



## About the identity of *Tagetes pauciloba* (Asteraceae, Tageteae)

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### Abstract

*Tagetes pauciloba*, a species previously included in the synonymy of *T. filifolia*, is reinstated as a distinct species, and *T. mendocina* is placed in the synonymy of *T. pauciloba*. An epitype of *T. pauciloba* is designated. A revised morphological description of *T. pauciloba* is presented, including the presence of gemmiferous roots noted for the first time in Argentinian species of *Tagetes*. Distribution of *T. pauciloba* and *T. filifolia* in Argentina is mapped. A key to distinguish *T. pauciloba* from its Argentinian congeners with perennial habit is provided.

**Keywords:** Asteraceae; Tageteae; *Tagetes*; Taxonomy

### Introduction

*Tagetes* Linnaeus (1753: 887) is an American genus with a continuous distribution from southwestern United States to central Chile and northern Patagonia in Argentina (Neher 1966, Gutiérrez & Stampacchio 2015, Schiavinato *et al.* 2017). According to Soule (1996), its greatest species richness was recorded in Mexico; however, there is another diversity center in Argentina, where 12 species occur (Gutiérrez & Stampacchio 2015, Schiavinato *et al.* 2017).

*Tagetes filifolia* Lagasca (1816: 28) was originally described as an annual herb from Mexico. According to various authors, *T. filifolia* shows morphological variability in a wide range of ecological conditions (Ariza Espinar 1967, Keil 1975, Williams 1976, Gutiérrez & Stampacchio 2015, Pruski 2015). Although its presence in Argentina has been ignored by Zelada (1918) and Ferraro (1955) and later questioned by Cabrera (1978), the most recent studies indicate that *T. filifolia* occurs in Argentina at the southern limit of its continuous distribution from Mexico (Schiavinato *et al.* 2017).

*Tagetes pauciloba* Candolle (1836: 644) was originally described as a perennial subshrub from “Chile”. Hooker & Arnott (1841) and Hicken (1930) reported *T. pauciloba* from Mendoza province, western Argentina. Some years later, Neher (1966) included *T. pauciloba* in the synonymy of *T. filifolia*, and this was followed by some authors in regional floristic studies (Keil 1975, Gutiérrez & Stampacchio 2015).

As part of our revision (in progress) of the South American species of *Tagetes*, we detected that the protologue and type specimens of *T. pauciloba* differ markedly from those of *T. filifolia*. Also, a comprehensive study of protologues, type specimens and field observations indicated that *T. pauciloba* fits with the description of *T. mendocina* Philippi (1865: 337), a perennial species that inhabits western Argentina, in Catamarca, La Pampa, La Rioja, Mendoza, San Juan and San Luis provinces (Gutiérrez & Stampacchio 2015). On the other hand, the presence of *T. pauciloba* in Chile is doubtful because there is no herbarium specimen collected in Chile that fits the protologue, except the type specimen, which is labeled “Chile” without locality data.

In this paper, *T. pauciloba* is reinstated as a correct species name, and *T. mendocina* is placed in the synonymy of *T. pauciloba*. The perennial habit of *T. pauciloba* is confirmed, reporting here the presence of gemmiferous roots in Argentinian species of *Tagetes* for the first time. An epitype has been chosen, based on what can be deduced about the original collection locality, in the absence of direct evidence. Finally, a key is presented to differentiate this species from its congeners with perennial habit: *T. campanulata* Grisebach (1874: 188), *T. perezii* Cabrera (1937: 186) and *T. riojana* Ferraro (1955: 34).

## Materials and methods

We analyzed the protologues and specimens (types and non-types) from the following herbaria: BA, BAA, BAB, CORD, LIL, LP, MERL, SGO and SI (Thiers 2013). When physical specimens were not available, their photographs were obtained from JSTOR (2017) or virtual herbaria (E [<http://elmer.rbge.org.uk/bgbase/vherb/bgbasevherb.php>], G [<http://www.ville-ge.ch/musinfo/bd/cjb/chg/?lang=en>] and P [<https://science.mnhn.fr/all/search>]), or digital images were requested from curators of the herbaria and then analyzed. We also conducted field observations of *Tagetes* species in western and central Argentina.

The material used for the anatomical study of *T. pauciloba* roots was obtained from plants collected by the first author in a field trip to Manzano Histórico (33° 36.290'S 69° 26.621'W), Mendoza province. A voucher specimen was deposited at Gaspar Xuarez Herbarium (BAA). Small pieces of roots were fixed in FAA for 48 hours and later softened in water-glycerin for several days in an oven at 42° C. Subsequently, it was dehydrated in a series of ethanol solutions of increasing concentrations, clarified with xylol and included in pure paraffin (Johansen 1940). Sections (10–15 µm thick) were cut using a Minot rotary microtome. The material was stained with safranin combined with fast green (D'Ambrogio de Argüeso 1986) and mounted in Canada balsam. The photomicrographs were taken using a Zeiss Axioplan fluorescence microscope.

For the description of *T. pauciloba* we based our study on morphology: habit, leaves, capitula, phyllaries and flowers.

## Results and Discussion

### Clarification of *Tagetes pauciloba*

Our examination of the protologues and digital images of type specimens showed that *Tagetes pauciloba* and *T. filifolia* are actually different: *T. pauciloba* has a perennial habit with pedunculate capitula (occasionally subsessile) and cylindrical involucre with 5 phyllaries, mutic, with linear glands; ray florets ca. 5. On the other hand, *T. filifolia* is annual, with sessile or subsessile (occasionally pedunculated) capitula and fusiform involucre with 5 phyllaries, apex toothed, with punctiform glands; ray florets 1–3 (see Table 1). For the differences outlined above, *T. pauciloba* is here rehabilitated as a valid species.

