
Phaseolus talamancensis, a New Wild Bean Species (Leguminosae, Phaseolinae) from Montane Forests of Eastern Costa Rica

Alba Marina Torres González, Orlando Toro Chica, and Daniel G. Debouck
Genetic Resources Unit, Centro Internacional de Agricultura Tropical,
Apartado Aéreo 6713, Cali, Colombia

ABSTRACT. A new species of *Phaseolus* (Leguminosae, Phaseolinae) has been found in the montane forests of the Sierra de Talamanca in eastern Costa Rica, where it appears endemic. Distinctive traits include: radicant roots, purplish red internodes, veins of leaflets, primary bracts, inner face of standard, and wings. Differences with related taxa of Costa Rica and other parts of Central America are discussed, namely the smaller and rounded primary bracts as compared to *P. macrolepis*, and the radicant fibrous root system as compared to *P. xanthotrichus*.

Key words: Costa Rica, Leguminosae, Phaseolinae, *Phaseolus*.

With a view to enrich germplasm collections for bean breeding and future genetic engineering, one of us (DGD) has collected and studied *Phaseolus* beans in Latin America since the late 1970s. During the 1987 preparation of a germplasm exploration in Costa Rica, a specimen of *G. Davidse* & *G. Herrera* 29127 (CR) collected in 1984 from Limón appeared to be a new *Phaseolus* species for Costa Rica since it did not match with any species reported so far for that country (Debouck et al., 1989; Delgado Salinas, 1985; Piper, 1926; Standley, 1937). In the subsequent germplasm exploration, corresponding plants were found in the buffer zone of Parque Nacional Chirripó.

Phaseolus talamancensis Debouck & Torres, sp. nov. TYPE: Costa Rica. San José: San Isidro El General, 5 km N de Herradura, orillas del Río Blanco, al pie de la Fila Ojo de Agua, 83°37'W, 9°31'N, 1890 m, 13 Jan. 1987, *Debouck, Araya Villalobos, Ocampo Sánchez & González Ugalde* 2130 (holotype, CR; isotypes, COL, K, MO, US). Figures 1–5.

Haec species *Phaseolo macrolepidi* similis, sed ab eo inflorescentiae bracteis primariis rotundatis vel late ovatis minoribus, ab aliis congeneris costaricensibus caulibus petiolis foliorum nervis principalibus pedunculisque pur-

pureis vel rubropurpureis distinguitur; cum leguminibus *Phaseolo xanthotricho* primo adpectu similibus.

Seedlings small, delicate, from hypogeal germination; epicotyl terete, green to slightly reddish, 28–32 mm long, glabrous (Fig. 1c). Primary leaves opposite, simple; lamina deltoid, acuminate, petiolate, margin puberulent with minute whitish uncinuate hairs; petioles canaliculate, 4–5 mm long, green; central and two lateral main veins prominent. Stipules erect, basifixed, 1–2 mm long, oblong, slightly bifid, green; no stipels or stipels reduced to minute triangular scales, pulvini green glabrous. First true leaf trifoliolate, stipels reduced to minute triangular scales. *Roots* fibrous, often radicant with adventitious roots arising from nodes of lower stems, superficial not penetrating deep into the soil, gray brown (199A on 1966 RHS colour chart; Anonymous, 1966), with numerous nodules spheroidal, 1–3 mm, finely ridged, light to dark brown (Fig. 1a). *Plant* a short-lived herbaceous perennial with reduced branching from lower and middle stem nodes (Fig. 3a). Stem vine sprawling 1–3 m (Fig. 1b). Internodes 12 (4–17) cm, 0.7–2.5 mm diam. (up to 4.8 mm at base of main stem), terete, slightly grooved, red purplish (59A) fading green straw on drying, sparsely covered with yellow medium and short retrorse hairs, with minute uncinuate hooked hairs abundant around nodes. Nodes red purplish that fade straw or light tan on drying. Stipules membranaceous, thin, basifixed, deltoid to ovate, 5–7 × 4–5 mm, reflexed or sprawling, strongly 6- to 12-nerved, red purplish (59A), sparsely puberulent, margin sparsely ciliate toward the acute to obtuse apex. *Leaves* trifoliolate, medium green (137B), slightly lustrous, sparsely puberulent with small to minute almost translucent uncinuate hairs on veins, the main veins conspicuous and purplish on the upper surface, the main and secondary veins strongly conspicuous and purplish beneath with few grouped yellowish brownish long hairs, lamina finely reticulate. Petioles stout, canaliculate, 3.8–7.3 cm, purplish, sparsely puberu-



