
Phaseolus novoleonensis, a New Species (Leguminosae, Phaseolinae) from the Sierra Madre Oriental, Nuevo León, Mexico

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ABSTRACT. A new species of *Phaseolus* occurs on the eastern slope of Sierra Madre Oriental of Mexico, in the state of Nuevo León, at the northeastern corner of the Chihuahuan desert. Because of its coriaceous leaflets, *Phaseolus novoleonensis* belongs to section *Coriacei* Freytag. Although morphologically related to *P. maculatus* subsp. *maculatus* and subsp. *ritensis*, it differs by its having trifoliolate leaves at first nodes, small rounded leaflets, few-noded racemes, and flattened cream-colored seeds.

RESUMEN. Una nueva especie de *Phaseolus* ha sido encontrada en la vertiente oriental de la Sierra Madre Oriental de México, en el estado de Nuevo León. Los foliolos coriáceos indican que pertenece a la sección *Coriacei* Freytag. Aunque esta especie es cercana a las subespecies de *P. maculatus*, i.e. subsp. *maculatus* y subsp. *ritensis*, se diferencia por tener hojas trifolioladas en los primeros nudos, foliolos pequeños y redondos, racimos con pocas inserciones y semillas aplanadas de color crema. Su rango de distribución parece limitado a la parte nororiental de la Zona Árida Chihuahuense de México.

Key words: Fabaceae, Mexico, Neotropics, *novoleonensis*, Phaseoleae, *Phaseolus*.

In a recent monograph (Freytag & Debouck, 2002), “*Phaseolus metcalfei* and its close relatives,” as recognized early by Piper (1926), were classified in the section *Coriacei* Freytag. Recognition of this group was supported by molecular evidence (Delgado et al., 1999). *Phaseolus* section *Coriacei* includes four wild bean taxa (*P. maculatus* Scheele subsp. *maculatus*, *P. maculatus* Scheele subsp. *ritensis* (Jones) Freytag, *P. venosus* Piper, and *P. reticulatus* Freytag & Debouck) with prostrate, trailing stems from perennial thick roots and coriaceous, leathery, ovate to rhombic leaflets. These taxa are mainly distributed in the Chihuahuan desert, extending from the Trans-Pecos region of southwestern Texas as far south as Puebla in Mexico (Freytag & Debouck, 2002). While exploring the geographical limit of this group in northeastern Mexico, or the regions of Sierra Madre Oriental and Huasteca in the late 1980s, the senior author found

specimens that eventually proved to be different from all the species related to *P. metcalfei* Wootton & Standley, which is known as the ‘Metcalf bean’ in honor of J. K. Metcalfe, the agronomist who studied and distributed the legume (Nabhan et al., 1980; Wootton & Standley, 1913).

Phaseolus novoleonensis Debouck, sp. nov. TYPE: México. Nuevo León: Iturbide, 2 km E of Los Altares, 0.5 km W Puente Santa Rosa, near El Ebanito, 99°50'W, 24°43'N, 970 m, 10 Nov. 1986, D. G. Debouck & J. Muruaga Martínez 2061 (holotype, IBUG; isotypes, ANSM, BR, CHAPA, COL, ENCB, F, G, K, MEXU, MICH, MO, P, SI, UC, US). Figures 1–4.

Haec species *Phaseolo maculato* subsp. *maculato* similis, sed ab eo foliis rotundis minoribus racemis brevioribus primariis bracteis brevioribus seminibus complanatis minoribusque distinguitur. Crescit in montibus occidentalibus citatis Linaris *Novoleonensis* rarus.