Moreover, our critical analysis of the protologue and type specimen of *T. mendocina* revealed that it is identical to *T. pauciloba*, differing only in the number of leaf lobes: in *T. pauciloba* the leaves have 1–2 pairs of segments, while in *T. mendocina* they have 3–5 pairs of segments. Several botanists (e.g. Ariza Espinar 1967; Gutiérrez & Stampacchio 2015) indicated that the latter species shows leaves with a variable level of division, depending on their position in the plant architecture: lower leaves can have up to 6 pairs of segments; upper leaves can have 1 or 2 pairs of segments. Our examination of herbarium specimens and our observations in the field confirmed that. For the evidence stated above, we conclude that *T. mendocina* is a synonym of *T. pauciloba*.

**TABLE 1.** Morphological differences between *T. filifolia* and *T. pauciloba*

Characters	<i>T. filifolia</i>	<i>T. pauciloba</i>
Habit	Annual	Perennial
Involucre	Fusiform	Cylindrical
Involucre glands	Punctiform	Linear
Phyllaries apex	Truncated, toothed	Acute or obtuse, mutic
Ray florets	1–3	5

### Epitypification of *Tagetes pauciloba*

Candolle (1836: 644) indicated that the type specimen of *Tagetes pauciloba* was collected by Thaddäus Haenke in Chile. The herbarium and types of Candolle are deposited at G (Stafleu & Cowan 1976). We found the holotype of *T. pauciloba* (G 00456857, image available at <[http://www.ville-ge.ch/imagezoom/?fif=cjbip/cjb38/img\\_183/GDC026224\\_1.tif&cvt=jpeg](http://www.ville-ge.ch/imagezoom/?fif=cjbip/cjb38/img_183/GDC026224_1.tif&cvt=jpeg)>) and a specimen indicated as an isotype in P (P 02140934, image available at <<http://mediaphoto.mnhn.fr/media/1444270918729L9yyYg2DY6bJBDGW>>) (Fig. 1). Those specimens are poor in vegetative and reproductive material, and they are insufficient for a correct identification of the species, their perennial habit and division of leaves.

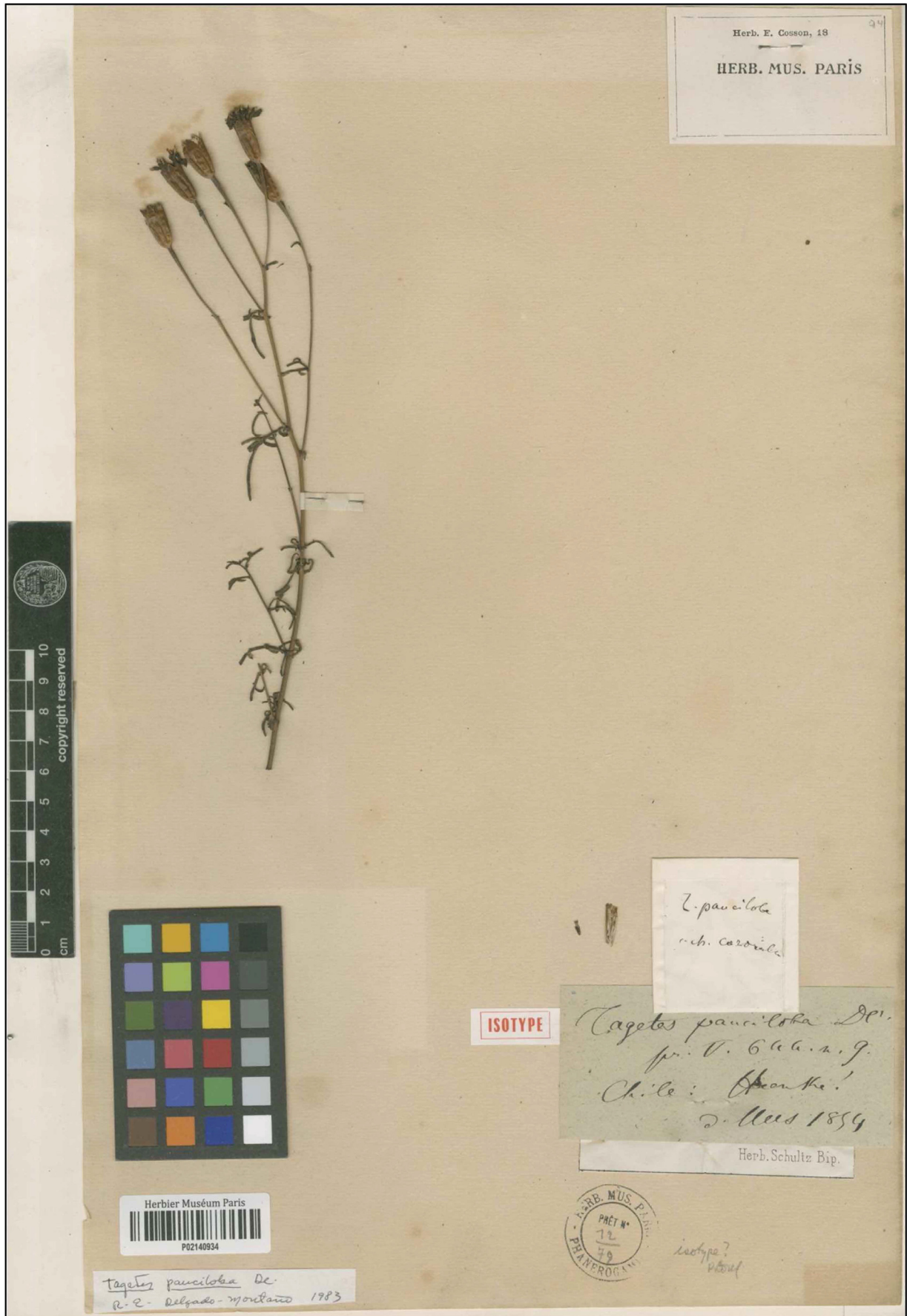


FIGURE 1. Isotype sheet of *Tagetes pauciloba* (P).