Figure 1. *Phaseolus talamancensis* Debouck & Torres. —a. Root system. —b. Habit of fertile plant. —c. Seedling. —d. Pod. —e. Seed. Floral parts (f–m):—f. Primary bract. —g. Calyx. —h. Wing. —i. Standard. —j. Vexillary stamen. —k. Keel. —l. Ovary and style. —m. Staminal tube. Scale: a–d in cm; e–m in mm. All drawings are from plants grown in Palmira and Tenerife, Colombia, of seed from the type collection (Debouck, Araya Villalobos, Ocampo Sánchez & González Ugalde 2130) from near Fila Ojo de Agua, orillas del Río Blanco, 5 km N de Herradura, distrito de San Isidro El General, Provincia de San José, Costa Rica.

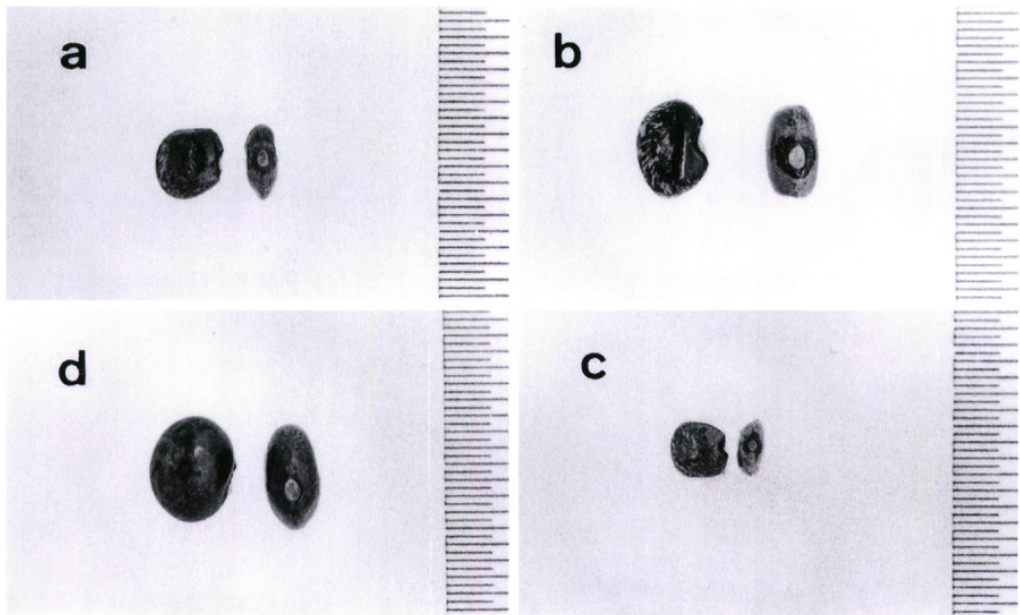


Figure 2. Close-ups of seeds in lateral views and views from hilum of: —a. *P. talamancensis* (Debouck et al. 2130) from type collection site. —b. *P. vulgaris* (Debouck, Araya Villalobos & Sánchez Trejos 3131) (wild form) from Jérico, San José, Costa Rica. —c. *P. xanthotrichus* (Debouck, Araya Villalobos, González Ugalde, Sánchez Trejos & Camacho Chacón 3104) from San José de la Montaña, Heredia, Costa Rica. —d. *P. macrolepis* (Debouck & Soto 1634) from Nahuala, Sololá, Guatemala. Same scale in mm and half mm, used for all four photographs.

