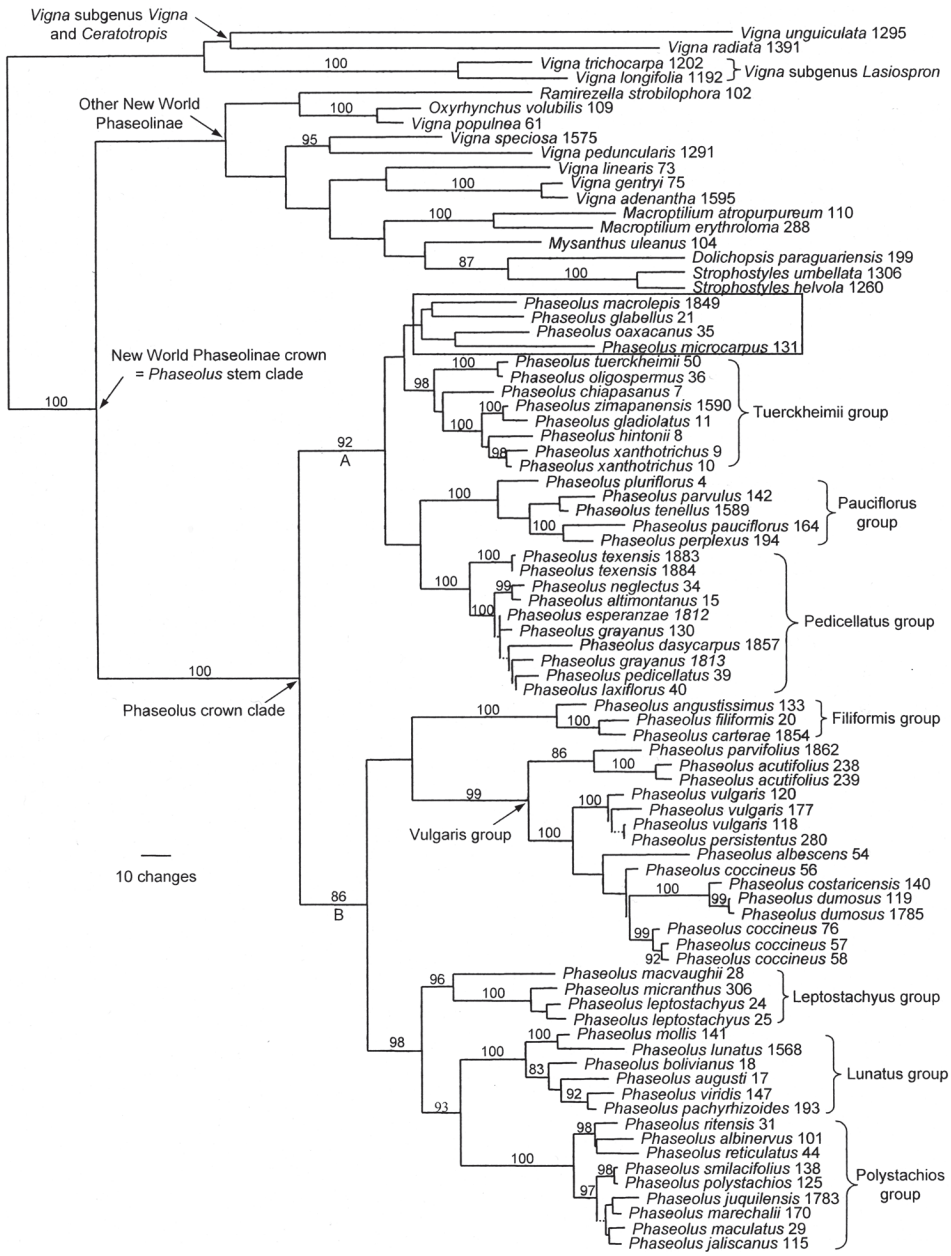

FIG. 1. One of 10,000 maximum parsimony trees from a combined analysis of *trn*k/*mat*K and ITS sequences sampled from *Phaseolus* and outgroups (Delgado-Salinas et al., 2006). Bootstrap values greater than 75% are reported above (or below) the branch when resolved in the strict consensus. Eight clades are recognized and species not resolved in one of the eight species clades are shown in the box. *Phaseolus texensis* is a member of the Pedicellatus group.

groups (Fig. 1). Thus, the combination of morphological, distributional, and molecular evidence strongly supports the recognition of these central Texas populations as a separate, narrowly endemic species, placed in a rather enlarged but well supported section *Pedicellati* (Delgado-Salinas et al., 2006). Within the Pedicellatus group, this

new species is sister to accessions of north and central Mexico, and to the geographically closer *P. grayanus* Wooton & Standl., inhabiting the Chihuahuan Desert region of northern Mexico, Trans-Pecos Texas, southern New Mexico, and southeastern Arizona.