Seedling 8–9 cm high, from hypogeal germination; cotyledons slightly petiolate, spreading jointly downward; epicotyl green, terete, 45–90 mm long, covered with white uncinat trichomes. Eophylls (primary leaves) simple, broadly triangular, green (137B on *Royal Horticultural Society Colour Chart*, 1966), opposite, loosely pilose margins, puberulent with minute white uncinat trichomes, 39 × 29 mm, base slightly cordate; petioles canaliculate, green, 20–22 mm long, stipels absent, pulvini green, pubescent; stipules triangular, reflexed, basifixed, 1–2 mm long, bifid to double, 3-nerved, green. First true leaf trifoliolate, leaflets rhombic to orbicular (Fig. 1m). *Root* pluriannual, thick, fleshy, tapering, fusiform, 11 cm long, 2.5 cm diam. in thickened part (possibly more in older plants), yellow (163D) drying dark brown (199A), barred with horizontal brown lenticels, with 5 to 7 lateral roots becoming thickened, spreading from the upper third, profusely, finely branched below (Fig. 1a). *Plant* a short-lived perennial, rosette of 4 to 7 stems 50–150 cm long, spreading from eophyll node and basal stem nodes. Stems sprawling, nonclimbing, terete, green (147A)

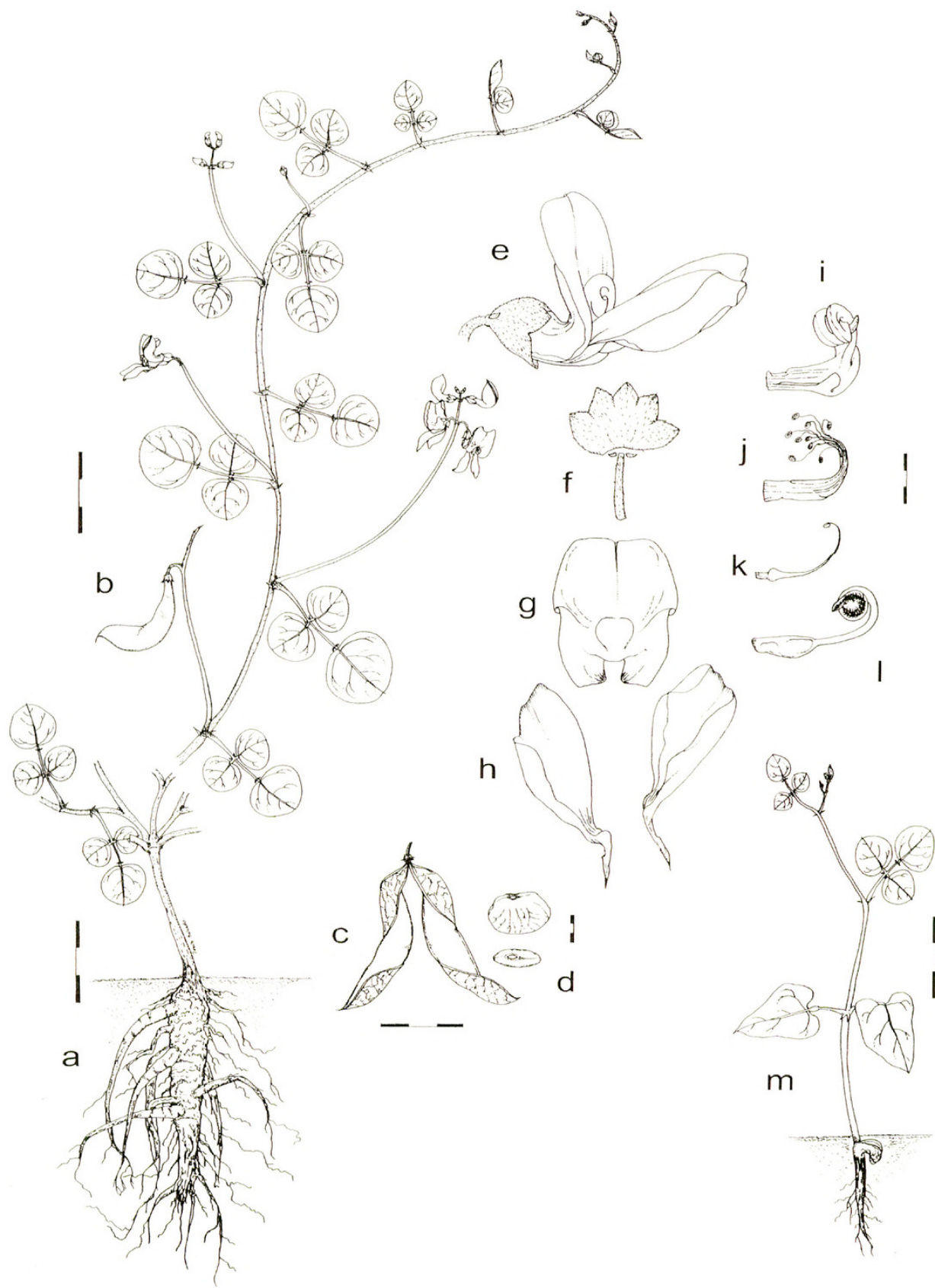


Figure 1. *Phaseolus novoleonensis* Debouck. —a. Root system and lower part of one-year plant. —b. Habit of fertile stem. —c. Pod. —d. Seed. —e. Flower (lateral view). Floral parts (f–h): —f. Pedicel, bracteoles, and calyx. —g. Standard. —h. Wings. —i. Keel. —j. Staminal tube. —k. Vexillary stamen. —l. Ovary and style. —m. Seedling. Scale: a–c, m in cm; d–l in mm. All drawings made from plants grown in Palmira, Colombia, from seed of the type collection (Debouck & Muruaga 2061, IBUG).