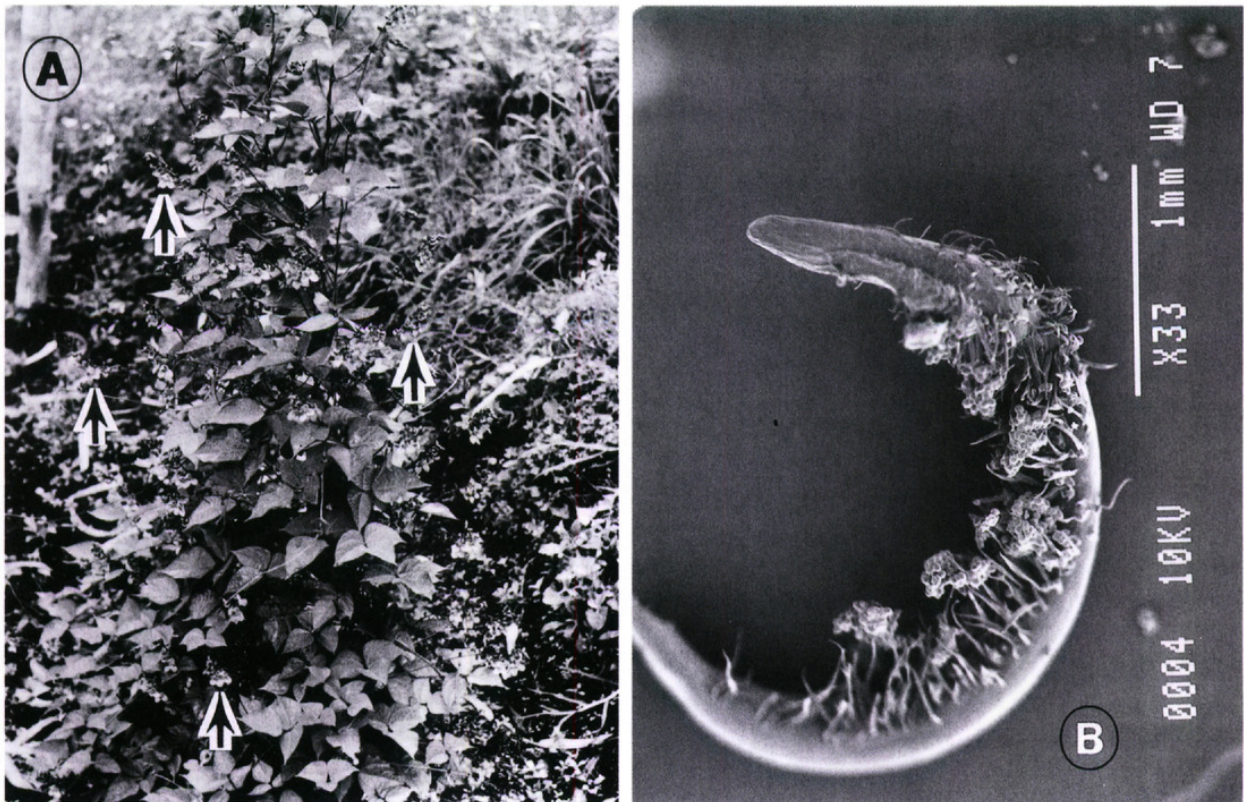


Figure 3. —a. Living plant in seed production plot in Tenerife, Valle del Cauca, Colombia; four pointing arrows indicate the location of racemes at blooming. —b. SEM micrograph of the distal portion of style and stigma. Scale bar: 1 mm.

