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Original Paper

Tagetes dombeyi (Asteraceae, Tageteae), a new species from the Central Andes first collected in the 18th century

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Abstract

Tagetes dombeyi (Asteraceae, Tageteae), a new species from the Central Andes first collected in the 18th century. A new annual species of *Tagetes* from the Central Andes of Peru and Bolivia, *T. dombeyi*, is described and illustrated based on herbarium collections and photographs of the plants in their habitat. *Tagetes dombeyi* is closely related to *Tagetes imbricata*, *Tagetes multiflora* - both of which can occasionally be found mixed with the former on the same herbarium sheet - and *Tagetes iltisiana*. However, they can be distinguished by diagnostic characters of leaf, corolla, and pappus. A morphological description is provided along with an illustration, a range map, and a key to differentiating the *Tagetes* species that inhabit Peru and Bolivia.

Key words: Bolivia, Compositae, herbarium collections, Peru, taxonomy.

Resumen

Tagetes dombeyi (Asteraceae, Tageteae), una especie nueva de los Andes Centrales coleccionada por primera vez en el Siglo XVIII. Una especie anual de *Tagetes* de los Andes Centrales de Perú y Bolivia, *T. dombeyi*, es descrita e ilustrada por primera vez a partir de colecciones de herbario y fotografías de las plantas en su hábitat. *Tagetes dombeyi* se asemeja a *Tagetes imbricata*, *Tagetes multiflora* - siendo éstas dos ocasionalmente halladas montadas en la misma cartulina de herbario junto con la primera - y *Tagetes iltisiana*. Sin embargo, estas especies estrechamente relacionadas pueden ser distinguidas a partir de caracteres diagnóstico de hoja, corola y papus. Se provee una descripción morfológica de la nueva especie junto con una ilustración, un mapa de distribución geográfica y una clave para diferenciar las especies de *Tagetes* que habitan en Perú y Bolivia.

Palabras clave: Bolivia, Compositae, colecciones de herbario, Perú, taxonomía.

Introduction

Tagetes L. is a genus of 45–55 species with a native distribution from the southwestern United States to central Chile and central Argentina, primarily in xeric highlands and montane regions (Strother 1977; Soule 1993; Schiavinato *et al.* 2017). Historically, the greatest richness of *Tagetes* species was recorded in Mexico with ca. 30 species (Soule 1993; Turner 1996; Schiavinato *et al.* 2021). However, the second high diversity area is the Central Andes (mainly western and northwestern Argentina, Bolivia, Ecuador, and Peru) where 15–20 species occur (Robinson 1999; Robinson & Soule 2006; Robinson 2014; Gutiérrez & Stampacchio 2015; Schiavinato *et al.* 2017). Furthermore, some species (e.g., *Tagetes erecta* Linnaeus [1753: 887], *Tagetes lemmonii* Gray [1883: 40], *Tagetes minuta* Linnaeus [1753: 887]) have been introduced around the world for horticultural purposes, becoming naturalized and invasive due to their weedy behavior (Soule 1996; Schiavinato *et al.* 2021, GBIF.org 2023).

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Tagetes includes annual or perennial herbs, subshrubs, and shrubs, strongly aromatic due to the presence of secretory cavities in leaves and phyllaries; leaves opposite below, most of the upper ones alternate, with usually pinnately dissected blades; capitula radiate or subradiate, with phyllaries fused in one series; and a pappus of few scales in one or - more rarely - two series, each scale truncated or ending in a single long awn (rarely 3–5-awned) at the apex (Robinson 1973; Soule 1993; Schiavinato & Bartoli 2018).

As part of our integral taxonomic revision of *Tagetes*, in recent years we have been working in depth on a complex of South American species that are similar in appearance as they have an annual growth habit, their capitula are arranged in lax corymbiform capitulescences, and the involucres of phyllaries are partially purplish. Characters such as shape and color of leaf blades, number of phyllaries, color of corollas, and shape and size of pappus scales have proven useful for differentiating species, especially when working with early and/or depauperate herbarium specimens. An exhaustive morphological study of these diagnostic characters has allowed us to recircumscribe some very little-known species (Schiavinato & Bartoli 2018, 2019a) and to describe a new species (Schiavinato & Bartoli 2019b). Continuing with our work in this complex, we have recently detected several herbarium specimens from the Central Andes of Peru and Bolivia that show a combination of the aforementioned diagnostic characters that does not match any of the known species of the genus. This evidence, supported by photographs of the plants in the wild, allows us to describe a species new to science.