Phaseolus texensis A. Delgado & W. R. Carr, sp. nov. (Figs. 2, 3).

TYPE: **UNITED STATES. TEXAS. Kerr Co.:** E side of St. Rt. 16 at foot of switchbacks on ridge separating Guadalupe and Medina watersheds, 3.2 road miles S of Turtle Creek bridge S of Kerrville, Fall Creek Quadrangle, at N 29° 55′ 24.5″, W 099° 14′ 15.2″, elev. 1180–1900 ft, 29 Oct 2005, *W. R. Carr et al. 24232* (TEX) (HOLOTYPE: TEX!; ISOTYPE: MEXU!).

Phaseolus grayanus Wooton & Standley affinis, sed differt petioliis, inflorescentiis axe, pedicellis pilis uncinatis (vs. plerumque numerosis pilis recti vel curvi antrorsis), bracteolis 0.5 mm (vs. 1.0 mm), fructibus 5–6(7) (vs. 4–5(6)) seminibus.

Herbaceous perennial VINES, trailing or climbing up to 7 m long, from tuberous taproots. STEMS terete, striate, lignescent at maturity, sparsely beset with hooked and retrose hairs. LEAVES with axillary buds sometimes developed at the base of the inflorescence; stipules lanceolate, 1.5–3.0 mm long, 0.8–1.2 mm wide, acute at tip, 3-veined, ascending to reflexed; petioles and rachises canaliculate, sparsely covered with hooked hairs; petioles 1.0–5.0 cm long; rachises 0.7–1.7 cm long; stipels subulate-obovate, 1.0–2.5 mm long, ascending on terminal pulvinus and spreading on lateral pulvini; leaflets membranous to slightly chartaceous, terminal leaflets ovate to broadly so, occasionally round to quadrate lobed at base, 2.0–8.5 cm long, 2.0–7.0 cm wide; lateral leaflets ovate, sometimes basally lobed, acute at tip, apiculate, 1.5–7.0 cm long, 2.2–4.8 cm wide, rounded to subtruncate at base; upper and lower surfaces of leaflets sparsely covered with hooked hairs intermixed with antrorse-curved hairs. INFLORESCENCES of pseudoracemes, often minute secondary axes or stalks developed on floral nodes, main axis usually covered with hooked hairs; peduncles 5.0–10.0 cm long; rachises up to 12.0 cm long, with 5–13 floral nodes, each 2–3 flowered, often the middle one on a short stalk; primary nodal bracts triangular, 1.0–2.0 mm long, ca. 0.8 mm wide, 3-veined, persistent; secondary nodal bracts oblong, ca. 1 mm long, usually caducous; pedicels 4–9 mm long, sparsely covered with hooked hairs, arcuate in fruit; bracteoles ovate, ca. 0.5 mm long, 1-veined, persistent. CALYCES campanulate, 2.5–3.5 mm long, ca. 2.5 mm broad; inner surface covered with appressed hairs in the tube, outer surface with minute hooked and straight hairs on the lobe margins; upper lobe emarginate, laterals and lower lobes triangular, ca. 1.0 mm long. COROLLAS pink fading to dark pink, 1.2–1.5 cm long, ca. 7.0 mm high; standards oblong to orbicular, ca. 1.2 cm long, ca.1.0 cm wide, emarginate at apex, glabrous, lamina thickened at point of flexure, toward the base on both sides of claw bearing two flap-like appendages, tongue-guide surface concave and papillose, basal claws ca. 1.0 mm long; wings obovate, 1.2–1.5 cm long, ca. 8.0 mm wide, constricted toward base, upper basal margin folded and thickened, round-auriculate, claws ca. 4.0 mm long; keels 6.5–9.0 mm long, ca. 6.0 mm high, 1½ closely-coiled diameter ca. 2.0 mm across, twisted and facing forward, transverse pouch ca. 1 mm long, claws of keel ca. 4.0 mm long. ANDROECIUM with vexillary stamen ca. 1.0 cm long with a globose appendage toward the base; staminal tube ca. 1.5 cm long, biauriculate toward the base, with 4 dorsifixed and 5 basifixed anthers, these oblong, ca. 0.6 mm long. POLLEN tricolporate, often with pseudocolpi, subtectate, finely reticulate. GYNOECIUM with nectary disc ca. 1.0 mm long; ovary linear, ca. 6.0 mm long, sericeous; ovules 5–7; style bearded introrsely; stigmas usually introrse; stigmatic pads oblanceolate, ca. 0.6 mm long. FRUITS oblong, slightly falcate, 3.5–5.2 cm long, ca. 8.0 mm wide, short-beaked