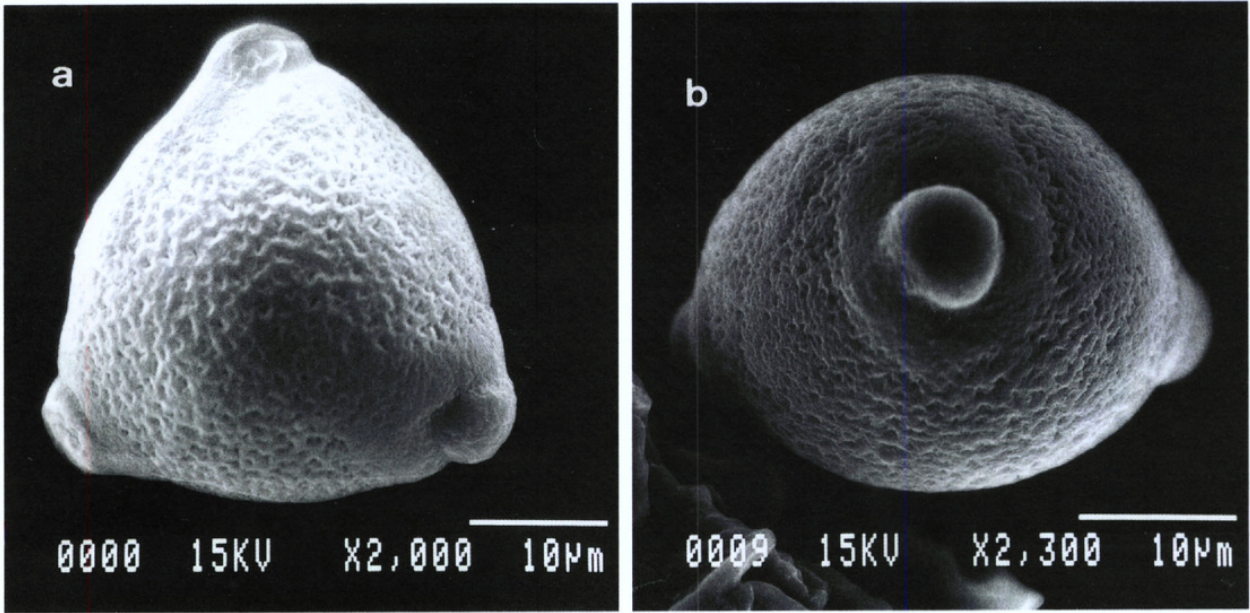


Figure 4. Micrographs of pollen grains. Polar (a) and equatorial (b) views; in the latter a colpus is clearly visible in the center, surrounded by mesh walls. Scale bar: 10 microns.

lent; basal pulvinus 6–7 mm, hairy, green turning yellowish green on drying; distal pulvinus 3–4 mm, hispid above. Rachis canaliculate, 9–11 mm, purplish, glabrescent. Lateral stipels lanceolate, acute, 2- or 3-nerved, $2\text{--}3 \times 1$ mm, glabrescent, margin sparsely ciliate. Distal stipels 1-nerved, $1 \times 0.8\text{--}0.9$ mm, margin puberulent. Lateral leaflets with pulvini 2–4 mm, green, ventrally tawny-hispid. Terminal leaflet deltoid to ovate, acuminate, occasionally curvilinearly caudate, $7.5\text{--}8.9 \times 5\text{--}6.3$ cm. Lateral leaflet inequilateral, ovate acuminate to curvilinearly caudate, $6.5\text{--}7.7 \times 4.4\text{--}5.2$ cm, main vein dividing lamina 1/3 distally and 2/3 proximally. *Inflorescence* a raceme of racemes, 26.5 (14.8–34) cm long, ascending, twice exceeding the leaves. Peduncle 14.8 (5.9–17.5) cm, terete, purplish green turning yellowish green upon drying, glabrous. Rachis stout, with 14 to 24 flowering secondary racemes; secondary racemes proximally 2.7 (3.1–1.4) cm distally 0.5 (0.8–0.2) cm spaced, purplish green turning yellowish green upon drying, sparsely puberulent with small whitish uncinata hairs. Secondary racemes extremely reduced. Primary bracts rounded to broadly ovate, $8\text{--}10 \times 6\text{--}7$ mm, with a short acumen seldom 2- or 3-toothed, ciliate, 6- to 9-nerved, purplish red (59A) fading purplish tan upon drying, persistent until anthesis, often caducous once pods fully develop (Fig. 1f). Pedicellar bracts triangular, hyaline, 0-nerved, 1 mm long or less, early caducous. Pedicels terete, 9 (7–11) mm long, ascending, purplish red fading yellow or tan, with sparsely minute uncinata hairs. Bracteoles

lanceolate, hyaline, 0- to 1-nerved, 1 mm long or less, caducous shortly after anthesis. *Flowers* purplish red fading purplish violet, 2 for each secondary raceme. Calyx campanulate, 5 (4–6) mm long, lobes subequal, the upper lobes wider than the lower ones, triangular, short, margin shortly ciliate, glabrous with minute whitish uncinata hairs, purplish (Fig. 1g). Standard purplish red (74A) fading purple (77A), outer face shiny purple violet (83A), 12×12 mm, with claw forward and limb erect above a deep sinus, rounded, emarginate, glabrous, auricles reflexed (the right auricle more reflexed than the left one), thickened at flexure; claw 2 mm long, channel-shaped, with two subequal longitudinal triangular callosities (Fig. 1i). Wings purplish red (74A) fading purple (77A), spreading obliquely forward, subequal, rounded, cupped, 17–19 mm long, blade 14×10 mm, channel-shaped above the claw, claw 5×1 mm, spur squarish, adherent to the keel (Fig. 1h). Keel tubular, spirally incurved, ca. 10 mm long, $1\frac{1}{4}$ coil, claws divided 3–4 mm long, 2 mm to flexure and 3.7–4.6 mm from flexure to terminal coil, convex “pockets” 2 mm long at the flexure adhering to the wings, glabrous, whitish at base (Fig. 1k). Stamens diadelphous (9 + 1). Vexillary stamen free, ca. 8.7 mm long, curved claw 1 mm long to cupulate knob 0.8 mm long, 1.3 mm wide (Fig. 1j). Staminal tube 10 mm long, smoothly veined, circular opening for the vexillary stamen with small appendages when closing (Fig. 1m). Anthers ellipsoid, dorsifixed, dithecal, yellow. *Pollen* spheroidal, tricolporate, and finely reticulate; both axes subequal, diameter 30–32 μm ,