Moreover, several authors indicated that the presence of *T. pauciloba* in Chile is doubtful (Gay 1849, Reiche 1903, Gutiérrez & Stampacchio 2015). During the study of Chilean specimens of *Tagetes* deposited in the greatest herbaria of Argentina and Chile, we have not found any Chilean specimen that fits the protologue of *T. pauciloba*. According to Haenke's biographers (Presl 1827, Goodman 1972, David *et al.* 2001), in 1790 he left Buenos Aires on February 24 and arrived to Mendoza on March 17. After 4 days, he continued to Santiago to join the Malaspina Expedition. When he arrived to Santiago, he had collected nearly 1400 herbarium specimens. Though the evidence outlined above is very limited, it is not unreasonable to think that the type material of *T. pauciloba* was collected by Haenke in Mendoza and not in Chile.

According to the Melbourne Code (McNeill *et al.* 2012), we designated an epitype for *T. pauciloba* (Fig. 2). This specimen, deposited in BAA (BAA 00004830), was collected by the first author in a field trip to Villavicencio (32° 31,885'S, 69° 01,328'W), Mendoza province, where also the holotype of *Tagetes mendocina* was presumably found.

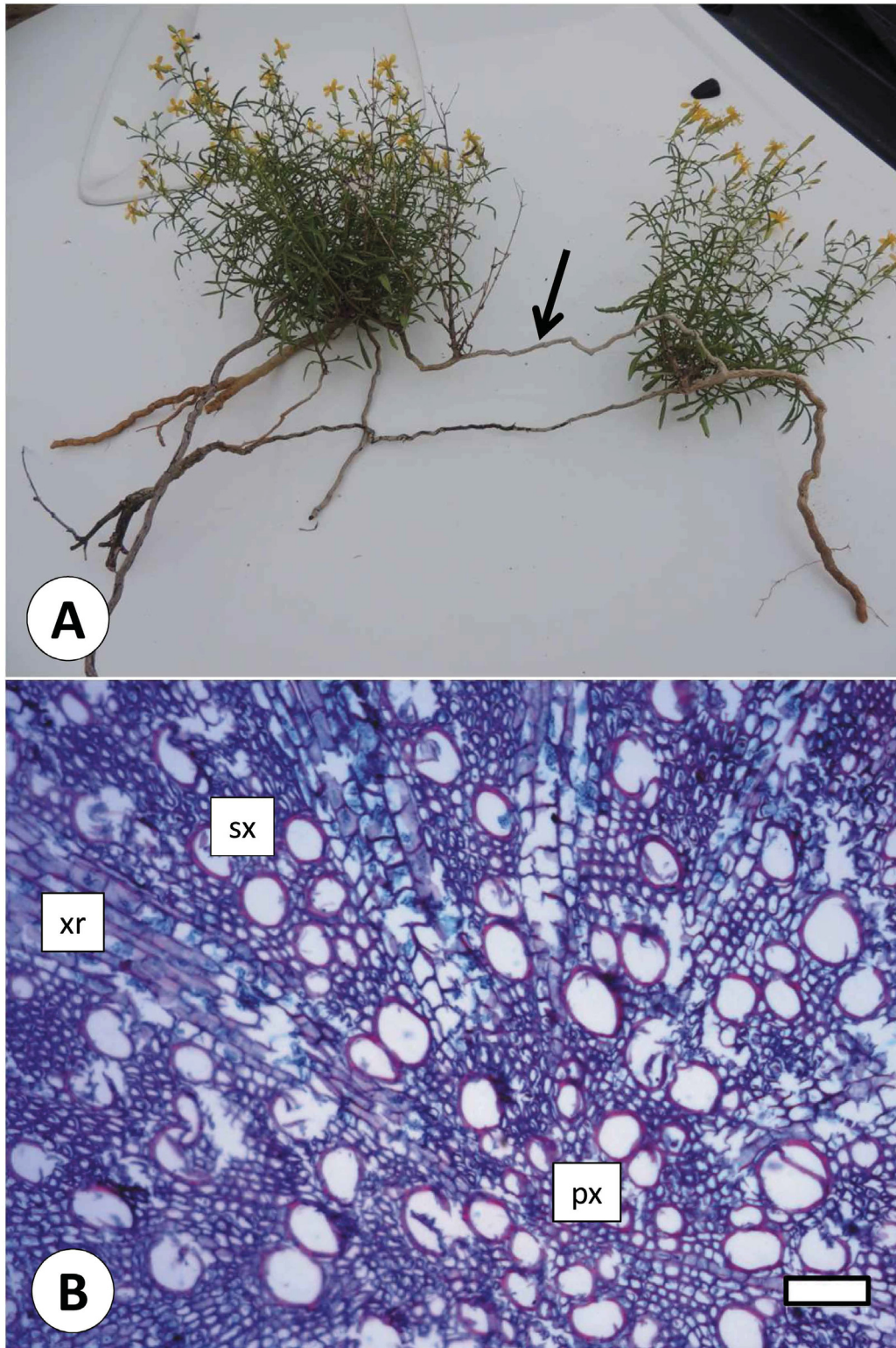


FIGURE 2. Epitype sheet of *Tagetes pauciloba* (BAA).