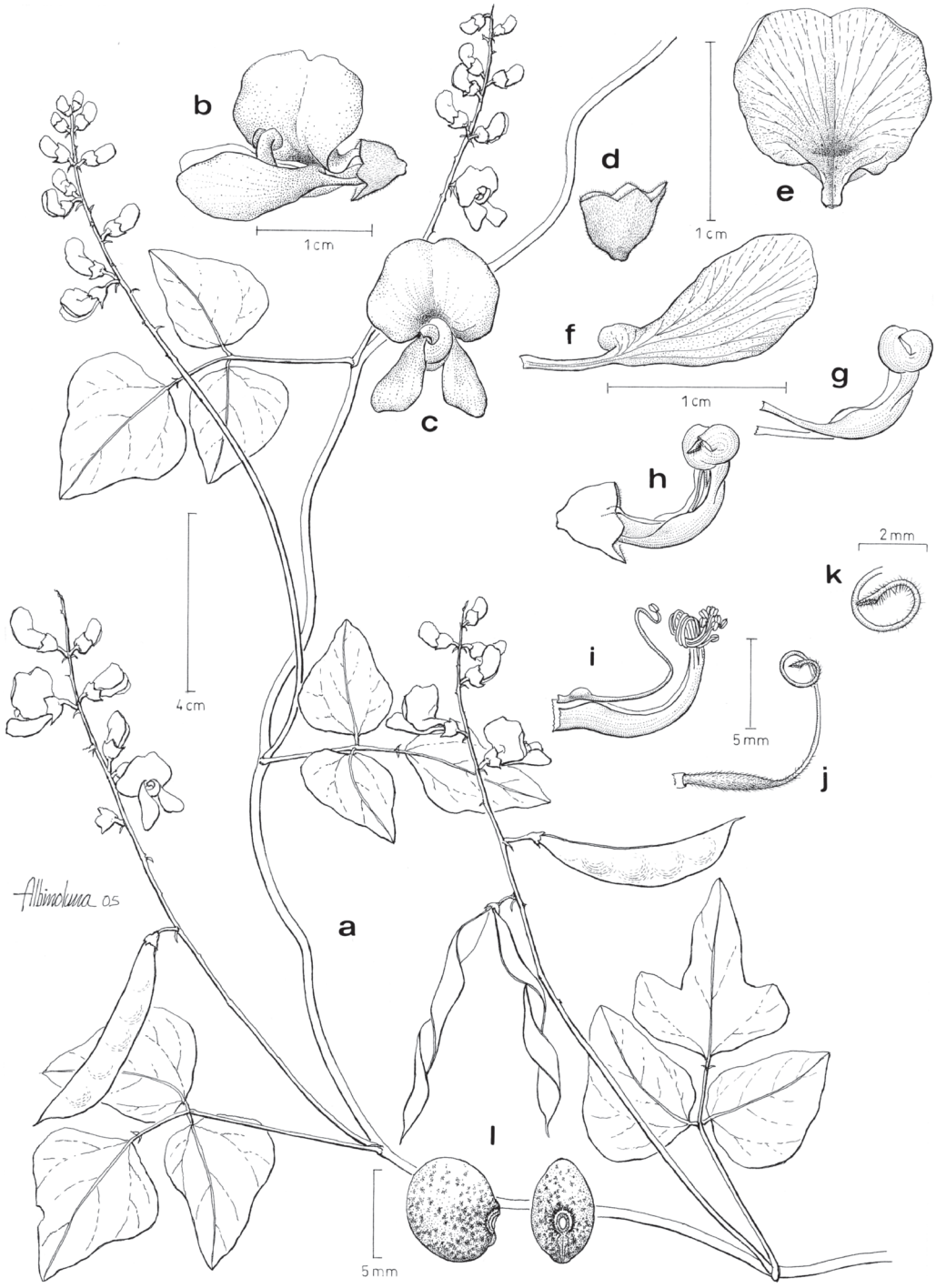

FIG. 2. *Phaseolus texensis* (*H. B. Parks 35738*, GH, *V. L. Cory 24567*, GH, *W. R. Carr et al. 24232*, TEX). a. Plant habit, showing inflorescences with flower buds, flowers at anthesis, and immature and elastically dehiscent fruits with twisting valves. b. Flower, side view. c. Flower, front view. d. Calyx. e. Standard. f. Wing petal. g. Keel, distally 1 1/2 coiled. h. Keel, with stigma protruding. i. Androecium, staminal tube and free vexillary stamen with globose base. j. Gynoecium. k. Distal portion of style with pollen brush and introrse stigma. l. Seed, front and side views. Figure by Albino Luna (IBUNAM).

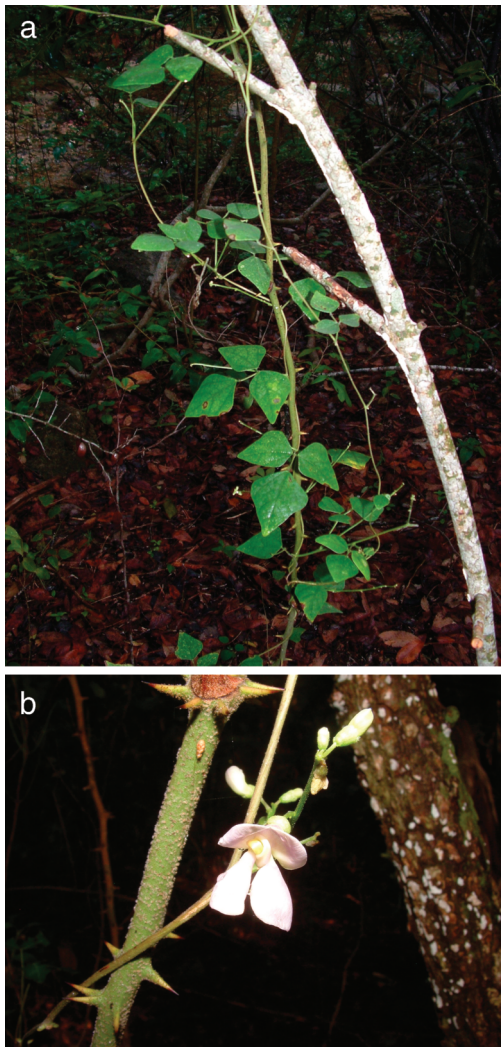

FIG. 3. *Phaseolus texensis* in mixed woodlands at Travis Co. a. Plant climbing habit b. flower at anthesis (Photos W. R. Carr).

(2.0–3.0 mm), pendent, elastically dehiscent, compressed; valves chartaceous, strigose, expanding slightly over the 5–6(7) seeds. SEEDS oblong, ca. 5.0 mm long, ca. 4.5 mm wide; hilum oblong, ca. 1.0 mm long, with epihilum; lens not prominent; halo black; surfaces smooth, brown mottled with black. SEEDLINGS with hypogeal germination (or phanerogeal); epicotyl pilose, often red-pigmented; stipules entire to bifid; petioles with basal and apical pulvini; stipels minute; eophylls simple, ovate, obtuse to acute at tip, truncate or slightly lobed at base; next leaves trifoliolate. Chromosome number unknown.

FLOWERING AND FRUITING: September through November.