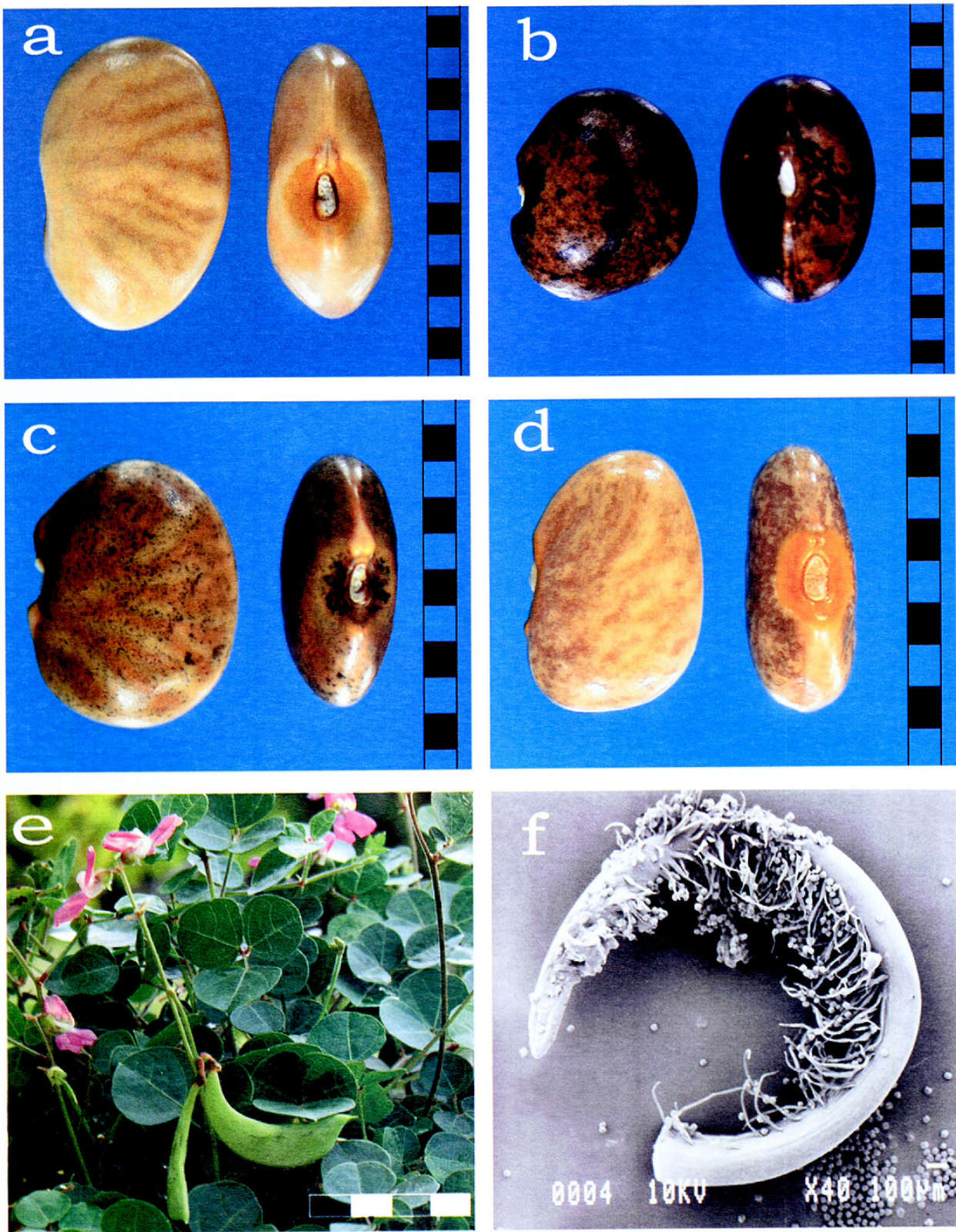


Figure 2. a—d. Close-ups of seeds in lateral views and views from hilum. —a. *P. novoleonensis* (Debouck & Muruaga 2061, as accession G40590 at CIAT) from type collection site. —b. *P. maculatus* subsp. *maculatus* (Debouck & Acosta 272, at G, K) from volcano “El Jagüey,” Durango, Mexico. —c. *P. maculatus* subsp. *ritensis* (Buhrow GVR, as accession PI535372 at USDA-Pullman, WA) from Geology Vista, Santa Catalina Mountains, Pima Co., Arizona, U.S.A. —d. *P. vulgaris* (Muruaga 4002, as accession G24571 at CIAT) from Tilapa, Oaxaca, Mexico. Please note the considerable difference in scale for 2b; each square length is 1 mm. —e. Living plant growing in Palmira station, Valle del Cauca, Colombia. Scale in cm. —f. SEM micrograph of the distal portion of style and stigma. Scale bar: 0.1 mm.