Material and Methods

The description of the new species was based on 29 herbarium specimens housed at LIL, LP, MA, NY, P, and US (Thiers, continuously updated), which were cross-checked against the type specimens of all accepted species of *Tagetes*. When physical specimens were unavailable, digital images were obtained from GBIF.org (2023), JSTOR (2023), or requested from the curators. The morphological study was complemented with photographic records of the new species available at iNaturalist (Lindqvist 2018).

General terminology for morphological and anatomical structures follows Beentje (2010). Terminology for leaf architecture follows Ellis *et al.* (2009), and for pappus morphology, it follows Roque & Bautista (2008) and Beentje (2010). When comparing the new species with its congeners, leaf blade measurements were taken in all cases from leaves located in the middle zone of the stems, excluding the reduced or bractiform upper ones to avoid distortions. The flowering and fruiting period of *T. dombeyi* was determined by cross-checking the phenological stages of the plants against the information available on the labels, considering only those specimens in which the reported collection date corresponds to a period of no more than two months.

The range map of the new species was made with QGIS.

Results and Discussion

Tagetes dombeyi Schiavinato, D.G.Gut. & Adr. Bartoli, sp. nov. Figs. 1-5

TYPE: PERU. Without locality, without date [between years 1778-1781], *J. Dombey* (holotype P 02140932! [Figs. 1, 2]; isotype P 02140933!). Fig. 3.

Tagetes dombeyi is morphologically close to *Tagetes multiflora* Kunth in Humboldt, Bonpland & Kunth (1818: 154), from which it differs in having discolorous leaves, darker on the adaxial surface (*vs.* concolorous leaves in *T. multiflora*); leaf blades pinnately dissected in broader segments, 2.5–5.5 mm wide (*vs.* leaf blades pinnately dissected in narrower segments, 1–2 mm wide), and scale pappus subulate - *i.e.*, the widest part at the base of the scale and ending in a long, sharp point - and barbellate - *i.e.*, bearing lateral projections much shorter than the width of the scale base - (*vs.* scale pappus oblanceolate or ensiform [*i.e.*, the widest part in the distal two-fifths of the scale and ending in a triangulate apex] and plumose [*i.e.*, bearing lateral projections longer than the width of the scale base]). *Tagetes dombeyi* also resembles *Tagetes iltisiana* Robinson (1973: 378) and *Tagetes imbricata* Schiavinato & Bartoli (2019b: 277), from which it differs in having limb of ray florets orange-yellow (*vs.* white-yellowish in both *T. iltisiana* and *T. imbricata*), and pappus equal to or longer than the cypsela - pappus/cypsela ratio 1 to 1.25 - (*vs.* pappus shorter than the cypsela [pappus/cypsela ratio 0.25 to 0.75]).

Slender annual herbs with a slender, unthickened taproot, (12–)20–40(–50) cm tall, marigold-like scent. Stems erect or decumbent, leafy except towards base, striate, glabrescent. Leaves herbaceous, green, discolorous, the adaxial surface slightly darker than the abaxial, opposite