DISTRIBUTION AND HABITAT: *Phaseolus texensis* is restricted to the eastern and southern parts of the Edwards Plateau of Texas at elevations from 200 to 600 m. This species is usually found in small populations, in mixed woodlands, on limestone cliffs and outcrops, frequently along creeks. In Travis Co. this wild bean grows associated with *Juniperus ashei* J. Buchholz, *Quercus buckleyi* Nixon & Dorr, *Ulmus crassifolia* Nutt., *Verbesina virginica* L., *Chasmanthium latifolium* (Michx.) H.O. Yates, *Desmodium paniculatum* (L.) DC., *Ruellia drummondiana* (Nees) A. Gray, *Ligustrum japonicum* Thunb., *Parthenocissus quinquefolia* (L.) Planch., *Rhamnus caroliniana* Walter, *Garrya lindheimeri* Torr., *Vitis* sp., and *Forestiera pubescens* Nutt. In Kerr Co. it grows with *Aster texanus* E. S. Burgess, *Brickellia cylindracea* A. Gray & Engelm., *Celtis reticulata* Torr., *Hamamelis virginiana* L., *Lindera benzoin* (L.) Blume, *Parthenocissus quinquefolia* (L.) Planch., *Platanus occidentalis* L., *Prunus serotina* Ehrh., *Quercus buckleyi*, *Q. laceyi* Small, *Q. muehlenbergii* Engelm., *Rhamnus caroliniana*, *Tilia americana* L., *Verbesina virginica* L., and *Vitis cinerea* (Engelm.) Engelm. ex Millardet.

The species epithet alludes to the distribution of this species, which is endemic to the state of Texas.

ADDITIONAL SPECIMENS EXAMINED: UNITED STATES. TEXAS. Bandera Co.: W-facing but rather mesic slope on E side of Williams Creek, ca. 500–1000 ft. N of Williams Creek Rd. crossing ca. 4.5–4.6 road miles N of jct. R. M. 470 at Tarpley, on Creveling Ranch, Tarpley Quadrangle, at N 29° 42′ 19.3″, W 099° 19′ 10.2″, elev. 1480–1500 ft, 16 Apr 2002 (sterile), *W. R. Carr 20635* (TEX). Kerr Co.: 8.2 mi NE of Kerrville, 19 Sep 1937, *V. L. Cory 24567* (GH); 13 miles southwest of Kerrville, frequent on steep limestone bank of Lamb Creek, 2 Oct 1946, *V. L. Cory 52444* (CAS-DH); 9 mi SW of Kerrville, 13 Oct 1940, *H. B. Parks 35738* (GH-2). Travis Co.: Tributary of Bull Creek emanating from Stillhouse Hollow, ca. 100–200 ft. upstream from (E of) its confluence with Mayfield Creek, downstream from a trail crossing near

conspicuous 20–30 ft N-facing undercut bluff, ca. 1200 ft SW off eastern of two intersections of Spicewood Springs Rd. and Loop 360. Jollyville Quadrangle, at 30° 22′55″ N, 97° 46′06″ W, elev. 580 ft., 26 Sep 1995, *W. R. Carr 14861* (TEX); 1 Oct 1995, *W. R. Carr 14909* (TEX); 26 Oct 1995, *W. R. Carr 15065* (TEX); same locality, 5 Oct 2005, *T. L. Wendt & W. R. Carr 7379* (TEX). Uvalde Co.: Frio River, 30 Sep 1929, *E. Normand s.n.* (TEX-2).

Phaseolus texensis can be distinguished from *P. polystachios* (section *Paniculati*), with which it has been considered recently conspecific (Freytag and Debouck, 2002), by a basic difference in inflorescence structure. The inflorescences of *P. texensis* are pseudoracemes, while those of *P. polystachios* are contracted panicles with lateral branches developing along the axis of the inflorescence.

Phaseolus texensis is positioned in the section *Pedicellati*, because of the support from molecular data (Fig. 1), and to its morphological similarity with other species of this section. It is in many ways most similar to *P. grayanus*, but it differs in leaf form, density of vestiture, length of the bracts and bracteoles, and ovule number. The terminal or uppermost leaflets in *Phaseolus grayanus* tend to be mostly deeply tri-lobed, while those of *P. texensis* range from broadly ovate to slightly tri-lobed, not as dissected as in the former. Indument in *P. grayanus* tends to be more profuse than in *P. texensis*, especially distinctive by the presence of more ascending hairs on petioles, peduncles, and pedicels. Bracts and especially bracteoles are slightly smaller in *P. texensis* (bracteoles ca. 0.5 mm long) than in *P. grayanus* (bracteoles ca.1.0 mm long). Ovaries in *P. texensis* bear 5 to 7 ovules, whereas those of *P. grayanus* have 4 to 5 (rarely 6) ovules.