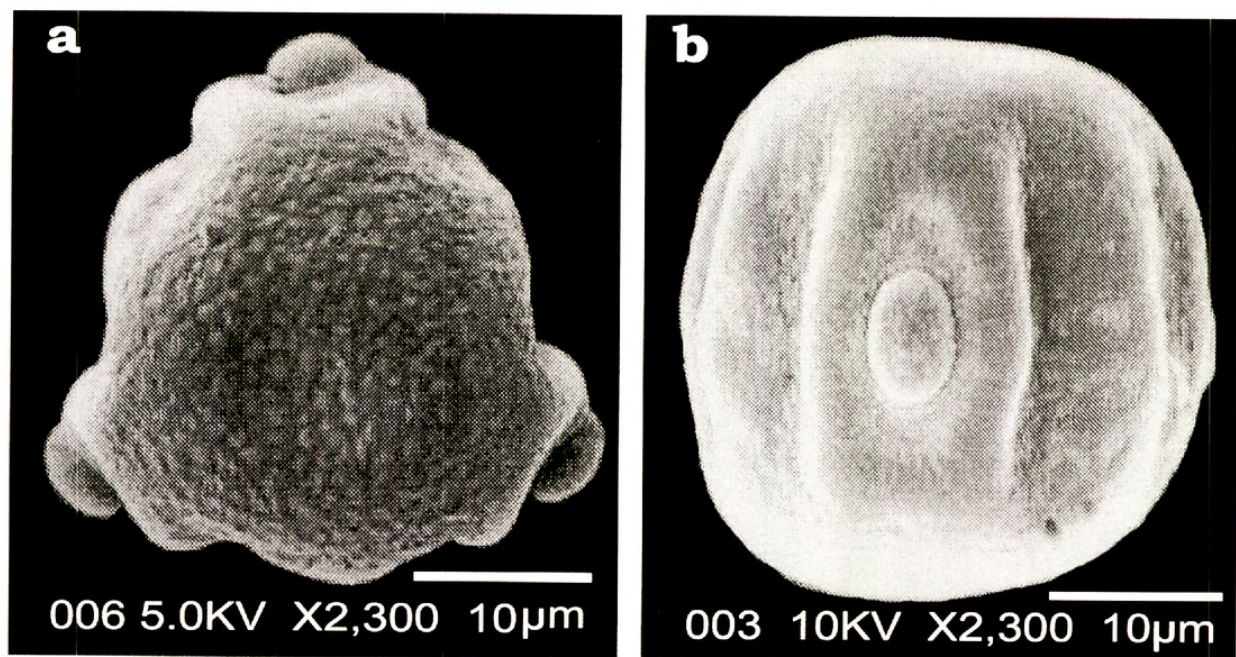


Figure 3. Micrographs of pollen grains. Polar (a) and equatorial (b) views; in the latter, a colporus is clearly visible in the center with deep pseudocolpi flanking both sides of the aperture. Scale bar: 10 microns.

reddish, finely striate, densely covered with white minute uncinata trichomes; internodes 4.7–7.6 cm long (Figs. 1b, 2c). Nodes reddened (60B) in sun-exposed stems, hay green to light tan on drying (152D). Stipules aciculate to narrowly lanceolate, thin, basifixed, spreading to appressed on drying, $2\text{--}3 \times 0.7\text{--}1$ mm, green, 3-nerved, margins sparsely ciliate. *Leaves* trifoliolate; leaflets green (137C), coriaceous, orbicular, mucronate, not variegated, primary veins prominent beneath, with a few straight or uncinata white trichomes, blade margins sparsely ciliate with white straight or uncinata trichomes; terminal leaflet symmetrical, orbicular on upper stems, slightly rhombic on lower portions (Fig. 1m, 2e), $28\text{--}35 \times 32$ mm (often wider in upper parts); lateral leaflets suborbicular to rounded truncate, often smaller than terminal leaflets, $10\text{--}26 \times 16\text{--}30$ mm. Petioles terete, canaliculate, spreading horizontally, green, 18–40 mm long, densely covered with minute white uncinata and straight trichomes. Petiolules terete, strongly canaliculate, green, 8–11 mm long, covered with minute white and a few straight trichomes. Basal pulvinus 2–2.5 mm long, reddish; distal pulvinus 2 mm long, greenish brown; pubescence as on the basal pulvinus and petioles. Lateral and terminal stipels minute, 0.75–1 mm long, acicular, green, 1- to 3-nerved, margins sparsely ciliate. *Inflorescence* short, stout, curved, 1 to 4-noded pseudoraceme, lateral racemes producing only 1 or 2 flowers (Fig. 1b, 2e); peduncle terete, 8–13 cm long, rachis 1–6 cm long, sparsely to densely covered with minute white uncinata trichomes and a few straight