### Anatomic study of gemmiferous roots of *Tagetes pauciloba*

In addition to the taxonomic revision, morpho-anatomical studies of vegetative organs and secretory tissues in the genus *Tagetes* are being carried out. Specimens of *T. pauciloba* collected in the field showed a structure that seems to be a gemmiferous root (Fig. 3: A). Anatomical studies confirmed that this structure is actually a root, as we can observe in the cross section (Fig. 3: B). This observation constitutes the first mention of the presence of gemmiferous roots in Argentinian species of *Tagetes*.



**FIGURE 3.** Gemmiferous root of *Tagetes pauciloba*. A. External view (arrow indicates the section zone). B. Cross section of the central area of the root (px = primary xylem; sx = secondary xylem; xr = xylem ray; note the absence of pith). Scale bar=100  $\mu$ m.

## Taxonomic treatment

*Tagetes pauciloba* Candolle (1836: 644).

Type:—‘CHILE’ but likely ARGENTINA. ‘Chile’, *T. Haenke s.n.* (holotype G 00456857 [photo!]; isotype P 02140934 ex Herb. Sch. Bip. in Herb. E. Cosson [photo!]).

Epitype (designated here):—ARGENTINA. Mendoza: Las Heras department, Villavicencio, 2176 m, 32° 31,885′ S 69° 01,328′ W, 15 February 2016, *D. Schiavinato, D. Sbarra & F. Ratto 23/2016* (BAA 00004830!).

= *Tagetes mendocina* Philippi (1865: 337), **syn. nov.**

Type:—ARGENTINA. Mendoza, Cordillera de los Andes cerca de Villavicencio, 19 April 1863, *M. Landbeck s.n.* (holotype SGO 000006357!).

## Description

Perennial subshrubs or shrubs with xylopodium and gemmiferous roots, 0.25–0.90 m tall, aromatic. Stems several, erect, ramified, glabrous, foliaceous. Leaves herbaceous, opposite below, most of the superior ones subopposite, shortly petiolate or subsessile, glabrous, leaf blade ovate to obovate, (1–)2–4(–7) × (0.5–)1–3(–4) cm, pinnately dissected into 1–6 pairs of linear-ovate lobes, (3–)6–20(–30) × 0.5–3.5 mm, entire or dentate, with pellucid, circular-ovate glands, 0.3–0.5 × 0.15–0.25 mm. Capitula radiate, heterogamous, 1–3, in lax terminal corymbiform inflorescences, pedunculated or rarely subsessile. Receptacles flat or slightly convex, naked. Involucres cylindrical, (10–)11–14(–19) × 4–5(–6) mm. Phyllaries 5, in one series, connate except the apex, oblong, glabrous, streaked with numerous linear glands, 1–2 × 0.15–0.3 mm, most of the upper one elliptic, 0.5–0.6 × 0.2–0.4 mm, apex of phyllaries triangular, 0.9–1.5 mm, acute or obtuse, hispidulous at margins. Ray florets 5, pistillate, corolla yellow, tube 5–6 mm long, pubescent, ligule oblong, (3–)5–9 × (2.5–)3–5 mm, entire or 2–3-lobate, glabrous; style branches linear, 1.7–2 mm long, apex obtuse, papillose. Disc florets 9–25, perfect, corollas yellow, tubular, 5-dentate, tube 6.5–17 mm, pubescent, lobes 0.75–1.50 mm long, glabrous. Anthers 5, rounded at the base, 2–2.5 mm × 0.3–0.5 mm, apical appendages triangulate, 0.6–0.75 × 0.3–0.4 mm, filament collar cylindrical, 0.4–0.7 × 0.15–0.25 mm; style branches linear, 1.25–2 mm long, bearing a short, obtuse papillate appendage, ca. 0.3 mm long. Achenes 6–10 × 0.5–1 mm, cylindrical to subfusiform, 5-ribbed, pubescent in the entire surface, black at maturity. Pappus of 5 inequal scales in 1 series, some aristiform, 3–6 mm long, barbellate, and the rest scamiform, 1–2 mm long, with apex setose or fimbriate; sometimes 1–5 additional scales, very reduced, 0.1–0.8 mm long (Fig. 4: A–B).

## Habitat and distribution

*Tagetes pauciloba* inhabits xeric areas in western Argentina, in the phytogeographical province Monte (Cabrera & Willink 1980). It grows on rocky soils, from 900 to 3500 m above sea level (Fig. 4: C; Fig. 5).

Some authors indicated that *T. mendocina* (now placed in the synonymy of *T. pauciloba*) occurs in Chile (Neher 1966, Katinas & Gutiérrez 2013). However, this information is doubtful because this species has not been documentably collected in Chile yet.

## Phenology

Blooming from November to May.