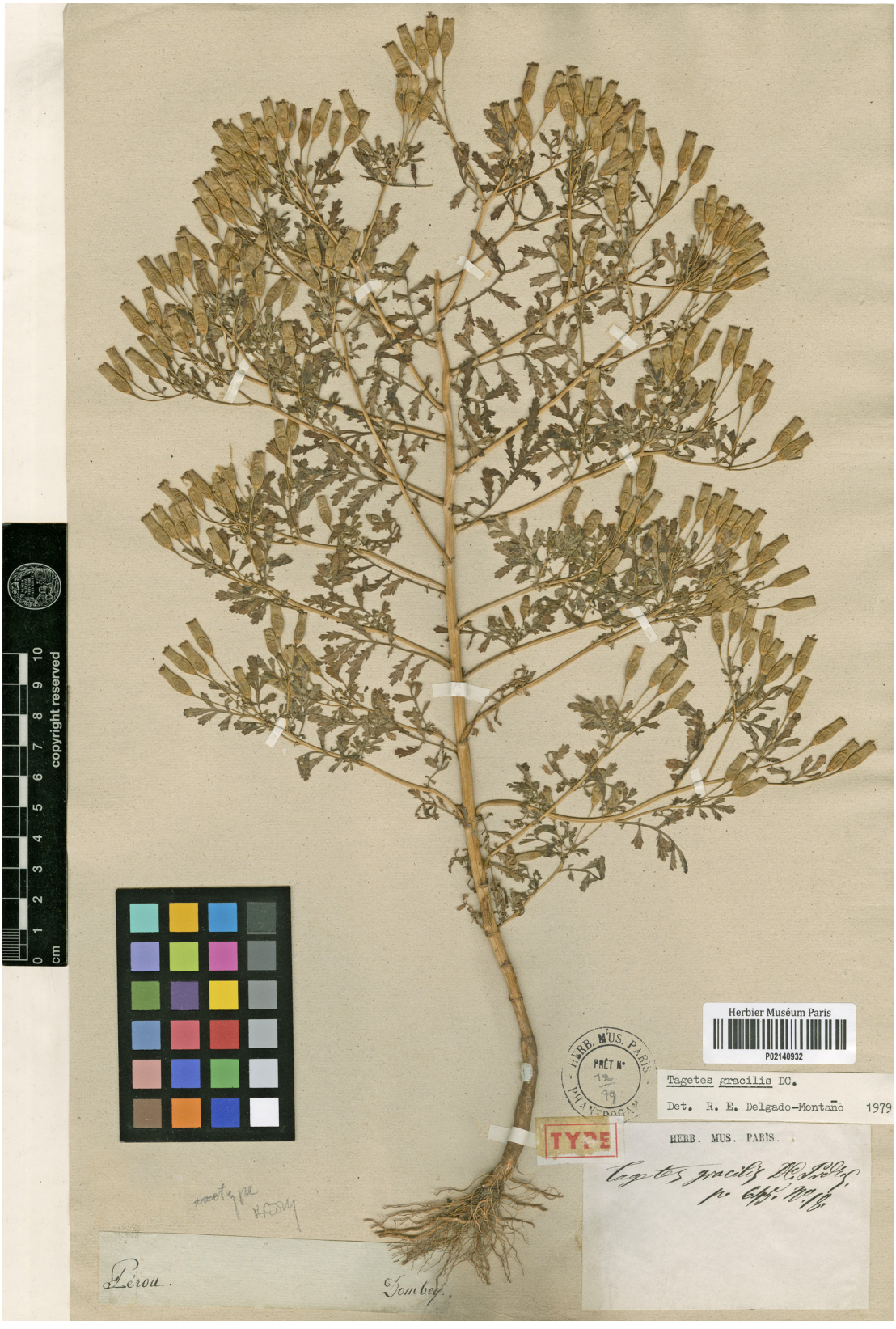

Figure 1 – Holotype sheet of *Tagetes dombeyi* (P 02140932).