hairs; primary bracts acicular with upper margin entire to seldom divided or trifid, 1–1.5 mm long, green, strongly 3 to 5-nerved, sparsely to densely covered with straight white trichomes; pedicellar bracts filiform, yellow, 1–1.5 mm long, strongly 1-nerved, densely covered with white, straight hairs; pedicels terete, green, 3–5 mm long, densely covered with white, straight or uncinata trichomes; bracteoles acicular, narrow, 1 mm long, 0-nerved, finely ciliate, light green, slightly reddened at base, white on drying, margin sparsely ciliate. *Flowers* papilionaceous, purple pink (81B) fading (85D), 2 for each secondary raceme (Fig. 1e, 2c); calyx round cupped, light green, base somewhat reddened, hirsute, calyx tube 3 mm long, the 3 lower calyx lobes triangular, 1×1 mm, the 2 upper lobes 0.5×1.5 mm, obtuse (Fig. 1f); corolla standard deep purple (82A) fading light purple, trapeziform, auricles much reflexed, outer face light purple (75D), glabrous with just a few straight short trichomes above, 10×7 mm, upper margin truncate, with a 1 mm, red-purple (59A) claw channel-shaped with two parallel, sigmoid callosities; the limb erect above a deep sinus; thickened at flexure (Fig. 1g); corolla wings spreading horizontally, deep purple (82B), obovate, subequal, blade 9×5 mm, outer margins slightly revolute, more so on the left wing, glabrescent with a few minute short straight hairs adjacent to the spur; claw linear, 4 mm long; the somewhat squared rounded spur slightly adhering to the keel (Fig. 1h); keel tubular in close spiral, white to yellow glabrous, $1 \frac{4}{5}$ closed counterclockwise coils, ca. 11 mm long, 2 claws divided, 3 mm long, with