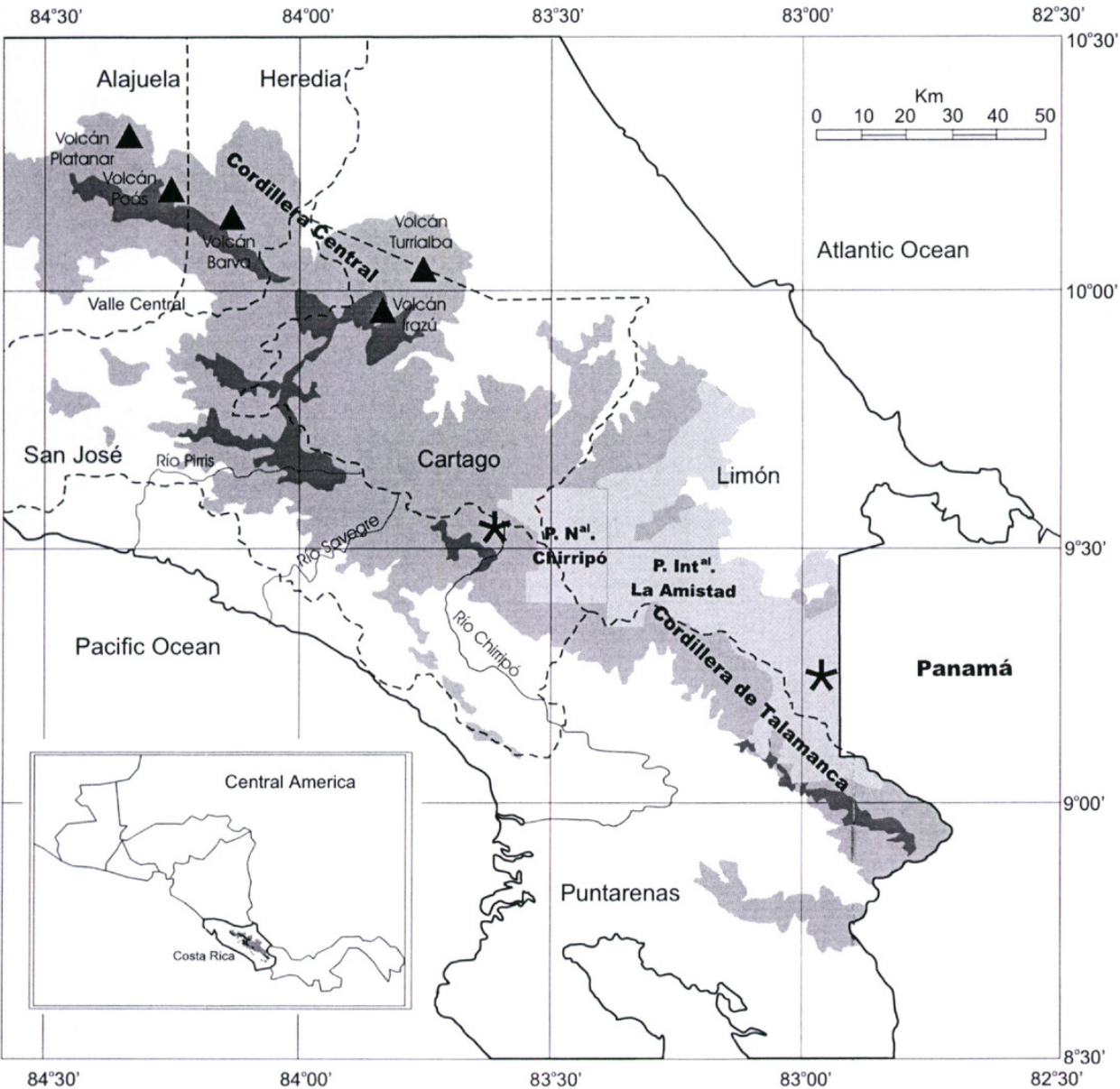


Figure 5. Distribution map for *P. talamancensis* in eastern Costa Rica. Stars mark where the two populations of *P. talamancensis* have been found so far. Solid triangles correspond to volcanoes. Dotted lines indicate limits of provinces. Light-shaded areas refer to protected areas “Parque Nacional Chirripó” and “Parque Internacional La Amistad.” Medium-shaded areas refer to landmasses above 1000 m a.s.l.; dark-shaded areas refer to the life zone Lower Montane Wet Forest (after Tosi, 1969).