below, most of the upper ones alternate, shortly petiolate or subsessile, abaxial surface glabrous, adaxial surface glabrous or with few short and scattered trichomes; leaf blades at the mid-stem elliptic to oblong, 2–4 cm long, 1–2.5 cm wide, pinnately dissected into 5–11 segments, reducing in size and division until becoming bractiform towards the apex of the plant; leaf segments obovate-elliptic, 7–15 mm long, 2.5–5.5 mm wide, the largest in the distal part of the blade, pinnately lobed; lobes 0.6–1.5(–1.7) mm long, margin entire or 1–2-toothed on the largest lobes; veins 0.2–0.4 mm wide, white; glands ovate-circular, 0.17–0.25 mm long, 0.15–0.2 mm wide, pellucid, one at the base of each lobe and the rest irregularly arranged along the laminar tissue. Capitula radiate, heterogamous, 2–3 in lax terminal corymbiform capitulescences, exceptionally solitary in early specimens, peduncles 1–2.5(–4) cm long. Receptacles flat or slightly convex, naked, smooth or slightly alveolate. Involucres cylindrical or slightly urceolate, (9.5–)11–12.5(–17) mm long, (3–)3.5–4.5(–5) mm wide, the upper half partially or completely purplish, the lower half greenish. Phyllaries 5, in one series, connate except the apex, oblong, glabrous, irregularly streaked with elliptic to linear glands, (0.3–)0.4–0.5(–0.6) mm long, 0.1–0.15 mm wide, apex of phyllaries triangular, 0.5–0.8 mm long, 1–1.7 mm wide, obtuse, mutic or mucronate, often with a subapical circular gland. Ray florets 5, pistillate; corolla orange-yellow, exceeding the involucre, tube 4–5.5 mm long, 0.3–0.4 mm wide, papillose, with an apical notch, 0.3–0.5 mm long, ligule oblate, 0.6–1.3 mm long, 1.2–1.4 mm wide, entire or 2–3(–4)-lobate, glabrous; style branches linear, 0.4–0.5 mm long, apex obtuse, papillose. Disc florets 10–11, bisexual, corolla orange-yellow, tubular, 5-dentate, tube 3.8–4.7 mm long, 0.3–0.5 mm wide, papillose, lobes 0.25–0.4 mm long, 0.25–0.35 mm wide, triangular, papillose on inner surface; anthers 5, 0.4–0.7 mm long, 0.15–0.2 mm wide, rounded at the base, apical appendage 0.2–0.25 mm long, 0.06–0.1 mm wide, ovate-triangular, apex obtuse, filament collar ca. 0.5 mm long, 0.05 mm wide, cylindrical; style branches very short, ca. 0.1 mm long, apex obtuse, papillose. Cypselae (5–)5.3–6(–6.5) mm long, (0.6–)0.8–1.2 mm wide, fusiform, 4–5-ribbed, pubescent, black at maturity. Pappus of (3–)4–5 scales in one series, equal to or longer than the cypselae, (5–)5.5–6(–7) mm long, 1-awned, subulate, barbellate, lateral projections 0.1–0.15 mm, occasionally interspersed with (3–)4–5 very reduced scales, 0.15–0.35 mm long, with apex obtuse, erose or fimbriate.

Additional specimens examined: BOLIVIA. COCHABAMBA: Tunari, 3,000 m, IV-V.1892, fl., *O. Kuntze* (NY 03227914). LA PAZ: Larecaja Province, vicinity of Sorata, "in ruderatis" [on waste ground], 2,697 m, fl. and fr., *G. Mandon 69* (P 02686602); "in ruderatis ad sepes", [on waste ground near fences] 2,700-2,800 m, IV-V.1859, fl. and fr., *G. Mandon 65* (NY 03227920, P 02509419, P 02686601); "Lancha de Cochipata, ad radicem montis Illampii" [Cochipata, at the base of the Nevado de Illampu], 3,100-3,200 m, IV.1859, fl., *G. Mandon 66* (NY 03227918, P 02686593, P 02686594, P 02686603, P 04286312 [only the second plant from the left]); "via ad Chulaya" [along the road from Sorata to Chulaya], 2,600-3,200 m, IX.1859-VI.1860, fr., *G. Mandon 66* (NY 03227919, P 02686595 [only the second plant from the left], P 02686596 [only the second and third plants from the left]). PERU. ANCASH: Recuay Province, Pararin, 2,800 m, 25.V.1988, fl., *A. Cano 1877* (US 01809067). AREQUIPA: Caylloma Province, Cabanaconde, Río Colca, 3,850 m, 7.IV.1966, fl. and fr., *J. López Guillén 252* (LP 083579). CAJAMARCA: Contumazá Province, vicinity of Guzmango, 2,500 m, 30.IV.1990, fl. and fr., *A. Sagástegui A. 14256* (NY 03227916); 2,600 m, 2.V.1981, fl. and fr., *A. Sagástegui A. et al. 9775* (NY 03227915). JUNÍN: "*ex* Tarma", fl. and fr., *H. Ruíz & J. Pavón* (MA 816617). LIMA: Huarochirí Province, Cuchicala, mountain N of Huarochirí, 3,560 m, 6.V.1953, fl. and fr., *E. Cerrate 1690* (LP 083578); Matucana, 22.IV.1877, fl., *L. Savatier 539* (P 02509422 [only the plant on the bottom left]); Escuela de Agricultura, 2,100 m, 6.IV.1953, fl. and fr., *E. Petersen & J. P. Hjerting 1234* (LIL 410577); Picoy, above Surco, 3,200-3,300 m, 22.V.1949, fl., *R. Ferreyra*

Figure 2 – Detail of cypselae and pappus of *Tagetes dombeyi* (from holotype sheet, P 02140932). Scale bar = 5 mm.