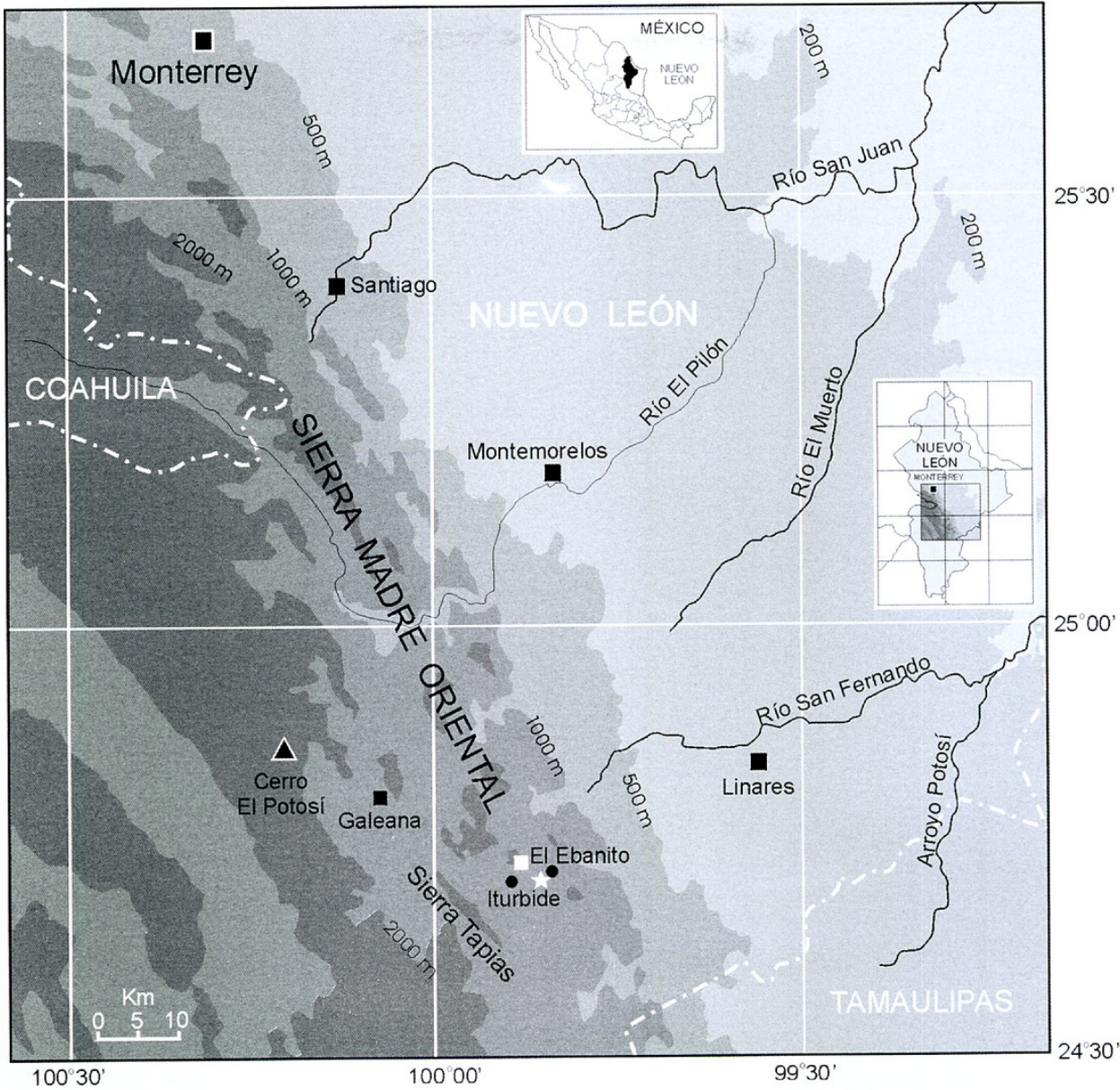


Figure 4. Distribution map for *P. novoleonensis* in northeastern Mexico (base map: Microsoft Encarta 2003). The white star refers to the type locality, while the white square refers to the paratype collection.

2 mm to flexure, pockets convex, rounded, 1 mm long, with few magenta spots toward the claw, pale yellow-green at apex (Fig. 1i); stamens diadelphous (9 + 1); vexillary stamen free, 10 mm long, claw terete, 2 mm to cupped knob, diameter 0.7 mm (Fig. 1k); staminal tube ca. 10 mm long, inconspicuously veined, appendages small and rounded (Fig. 1j); anthers oval, dorsifixed, dithecal, yellow; gynoecium with smooth basal disk, diameter ca. 1.5 mm; ovary green, slightly stipitate at base, laterally compressed, 3.7 mm long, smooth, glabrous, 3 to 4 ovules; style spiraled, ca. 10 mm long, with long fine white trichomes close to the stigma, not extending beyond it (Fig. 1l, 2f); stigma narrowly triangular, adaxially oriented, white, 0.8 mm long (Fig. 2f). *Pod* falcate, scimitar-like, 1 to 3-seeded (often with only the distal seed maturing),