margin bordering the colpi well developed 3–4 μ m wide, endoaperture circular diameter 7–8 μ m; endoaperture membrane smooth, ectoaperture membrane finely granular, tectum finely corrugated (Fig. 4a, b). Gynoecium with a basal disk diameter 1 mm, 0.5 mm high, denticulate. Ovary ca. 5 mm long, straight, laterally compressed, finely velvety with minute uncinata hairs, 6 or 7 ovules (Fig. 1l). Style upturned and spiraled, ca. 10 mm long with long fine hairs below the stigma, not pronounced beyond the stigma. Stigma triangular, adaxially oriented, orange yellow (Fig. 3b). *Pod* straight, slightly falcate, 43–67 \times 4–9 mm, chartaceous, obliquely finely veined, sutures pronounced, 4 to 7 seeds,

strongly dehiscent, beak small, delicately recurved, sparsely puberulent with few uncinata hairs, purplish green when young, green once fully developed drying tan brown (165A) (Fig. 1d). *Seed* suborbiculate convex, 3–5 \times 3–4 mm, black speckled on tan brown background, hilum elliptic white, a black ring around the hilum, lens slightly raised (Fig. 1e, 2a).

The above description has been made on holotype and isotype vouchers obtained from and on living plants grown at CIAT, in the substations of Palmira, Popayán, and Tenerife, Colombia, which allow the description of all parts, including seed-

lings. Color codes mentioned in the description refer to the RHS chart (Anonymous, 1966). Small amounts of seed are available from the Genetic Resources Unit of CIAT.

Geographic distribution. This species seems to be distributed only in the eastern part of Costa Rica, on both slopes of Sierra de Talamanca (Fig. 5). While the material *G. Davidse* & *G. Herrera* 29127 (CR) was found on the Atlantic slope of the Cordillera de Talamanca in the southeastern corner of the Limón province, the type population of *Debouck et al.* 2130 was found on its Pacific slope in the eastern part of San José province. It is premature to conclude about its rarity or level of endemism, given the incomplete botanical survey of eastern Costa Rica. Only two specimens have been found so far in herbaria. A possible explanation for this may lie in the fractionating and small acreage of the habitats in which *P. talamancensis* has been found so far (see below). On the other hand, part of its range could be in the Parque Internacional La Amistad, an important protected area between Costa Rica and Panama (Herlihy, 1997; Robison et al., 1993).

Ecology. This species is found in humid montane forests at elevations around 1800–1900 m. These habitats correspond to mixed forests described by Gómez Pignataro (1986) or the lower montane wet forest reported by Bolaños and Watson (1993), Hartshorn (1983), Sawyer and Lyndsey (1971), and Tosi (1969). They occupy only a small acreage in Costa Rica (767 km² or 1.5% of land; Hartshorn, 1983). There the short dry season would be from December to March (Herrera, 1985). As compared to other *Phaseolus* species thriving in Costa Rica, e.g., *P. lunatus* L., *P. oligospermus* Piper, *P. tuerckheimii* Donnell-Smith, and *P. vulgaris* L. (Araya Villalobos et al., 2001), *P. talamancensis* seems to be an early plant blooming around October and setting seeds in December. As searches for common bean germplasm are often carried late in the year in Central America, early species such as this one may have escaped the attention of plant collectors. Developing seeds of the type collection were heavily infested by bean pod weevils (Coleoptera, Curculionidae, *Apion* sp.). The presence of spider mites was noted at the type locality. While under cultivation in the field in Colombia, *P. talamancensis* was found susceptible to nematode attacks.

Etymology. The species is named in honor of the Talamanca Amerindians who first inhabited the mountainous range that is today called Sierra de Talamanca, where the species is distributed (Fig. 5).