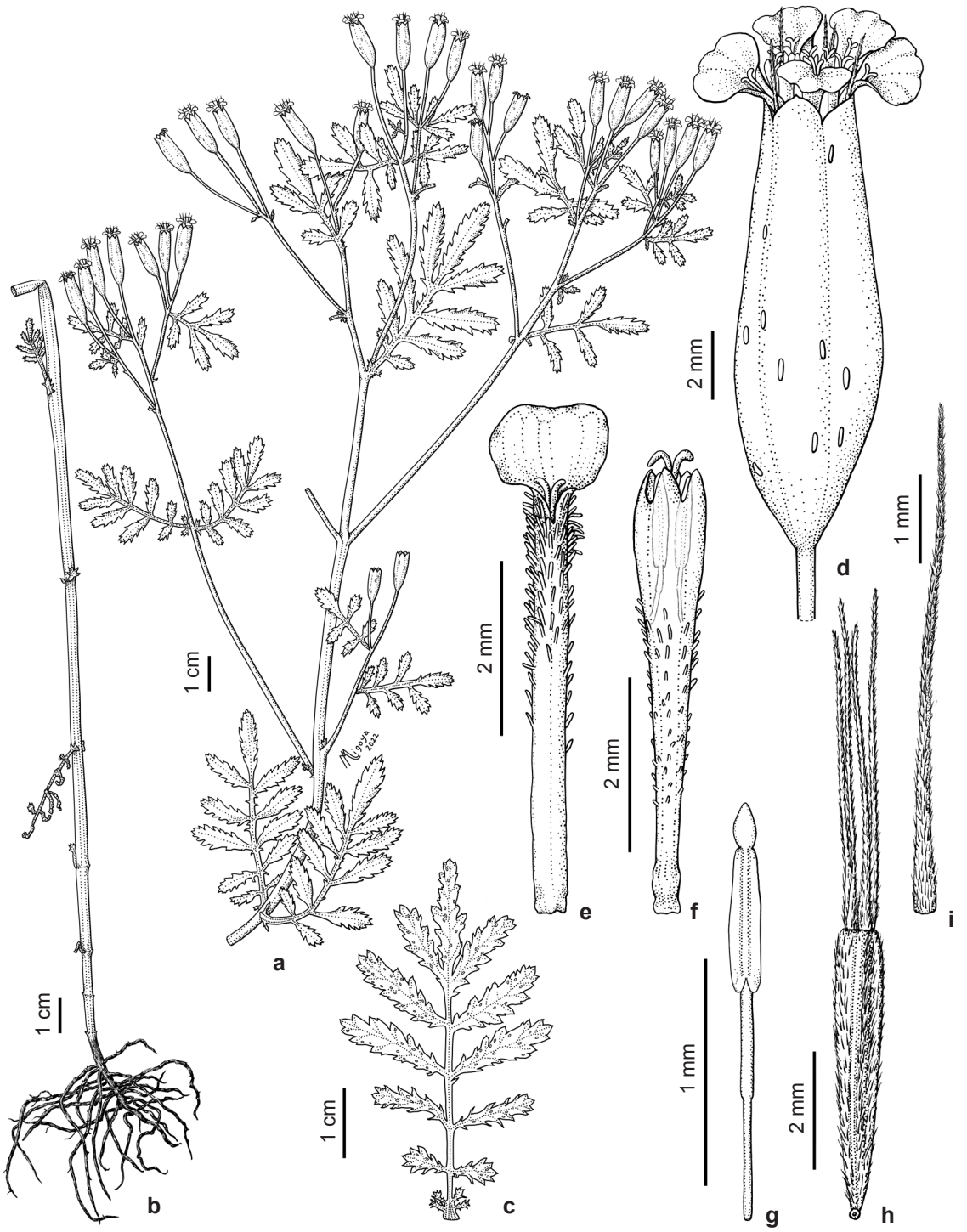

Figure 3 – a-i. *Tagetes dombeyi* – a-b. habit; c. leaf; d. capitulum; e. corolla of ray floret; f. corolla of disc floret; g. stamen; h. cypsela and pappus; i. pappus scale. Drawn by María Alejandra Migoya based on paratype *E. Cerrate 1690* (LP 083578).