25–35 × 9–11 mm, sutures finely demarcated, strongly dehiscent at maturity, drying tan, glaucous green (145C–143D), pod in mature development with fine, deep purple, sparsely distributed streaks and sutures reddish brown (165A) fading straw yellow (162A), beak 2 mm long (Fig. 1c, 2e). *Seed* oblong to lenticular, flattened, cream to light tan (164B–D), shiny, a few darker veins radiating from the hilum, 7–9 mm long, 4–6 mm wide, 3–5.5 mm thick; hilum elliptic, 1.3 mm long, a brown ring around the hilum; lens slightly raised (Fig. 1d, 2a). *Pollen* triangular (polar view), subprolate, tricolporate with 6 pseudocolpi, medium-sized, 30–35 µm diam., slightly brevixax, poles slightly flattened; margins surrounding the colpi prominent, smooth, 3 µm wide; endoaperture elliptic (longer axis 7 µm); endoaperture membrane

smooth, ectoaperture membrane finely punctate; tectum finely punctate (Fig. 3a, b).

The above description has been made on holotype and isotype vouchers obtained from living plants grown at CIAT (Palmira, Colombia), which were grown from seed of the original seed collection. Small amounts of seed (accessioned as G40590) are available from the Genetic Resources Unit of CIAT. The following key, after the one by Freytag & Debouck (2002), integrates the new taxon into sect. *Coriacei* Freytag.