Discussion. The intense purplish red color of the corolla is a distinctive trait of this new species. The large ovate red purple sometimes caducous primary bracts are also noteworthy. It is generally accepted (Lackey, 1983; Maréchal et al., 1978) that primary bracts are persistent up to anthesis in *Phaseolus*, in contrast with *Vigna* and *Macroptilium* species. As compared to other *Phaseolus* species present in Costa Rica, e.g., *P. lunatus*, *P. oligospermus*, *P. tuerckheimii*, and *P. vulgaris* (Debouck et al., 1989), floral bracts (primary and pedicellar bracts, and bracteoles) usually fall early in the course of floral ontogenesis and pod development in *P. talamancensis*. Pods and seeds (Figs. 1 and 2a–c, respectively) are similar to those of *P. xanthotrichus* Piper, although larger. In contrast with *P. xanthotrichus*, *P. talamancensis* has the distal part of the keel 1-¼ coiled, with the terminal part of the coil coming from the right, vertically located in the front, and counterclockwise. It thus belongs to the section *Phaseolus* of the genus as currently understood (Delgado Salinas, 1985; Maréchal et al., 1978). The pollen (Fig. 4) is tricolporate with a finely reticulate exine: both traits are relatively common in *Phaseolus* (Delgado Salinas, 1985). Another distinctive trait of *P. talamancensis* is the radicle and fibrous non-tuberous root system associated with hypogeal germination. This contrasts with the very frequent association of tuberous (conical, cylindrical, spherical) root systems with hypogeal germination in section *Phaseolus* (Caicedo et al., 1999). Lateral leaflets are often inverted once the plant is put in the plant press because of a peculiar phototropism on living plants (Fig. 3a).

The type collection has been elsewhere (Delgado et al., 1999) considered as *P. macrolepis* Piper, from which it clearly separates by several traits. In *P. macrolepis* inflorescence primary bracts are longer (10–25 mm long), foliaceous, and “elliptical, long-acuminate” (Piper, 1926: 698). Its leaflets are narrower and “long-acuminate and apiculate” (Piper, 1926: 698). Pods are broader (10–12 mm wide) and flattened in *P. macrolepis* as compared to *P. talamancensis*. Seeds are larger and roundish in *P. macrolepis* as compared to *P. talamancensis* (Fig. 2d and 2a, respectively). So far, *P. macrolepis* has not been found outside central and western Guatemala, where it seems to be endemic (Debouck, 1991, 1999; Delgado Salinas, 1985). According to Delgado Salinas and co-workers (1999), on the basis of ITS/5.8S DNA sequence, the material *Debouck et al.* 2130 would be remotely related to *P. oligospermus*, *P. tuerckheimii*, and *P. xanthotrichus*.

Paratype. COSTA RICA. **Limón:** Cordillera de Tal-

amanca, Atlantic slope, canyon of the Río Sini, elevation 1800–1900 m, 9°13'N, 82°59'W, “climbing vine, petals reddish-violet,” 15 Nov. 1984, G. Davidse & G. Herrera 29127 (CR, MO 5192727).

Acknowledgments. The senior author expresses gratitude to Rodolfo Araya Villalobos, Rafael Ocampo Sánchez, and William González Ugalde for enthusiastic and continuing support during fieldwork in 1987. The help of G. Davidse (MO) and W. Burger (F) in locating the paratype has been much appreciated. The financial support of the International Board for Plant Genetic Resources for the fieldwork is deeply acknowledged. The help of José Alejandro Arroyave and the Virology Unit of CIAT for the SEM micrographs of pollen and stigma has been most appreciated. The help of Oscar Idárraga and Fernando Pino, both at the Graphic Arts Unit of CIAT, for the preparation of the map and the photographs of seeds, respectively, is acknowledged. The authors thank the curators of CR, F, K, MO, US, and USJ for the loan of specimens.

Literature Cited

Anonymous. 1966. Royal Horticultural Society Colour Chart. The Royal Horticultural Society, London, United Kingdom, Fans 2 and 4.

Araya Villalobos, R., W. G. González Ugalde, F. Camacho Chacón, P. Sánchez Trejos & D. G. Debouck. 2001. Observations on the geographic distribution, ecology, and conservation status of several *Phaseolus* bean species in Costa Rica. *Genet. Resources & Crop Evol.* 47: in press.

Bolaños M., R. A. & V. Watson C. 1993. Mapa ecológico de Costa Rica. Centro Científico Tropical. Scale 1: 200,000, 9 sheets, San José, Costa Rica.

Caicedo, A. L., E. Gaitán, M. C. Duque, O. Toro Ch., D. G. Debouck & J. Tohme. 1999. AFLP fingerprinting of *Phaseolus lunatus* L. and related wild species from South America. *Crop Sci.* 39: 1497–1507.

Debouck, D. G. 1991. Systematics and morphology. Pp. 55–118. in A.v. Schoonhoven & O. Voysest (editors), *Common Beans—Research for Crop Improvement*. Commonwealth Agricultural Bureaux International, Wallingford, U.K.