Figure 4 – a-d. *Tagetes dombeyi* in the wild (Peru, Department of Lima, Huarochirí Province) – a. habit; b-c. capitula; d. habitat (plants of *T. dombeyi* growing along the edge of the road [marked with an arrow]). Scale bars = 1 cm. All photographs by Annika Lindqvist.

Figure 5 – Range map of *Tagetes dombeyi* (stars). Created using the Free and Open Source QGIS.

6090 (US 01809081); Río Blanco, E of Lima, 3,500-3,600 m, 14.V.1959, fl. and fr., *L. Diers 901* (LP 083538); Valley of Río Rímac, NW of Matucana, 5-6 km above San Mateo, ca. 3,400 m, 23.V.1979, fl. and fr., *H. Teppner 79/76* (US 01808762). Lima Province, "habitat Lima juxta aquas" [Lima, near watercourses], fl., *J. Dombey* (P 00673391 [ex Herb. Jussieu 9021]); mountains near Chosica, 2,000-2,100 m, IV.1910, fl. and fr., *A. Weberbauer 5358* (US 01808763). Yauyos Province, Atjsacki, mountain E of Tupe, 2,930 m, 4.I.1952, *E. Cerrate & O. Tovar 1047* (LP 083626). MOQUEGUA: Mariscal Nieto Province, Torata, 2,200-2,300 m, 17-18. III.1925, fl., *A. Weberbauer 7395* (US 01808760).

The specific epithet *dombeyi* honors Joseph Dombey (1742–1794), French naturalist and explorer of Brazil, Chile, and Peru (Stafleu & Cowan 1976) and collector of the holotype of the new species.

Flowering and/or fruiting specimens of *Tagetes dombeyi* were collected from March to May, at the end of summer and the first half of autumn in the Southern Hemisphere, coinciding with the other annual *Tagetes* that inhabit that area (Soule 1996). Paratype *J. Dombey s.n.* (P 00673391 [*ex* Herb. Jussieu 9021]) has a label annotation that reads "floret novembri" (flowering in November), which is probably a mistake; it may as well be a specimen cultivated in the Northern Hemisphere from Peruvian seeds collected by Dombey.

Tagetes dombeyi is widely distributed in the Central Andes of Peru (Departments of Ancash, Arequipa, Cajamarca, Junín, Lima, and Moquegua) and Bolivia (Departments of Cochabamba and La Paz). It inhabits hillsides, rocky soils, and roadsides between 1,900–3,850 m above sea level (Figs. 4; 5).

The vernacular names are "chalchallta", "chilche", according to labels on paratypes *E. Cerrate & O. Tovar 1047* (LP 083626) and *E. Cerrate 1690* (LP 083578), respectively.

Dried specimens of *T. dombeyi* might be easily confused with other annual *Tagetes* with lax terminal corymbiform capitulescences that occur in the Central Andes of Peru and Bolivia such as *T. iltisiana*, *T. imbricata*, and *T. multiflora*. The distinguishing character states of these taxa are summarized in Table 1. *Tagetes dombeyi* may be also confused with early specimens of *Tagetes terniflora* Kunth in Humboldt, Bonpland & Kunth (1818: 154), but they can be easily differentiated because *T. terniflora* is the only one in the genus having dimorphic capitula (*i.e.*, multiflorous and uniflorous capitula arranged in the same capitulescence).

Unfortunately, one or more of the diagnostic characters of *T. dombeyi* cited in the diagnosis are not easily observable in most of the specimens studied for this work due to inadequate herborization. To avoid ambiguity, then, we believe that the most appropriate specimen to be selected as the holotype of the new species is *J. Dombey s.n.* (P 02140932), which is complete and well-preserved (even having been collected more than 200 years ago) and adequately fits the description of the new species. A duplicate of this specimen is also kept at P (P 02140933). Despite the fact that both specimens only show "Pérou" on labels, information about the geographical distribution, habitat, and phenology of *T. dombeyi* can be obtained from paratypes. The year of collection of the holotype and isotype may be around 1778–1781 according to the itinerary of the Botanical Expedition that Dombey was part of (Álvarez López 1957; González Bueno & Rodríguez Nozal 2003). Specimen *J. Dombey s.n.* (P 00673391 [*ex* Herb. Jussieu 9021]) shows a label with a different collection locality ("habitat Lima juxta aquas"). Therefore, it cannot be considered a duplicate of the holotype and is treated here as a paratype of *T. dombeyi*.