- i. Leaflets rhombic, rounded to nearly ovate, not lobed at base; seed spherical to oblong, never lenticular.
 - ii. Leaflets not particularly strongly veined; stipules more than 2–3 mm long; stems usually 2 m long or longer.
 - iii. Leaflets mostly rhombic, usually obtuse; 1st leaves on new growth trifoliate; pods straight to slightly falcate, heavily sutured, usually not stipitate and 2- to 4-seeded; seeds rounded, more than 7 mm thick; common, in mountains and high grasslands of S United States (from Texas to Arizona) to NW Mexico (down to Puebla), 500–2600 m. *P. maculatus* subsp. *maculatus*
 - iii. Leaflets mostly ovate, usually acute; 1st leaves on new growth unifoliate; pods usually falcate, finely sutured, usually stipitate and 3- to 5-seeded; seeds oblong, less than 7 mm thick; common, in mountains of SW United States to NW Mexico (down to Jalisco), 600–2600 m. *P. maculatus* subsp. *ritensis*
 - ii. Leaflets strongly or distinctly veined; stipules 2–3 mm long; stems usually less than 2 m long.
 - iv. Stipules triangular, aciculate; leaflets orbicular; primary bracts acicular, 1.5 mm long, 3-nerved; rare, in foothills of Sierra Madre Oriental of Central Nuevo León at about 300–1000 m. O. 2. *P. novoleonensis*
 - iv. Stipules broadly ovate; leaflets rhombic-ovate; primary bracts orbicular, 3 mm long, strongly 5-nerved; rare, in grasslands of high plateaus of NE Jalisco and surrounding Aguascalientes and Zacatecas above 2000 m. O. 3. *P. venosus*
- i. Leaflets elongate, usually twice as long as wide or longer, often lobed at base, the veins distinct and arching forward; pod falcate, sutures finely thickened; seed lenticular; rare, in mountains of W Durango above 2000 m. O. 4. *P. reticulatus*

Geographic distribution. From the few specimens currently available, the species seems to be distributed on the eastern slope of Sierra Tapias (Fig. 4), and in other valleys along the eastern slope of Sierra Madre Oriental in the state of Nuevo León, Mexico, east of the regional divide (counties of Linares and Iturbide).

Ecology. The species has been found in *Quercus*, *Juglans*, and *Carya* forests in transition to tropical deciduous forest, on sunny and half shaded slopes, and on rocky soils (limestone, possibly Cretaceous) in mountain habitats (field notes, and Ferrusquía-Villafranca, 1993; Muller, 1939). It seems to be susceptible to spider mites. It appears to be the only species of the section in the northern range of Sierra Madre Oriental.

Etymology. The species is named after the state of Nuevo León in Mexico, the state to which it is confined.

Ethnobotany. The species is called “frijol de monte” by rural inhabitants in the county of Iturbide (personal observations, 1986); there are no reports about the use of its seeds.

Discussion. From the general morphology, it seems that *P. novoleonensis* belongs to the *Coriacei* section (Freytag & Debouck, 2002) and thus to the tertiary gene pool of lima bean (Maquet et al., 1999). With its sprawling stems and pluriannual fleshy root, the new species could be taken as a diminutive *P. maculatus* Scheele subsp. *maculatus*. It differs, however, from this subspecies by its small rounded leaflets (at least three times bigger in subsp. *maculatus*), by its short, curved, few-noded pseudoracemes, narrow primary bracts, falcate finely sutured pods, and flattened cream-colored seeds (Fig. 2a, b). In addition, the pollen pseudocolpi of *P. novoleonensis* contrast with those described for subsp. *maculatus* (Stainier & Horvat, 1985), being convex in the former. Similar to other taxa of the section (Freytag & Debouck, 2002), the standard is much reflexed, almost in the plane of the wings (Fig. 2e). Although it may also inhabit montane *Quercus* forests (Estrada & Martínez, 2000), *P. novoleonensis* differs from *P. maculatus* subsp. *ritensis* (Jones) Freytag by its first true leaves being trifoliate, petiolate eophylls, small rounded leaflets, veined not speckled seeds (Fig. 2a, c), and few-noded pseudoracemes. Although both subspecies of *P. maculatus* are distributed in the western half of the Chihuahuan desert (Nabhan et al., 1980; Freytag & Debouck, 2002), west of the 100°W meridian in Mexico, *P. novoleonensis* is restricted to the north-eastern part of this ecoregion. In contrast with the other species of the section *Coriacei* that thrive at high altitudes (Buhrow, 1983) and thus do not produce seed in Palmira, *P. novoleonensis* sets seeds there at 1000 meters in elevation, if pollen is brought on flower pistil, whereas it does not produce seeds in the Popayán station at 1800 meters above sea level.

Paratype. MEXICO, **Nuevo León:** Mpio. Linares, betw. settlements of El Ebanito & Los Pinos, 350 m, 28 Aug. 1986, A. E. Estrada Castillón 633 (BRI, CHAPA, MEXU 452041).

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