———. 1999. Diversity in *Phaseolus* species in relation to the common bean. Pp. 25–52 in S. P. Singh (editor),

Common Bean Improvement in the Twenty-first Century. Kluwer Academic Publishers, Dordrecht, Holland.

———. 2000. Biodiversity, ecology, and genetic resources of *Phaseolus* beans—Seven answered and unanswered questions. Pp. 95–123 in K. Oono (editor), *Wild Legumes*. National Institute of Agrobiological Resources, Tsukuba, Japan.

———, R. Araya Villalobos, R. A. Ocampo Sánchez & W. G. González Ugalde. 1989. Collecting *Phaseolus* in Costa Rica. *FAO/IBPGR Plant Genet. Resources Newsl.* 78/79: 44–46.

Delgado Salinas, A. 1985. Systematics of the Genus *Phaseolus* (Leguminosae) in North and Central America. Ph.D Thesis, University of Texas, Austin, Texas.

———, T. Turley, A. Richman & M. Lavin. 1999. Phylogenetic analysis of the cultivated and wild species of *Phaseolus* (Fabaceae). *Syst. Bot.* 24: 438–460.

Gómez Pignataro, L. D. 1986. Vegetación de Costa Rica. Editorial Universidad Estatal a Distancia, San José, Costa Rica.

Hartshorn, G. S. 1983. Plants—Introduction. Pp. 118–157 in D. H. Janzen (editor), *Costa Rican Natural History*. Univ. Chicago Press, Chicago, Illinois.

Herlihy, P. H. 1997. Central American Indians peoples and lands today. Pp. 215–240 in A. G. Coates (editor), *Central America—A Natural and Cultural History*. Yale Univ. Press, New Haven, Connecticut.

Herrera, W. 1985. Clima de Costa Rica. Editorial Universidad Estatal a Distancia, San José, Costa Rica.

Lackey, J. A. 1983. A review of generic concepts in American Phaseolinae (Fabaceae, Faboideae). *Iselya* 2: 21–64.

Maréchal, R., J.-M. Mascherpa & F. Stainier. 1978. Étude taxonomique d'un groupe complexe d'espèces des genres *Phaseolus* et *Vigna* (Papilionaceae) sur la base de données morphologiques et polliniques, traitées par l'analyse informatique. *Boissiera* 28: 1–273.

Piper, C. V. 1926. Studies in American Phaseolinae. *Contr. U.S. Natl. Herb.* 22: 663–701.

Robison, D. M., E. Barona, S. E. Castaño, M. Rincón, H. Becerra, M. R. Henao & L. García. 1993. Areas legalmente protegidas y su relación con la frontera agrícola en el trópico americano. Centro Internacional de Agricultura Tropical, Cali, Colombia.

Sawyer, J. O. & A. A. Lindsey. 1971. Vegetation of the life zones in Costa Rica. *Indiana Acad. Sci. Monogr.* 2: 1–214.

Standley, P. C. 1937. Flora of Costa Rica. *Field Mus. Nat. Hist. Bot. Ser.* 18: 1–1616.

Tosi, J. A. 1969. Mapa ecológico, República de Costa Rica, según la clasificación de zonas de vida del mundo de L. R. Holdridge. Centro Científico Tropical, San José, Costa Rica, 1 sheet.



Chica, O T, Debouck, Daniel G., and González, Alda. 2001. "Phaseolus talamancensis, a new wild bean species (Leguminosae, Phaseolinae) from Montane Forests of Eastern Costa Rica." *Novon a journal of botanical nomenclature from the Missouri Botanical Garden* 11, 280–286.
<https://doi.org/10.2307/3393067>.

View This Item Online: <https://www.biodiversitylibrary.org/item/14671>

DOI: <https://doi.org/10.2307/3393067>

Permalink: <https://www.biodiversitylibrary.org/partpdf/12788>

Holding Institution

Missouri Botanical Garden, Peter H. Raven Library

Sponsored by

Missouri Botanical Garden

Copyright & Reuse

Copyright Status: In copyright. Digitized with the permission of the rights holder.

License: <http://creativecommons.org/licenses/by-nc-sa/3.0/>

Rights: <https://biodiversitylibrary.org/permissions>

This document was created from content at the **Biodiversity Heritage Library**, the world's largest open access digital library for biodiversity literature and archives. Visit BHL at <https://www.biodiversitylibrary.org>.