## Etymology

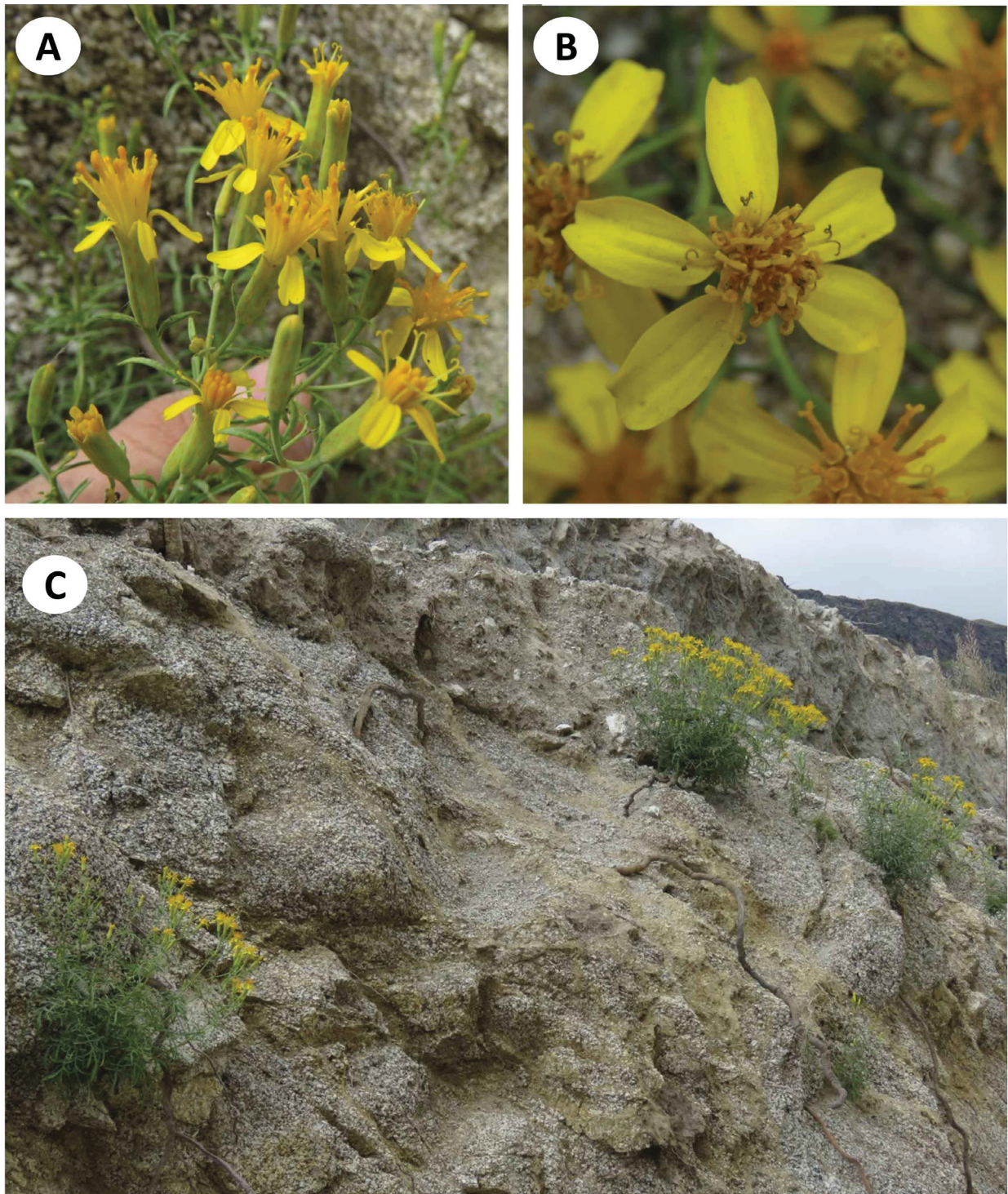
The specific epithet *pauciloba* refers to the low number of leaf lobes.

## Iconography

Ariza Espinar (1967: fig. 2, as *Tagetes mendocina* Phil.); Gutiérrez & Stampacchio (2015: 124, as *Tagetes mendocina* Phil.; available from [<http://www.floraargentina.edu.ar/>]).

Katinas & Gutiérrez (2013: fig. 270, as *Tagetes mendocina* Phil.).





**FIGURE 4.** *Tagetes pauciloba* in the wild (Mendoza, Argentina). A, B. Capitula. C. Habitat.

*Additional specimens examined*

***Tagetes filifolia* Lag.**

ARGENTINA. Córdoba: Punilla department, Provincial route 34 km 43, 2127 m, 31° 37.121'S 64° 51.408'W, 24 February 2016, *D. Schiavinato et al.* 131/2016 (BAA). Jujuy: Cochinoca department, National Route 9 Km 1910,5 between Abra Pampa and La Quiaca, 3490 m, 22° 38' 37.7''S 65° 41' 57.7''W, 12 March 2018, *D. Schiavinato et al.* 65/2018 (BAA). Salta: Chicoana department, Puente El Maray, 2201 m, 25° 10' 46.60''S 65° 46' 37.17''W, 20 February 2016, *D. Schiavinato et al.* 104/2016 (BAA). Tucumán: Tafí del Valle department, Provincial route 307, canyon between Carapunco and La Bolsa, 3011 m, 26° 45.873'S 65° 44.173'W, 18 February 2016, *D. Schiavinato et al.* 86/2016 (BAA).