In addition, the habitat preferences of these two species are distinct. *Phaseolus texensis* grows on limestone soils in mixed woodlands at low to mid-elevations (200 to 600 m), whereas plants of *P. grayanus* occur on drier slopes or canyons in rich volcanic soils, among oak and pine-oak forests between 1600 to 2500 m.

Based on our field observations and herbarium specimens, *Phaseolus texensis* is a rather rare species that deserves protection, and therefore, considering human activities around the few localities where it has been collected, we recommend treating it as vulnerable.

KEY TO THE SPECIES OF *PHASEOLUS* SECTION *PEDICELLATI* IN TEXAS

1. Leaflets mostly tri-lobed, lobes commonly quadrate; inflorescence with 5–7 floral nodes; bracteoles ovate-lanceolate, ca. 1.0 mm long; fruits 2.5–3.0 cm long, 4–5(6)-seeded; Chihuahuan Desert region of northern Mexico, Trans-Pecos Texas, southern New Mexico, and southeastern Arizona; elevations from 1600 to 2500 m . . . . . *P. grayanus*
1. Leaflets mostly ovate to broadly ovate, occasionally lobed, lobes commonly round; inflorescence with 5–13 floral nodes; bracteoles ovate, ca. 0.5 mm long; fruits 3.5–5.2 cm long, 5–6(7)-seeded; eastern and southern parts of the Edwards Plateau of Texas; elevations from 200 to 600 m . . . . . *P. texensis*

ACKNOWLEDGEMENTS

We are grateful to Tom Wendt, curator of the University of Texas at Austin Herbarium (TEX) for his uncompromising support both in the field and in the herbarium; to M. R. García Peña (MEXU) for her assistance in obtaining loans of herbarium material, and to L. Torres-Colín and A. Wong for technical help. We are indebted to the curators of the cited herbaria for kindly providing specimens on loan; Albino Luna for the excellent line drawing; Fernando Chiang for providing the Latin diagnosis, and James Henrickson, Matt Lavin, and Billie L. Turner for their continuing support. Beryl L. Simpson, B.L. Turner, and two anonymous reviewers generously improved the manuscript. Partial funding of

AD-S research by UNAM-DGAPA and by KLARF-Programme, Royal Botanic Gardens, Kew.

Literature Cited

Delgado-Salinas, A. 1985. *Systematics of the genus* Phaseolus *(Leguminosae) in North and Central America. Diss. Doctor of Philosophy (Botany)*. The University of Texas at Austin. 363 p.

———, R. Bibler, and M. Lavin. 2006. Phylogeny of the genus *Phaseolus* (Leguminosae): a recent diversification in an ancient landscape. Syst. Bot. 31(4): 779–791.

Freytag, G. F. and D. G. Debouck. 2002. Taxonomy, distribution, and ecology of the genus *Phaseolus* (Leguminosae – Papilionoideae) in North America, Mexico, and Central America. Sida, Bot. Misc. No. 23: 1–300.

Mercado-Ruaro, P., A. Delgado-Salinas, and F. Chiang. in press. Taxonomic re-assessment of *Phaseolus dasycarpus* (Fabaceae): Its systematic position, chromosome studies and re-description. Brittonia.

Index to scientific names:

1. *P. grayanus* Wooton & Standl.
2. *P. pedicellatus* Benth.
3. *P. polystachios* (L.) Britton, Sterns & Poggenb.
4. *P. polystachios* subsp. *smilacifolius* (Pollard) Freytag
5. *P. texensis* A. Delgado & W. R. Carr

Index to numbered collections examined:

Carr, W. R. 14909 (5); 14861 (5); 15065 (5); 20635 (5); 24232 (5); Cory, V. L. 24567 (5); 52444 (5); Normand, E. s.n. (5); Parks, H. B. 35738 (5); Wendt, T. L. & Carr, W. R. 7379 (5).