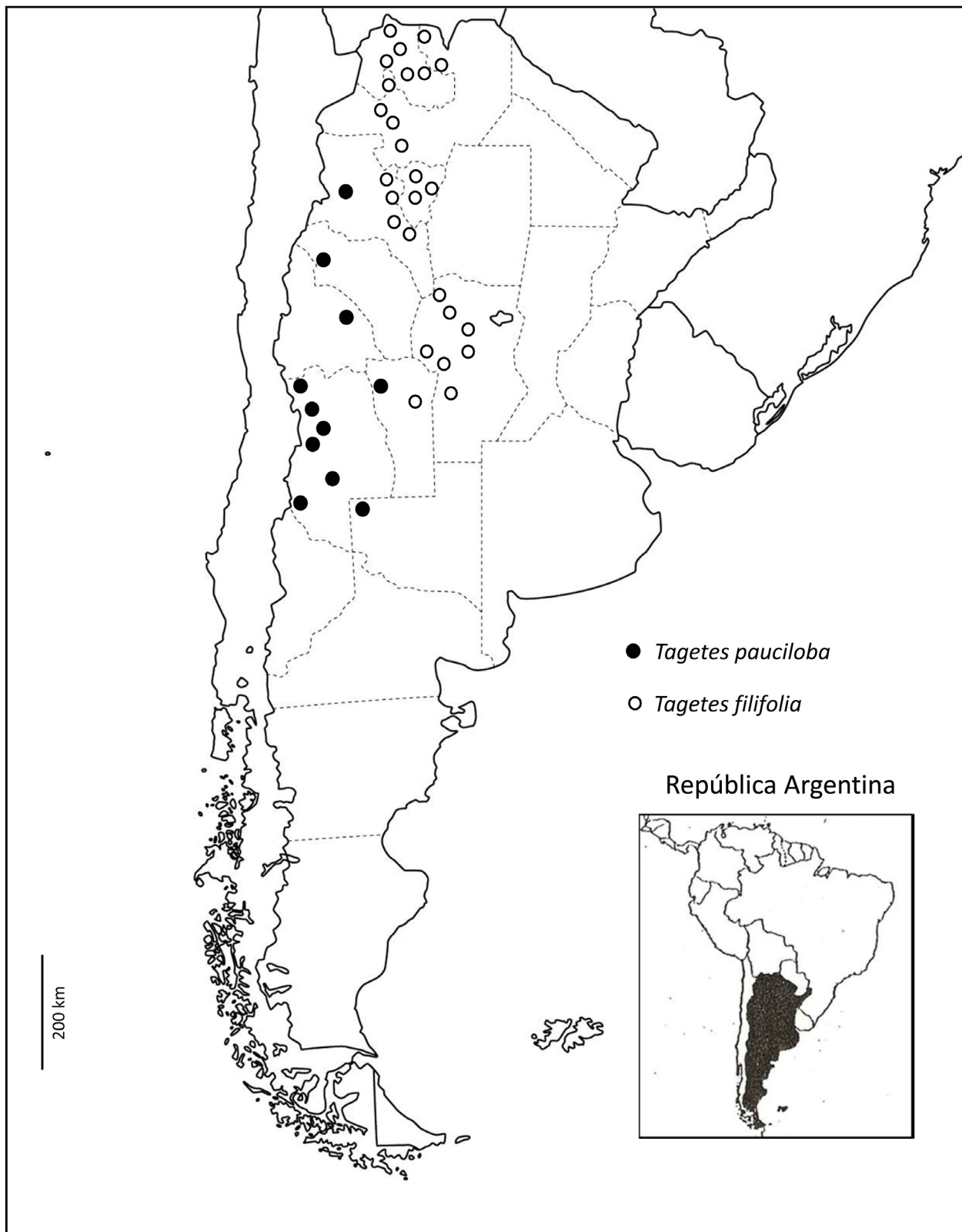


FIGURE 5. Distribution of *Tagetes pauciloba* and *T. filifolia* in Argentina.

***Tagetes pauciloba* DC.**

ARGENTINA. Catamarca: Andean region, no date, *without collector* (LP 005162). La Pampa: Chical-Co department, Cerro Agua de Torres, 1033 m, 36° 11.668'S 68° 08.479'W, 4 February 2018, *D. Schiavinato et al.* 31/2018 (BAA). La Rioja: La Madrid department, Sierra de Umango, April 1946, *Dirección de Lanas s.n.* (LP). Mendoza: Las Heras department, between Picheuta river and Polvaredas, 2050 m, 28 February 1985, *A. Ambrosetti* 1484 (CORD, MERL



39741), La Crucecita, 19 February 1944, *A. Burkart* 14947 (SI 017195); National route 7, 2054 m, 32° 41.317 'S 69° 31.595'W, 4 March 2017, *D. Schiavinato et al.* 9/2017 (BAA), National route 7, 2050 m, 32° 41.306'S 69° 31.582'W, 4 March 2017, *D. Schiavinato et al.* 10/2017 (BAA), National route 7, 2013 m, 32° 41.867'S 69° 31.875'W, 4 March 2017, *D. Schiavinato et al.* 11/2017 (BAA), National route 7, crossing with the Arroyo Seco channel, 1890 m, 32° 36.840'S 69° 26.053'W, 5 March 2017, *D. Schiavinato et al.* 15/2017 (BAA), National route 7, 7 km E of Polvaredas, 2300 m, 20 January 1985, *J. H. Hunziker et al.* 11240 (SI); Villavicencio, Provincial route 52, 2149 m, 32° 31.879'S 69° 01.338'W, 2 February 2018, *D. Schiavinato et al.* 18/2018 (BAA), Villavicencio, 12 February 1933, *A. Ruiz Leal* 1058 (LIL, MERL), Villavicencio, 1700 m, 21 January 1948, *J. H. Hunziker* 3112 (BAB 72102, CORD, LP), Villavicencio, 1700–1800 m, 20 April 1942, *A. Ruiz Leal* 8051 (MERL), Villavicencio, 12 January 1969, *H. Fabris & J. Crisci* 7520 (LP, P 02509475 [photo!]). Luján de Cuyo department, Cacheuta, Provincial route 82, 2022 m, 33° 02.016'S 69° 06.357'W, 2 February 2018, *D. Schiavinato et al.* 20/2018 (BAA), Cacheuta, 30 November 1913, *R. Sanzin* 219 (SI), Cacheuta, 10 April 1937, *A. Burkart* 8383 (SI 017190, SI 017191), Cacheuta, 10 April 1937, *A. Burkart* 8394 (SI 017192, SI 017193); National route 7, 1423 m, 32° 57.016'S 69° 12.664'W, 6 March 2017, *D. Schiavinato et al.* 26/2017 (BAA); Provincial route 89, 2196 m, 33° 03.276'S 69° 17.748'W, 15 February 2016, *D. Schiavinato et al.* 15/2016 (BAA). Malargüe department, Provincial route 180, between Agua Escondida and Malargüe, 1654 m, 36° 08.882'S 68° 41.765'W, 4 February 2018, *D. Schiavinato et al.* 33/2018 (BAA). San Rafael department, Cuesta de los Terneros, National route 144 Km 687, 1133 m, 34° 42.432'S 68° 24.067'W, 6 March 2017, *D. Schiavinato et al.* 34/2017 (BAA); Provincial route 184, 1414 m, 35° 19.300'S 68° 28.471'W, 3 February 2018, *D. Schiavinato et al.* 28/2018 (BAA); Sierra del Nevado, Zanjón del Plateado in front of Cerros Morados, 1650 m, 35° 40'S 68° 23'W, 8 December 1973, *O. Boelcke* 15720 (BAA, MERL 38679); Volcán Diamante, between 1800 meters and the edge of the crater, northeast slope, 21 February 1955, *A. Ruiz Leal* 17013 (LP, MERL); Volcán Diamante, no date, *Gillies* 150 (E 00322861 [photo!]). Tunuyán department, Cuchilla de la Virgen, 1600 m, 24 February 1941, *A. Castellanos s.n.* (BA 36927, LP), Las Peñas, Cuchilla de la Virgen, 1600 m, 24 February 1941, *A. Ruiz Leal* 7571 (LIL, MERL); between Paso de los Puntanos and Los Arenales, 18 February 1934, *A. Ruiz Leal* 2158 (MERL), Manzano Histórico, Cascada de la Vieja, 1961 m, 33° 36.290'S 69° 26.621'W, 2 February 2018, *D. Schiavinato et al.* 21/2018 (BAA). Tupungato department, Santa Clara, 2300 m, 2 February 1950, *M. A. Palacios & B. Balegno* 4545 (LIL). San Juan: Valle Fértil department, Sierra de Valle Fértil, about 9 km southwest of Valle Fértil, 12 December 1963, *L. Ariza Espinar* 1750 (CORD), Sierra de Valle Fértil, Cerro de la Antena, 13 April 2001, *C. Luján* 74 (CORD); Ischigualasto, 22 April 1973, *F. A. Roig & E. Méndez* 7809 (MERL 39038). San Luis: Belgrano department, east slope of Sierra del Gigante, 1944, *J. R. Guiñazú* 28 ½ (LP).

### Key to Argentinian species of *Tagetes* with perennial habit

- |    |  |                       |
|----|--|-----------------------|
| 1. | Phyllaries 2–3 .....   | <i>T. riojana</i>     |
| –  | Phyllaries 5–8 .....   | 2                     |
| 2. | Limb of ray florets 12–14 mm long; leaf lobes ovate, 5–8 mm wide, sharply serrate.....                               | <i>T. campanulata</i> |
| –  | Limb of ray florets 2.5–9 mm long; leaf lobes linear-ovate, 0.5–3.5 mm wide, entire or dentate but not serrate ..... | 3                     |
| 3. | Leaves subfleshy, 1–3 × 0.5–1 cm, limb of ray florets ca. 2.5 mm long.....   | <i>T. perezii</i>     |
| –  | Leaves herbaceous, 1–7 × 0.5–4 cm; limb of ray florets (3–)5–9 mm long.....  | <i>T. pauciloba</i>   |

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The photograph of the material in Figure 1 is reproduced with permission from Herbarium of the Muséum national d'Histoire naturelle (P), Paris, France. This work was supported by Universidad de Buenos Aires and Consejo Nacional de Investigaciones Científicas y Técnicas.

## References

- Ariza Espinar, L. (1967) Las especies de *Tagetes* (Compositae) de la región central argentina. *Kurtziana* 4: 51–71.
- Cabrera, A.L. (1937) Compuestas argentinas nuevas o interesantes. *Notas del Museo de la Plata, Botánica* 2 (16): 171–204, pls. I–IV.
- Cabrera, A.L. (1978) Compositae. In: Cabrera, A.L. (Ed.) *Flora de la Provincia de Jujuy. Colección Científica del Instituto Nacional de Tecnología Agropecuaria* 13 (10): 1–726.
- Cabrera, A.L. & Willink, A. (1980) *Biogeografía de América Latina*. O. E. A. Serie de Biología, Monografía 13, Washington, D. C., 117 pp.
- Candolle, A.P. de (1836) *Prodromus Systematis Naturalis Regni Vegetabilis. Vol. 5*. Treuttel & Würtz, Paris, 706 pp.
- D'Ambrogio de Argüeso, A. (1986) *Manual de técnicas en histología vegetal*. Hemisferio Sur, Buenos Aires, 83 pp.
- David, A., Fernández-Armesto, F., Novi, C. & Williams, G. (2001) *The Malaspina Expedition 1789–1794: The Journal of the Voyage by Alejandro Malaspina, Volumen I, Cádiz to Panamá*. The Hakluyt Society, Series 3, Volumen 8, in association with the Museo Naval, Madrid, xcvi + 338 pp. + 39 pls. + 9 maps.
- Ferraro, M. (1955) Las especies argentinas del género *Tagetes*. *Boletín de la Sociedad Argentina de Botánica* 6: 30–39.
- Gay, C. (1849) *Historia física y política de Chile según documentos adquiridos en esta república durante doce años de residencia en ella y publicada bajo los auspicios del Supremo Gobierno. Botánica [Flora chilena]*. Editorial Faine & Thunot, Vol. IV. Santiago, París, 516 pp.
- Goodman, E.J. (1972) *The Explorers of South America*. Macmillan, New York, 408 pp.
- Grisebach, A.H.R. (1874) *Plantae Lorentzianae. Abhandlungen der Königlichen Gesellschaft der Wissenschaften zu Göttingen, Physikalische Classe* 19: 49–280.
- Gutiérrez, D.G. & Stampacchio, M.L. (2015) *Tagetes*. In: Zuloaga, F.O., Belgrano, M.J. & Anton, A.M. (Eds.) *Flora Argentina: Flora Vasculare de la República Argentina. Vol. 7. Pt. 2*. Estudio Sigma SRL, Buenos Aires, pp. 118–129.
- Hicken, C.M. (1930) Primitiae Sanzinianae: Las primeras plantas recogidas en Mendoza por Renato Sanzin. *Darwiniana* 2 (2–3): 37–57.
- Hooker, W.J. & Arnott, G.A.W. (1841) Contributions towards a Flora of South America, and the Islands of the Pacific. *Journal of botany: being a second series of the Botanical miscellany* 3: 310–348.
- Johansen, D.A. (1940) *Plant Microtechnique*. McGraw-Hill, New York, 523 pp.
- JSTOR (2017) *Global Plants*. Available from: <http://plants.jstor.org/> (access 26 October 2017)
- Katinas, L. & Gutiérrez, D.G. (2013) *Tagetes*. In: Ariza Espinar, L. & Freire, S. (Eds.) *Flora de San Juan IIIb*. República Argentina, pp. 241–247.
- Keil, D.J. (1975) *Tageteae*. In: Woodson, R.E. & Schery, R.W. & Coll. (Eds.) *Flora of Panama, Part IX (Family 184. Compositae)*. *Annals of the Missouri Botanical Garden* 62 (4): 1220–1241.
- Lagasca y Segura, M. (1816) *Genera et species plantarum, quae aut novae sunt aut nondum recte cognoscuntur*. Madrid, 35 pp.
- McNeill, J., Barrie, F.R., Buck, W.R., Demoulin, V., Greuter, W., Hawksworth, D.L., Herendeen, P.S., Knapp, S., Marhold, K., Prado, J., Prud'homme Van Reine, W.F., Smith, G.F., Wiersema, J.H. & Turland, N.J. (Eds.) (2012) *International Code of Nomenclature for algae, fungi, and plants (Melbourne Code): Adopted by the Eighteenth International Botanical Congress Melbourne, Australia, July 2011. Regnum Vegetabile 154*. Königstein: Koeltz Scientific Books. Available from: <http://www.iapt-taxon.org/nomen/main.php> (accessed 23 October 2017)
- Neher, R.T. (1966) *Monograph of the genus Tagetes*. Ph.D. thesis, Indiana University, Bloomington, Indiana, 306 pp.
- Philippi, R.A. (1865) Excursión Botánica en Valdivia desde los Cuneos en el departamento de La Unión, a través de la Cordillera de la Costa, hasta el mar. *Anales de la Universidad de Chile, Santiago* 27: 289–351.
- Presl, C.B. (1827) *Reliquiae Haenkeanae, seu, Descriptiones et icones plantarum quas in America meridionali et boreali, in insulis Philippinis et Marianis collegit Thaddaeus Haenke /redegit et in ordinem digessit Carolus Bor. Presl. Cura Musei Bohemici. Vol. 1*. Apud J.G.Galve, Prague, 356 pp.
- Pruski, J.F. (2015) *Tagetes* L. In: Pruski, J.F. & Robinson, H. (Eds.) *Flora Mesoamericana. Vol. 5. Pt. 2*. Available from: <http://www.tropicos.org/> (accessed 12 June 2018)
- Reiche, C. (1903) Estudios críticos sobre la Flora de Chile. *Anales de la Universidad de Chile* 112: 97–179.
- Schiavinato, D.J., Gutiérrez, D.G. & Bartoli, A. (2017) Typifications and nomenclatural clarifications in South American *Tagetes* (Asteraceae, Tageteae). *Phytotaxa* 326 (3): 175–188. <https://doi.org/10.11646/phytotaxa.326.3.2>
- Soule, J.A. (1996) Infrageneric systematics of *Tagetes*. In: Hind, D.J.N. & Beentje, H.J. (Eds.) *Compositae: Systematics. Proceedings of the International Compositae Conference, Kew, 1994*, vol. 1. Royal Botanic Gardens, Kew, pp. 435–443.
- Stafleu, F.A. & Cowan, R.S. (1976) *Taxonomic Literature. 2nd Ed. Vol. 1: A–G*. Bohn, Scheltema & Holkema, Utrecht, 1135 pp. Available from: <http://www.sil.si.edu/DigitalCollections/tl-2/> (accessed 23 October 2017)



- Thiers, B. (2013) *Index Herbariorum: A global directory of public herbaria and associated staff*. New York Botanical Garden's Virtual Herbarium. Available from: <http://sweetgum.nybg.org/ih/> (accessed 26 October 2017)
- Williams, L.O. (1976) Tribe VI, Helenieae. *In*: Nash, D.L. & Williams, L.O. (Eds.) *Flora of Guatemala – Part XII. Fieldiana, Botany* 24: 361–386, 571–580.
- Zelada, F. (1918) Estudio del *Tagetes anisata* Lillo nov. sp. *Informes del Departamento de Investigaciones Industriales de la Universidad Nacional de Tucumán* 8: 3–15.