P 02140932 and P 02140933 were previously identified as *Tagetes gracilis* Candolle (1836: 645) by former P curator Edouard Spach (1801–1879) (Steinberg 1977; Stafleu & Cowan 1985) and show "Type" and "Isotype" labels, respectively. However, both specimens differ taxonomically from the holotype of *T. gracilis*, which is *J. Dombey 29* (P02509420 [<http://coldb.mnhn.fr/

catalognumber/mnhn/p/p02509420>], isotype G 00457009 [<http://www.ville-ge.ch/musinfo/bd/cjb/chg/adetail.php?id=308526&lang=en>]) (Neher 1966; Soule 1993; Robinson & Soule 2006; Hind 2011), and should be excluded from the original material of this name. *Tagetes gracilis* was previously treated as a synonym of *T. multiflora* (Soule 1993; Robinson & Soule 2006; Hind 2011; Rodríguez Rodríguez *et al.* 2016), which we agree with after having examined the type specimens and protologues of both names.

Some collections from the 18th and 19th centuries have mixed materials. Specimen *H. Ruiz & J. Pavón s.n.* housed at MA shows one plant belonging to *T. dombeyi* (MA 816617) and the other three to *T. multiflora* (MA 816616) mounted on the same sheet. This mixture of material was opportunely detected by Rosario E. Delgado-Montaño in 1995, although she identified MA 816617 as *T. gracilis*. On the other hand, sheet P 02509422 of *L. Savatier 539* shows only one plant belonging to *T. dombeyi* (mounted on the bottom left) and the rest to *T. multiflora*, but at least two other sheets of the same gathering (P 02509423 and P 02509424) have only *T. multiflora* material.

Schultz (1866) listed *G. Mandon 66* as *Tagetes pusilla* Kunth in Humboldt, Bonpland & Kunth (1818: 152) - currently a synonym of *Tagetes filifolia* Lagasca y Segura (1816: 28) (Soule 1993; Schiavinato *et al.* 2017) - and *G. Mandon 65* and *G. Mandon 69* as *T. multiflora*, but they are recognized here (at least in part) as *T. dombeyi*. These gatherings are made up of a large number of sheets with plants collected from various sites near Sorata in Bolivia. All the plants mounted on the sheets of *Mandon 65* and *Mandon 69* examined for this work belong to *T. dombeyi*. On the other hand, many sheets of *Mandon 66* (which come from two different sites, "Lancha de Cochipata" and "via ad Chulaya") show a mixture between the new species and *T. imbricata*; furthermore, at least one sheet of *Mandon 66* (P 04286316) with only *T. imbricata* and no *T. dombeyi* was found. Since Mandon's collections come from the same area and the information on the labels is ambiguous, it would not be unexpected that unseen duplicates of *Mandon 65* and/or *Mandon 69* also show mixed material.

Kuntze (1898) and Robinson (2014) reported *Tagetes daucoides* Schrader (1833: 5) from Bolivia based on specimen *O. Kuntze* (NY 03227914), but it differs taxonomically from the type material of this name and is here recognized as *T. dombeyi*. As was indicated by Soule (1993), *T. daucoides* is a dubious name that may refer to a cultivated taxon of hybrid origin and has never been found in the wild; there is no evidence of its presence in Bolivia (Soule 1993; Hind 2011).

Table 1 – Morphological differences between *Tagetes dombeyi* and related taxa.

	***Tagetes dombeyi*, sp. nov.**	***Tagetes iltisiana***	***Tagetes imbricata***	***Tagetes multiflora***
Leaf blade segments (width)	2.5–5.5 mm	2–4 mm	1–1.5 mm	1–2 mm
Leaf surfaces (color)	discolorous	discolorous	concolorous	concolorous
Ray florets limb (color)	orange-yellow	white-yellowish	white-yellowish	orange-yellow
Pappus (relative length)	equal to or longer than the cypsela (pappus/cypsela ratio 1–1.25)	shorter than the cypsela (pappus/cypsela ratio 0.25–0.75)	shorter than the cypsela (pappus/cypsela ratio 0.25–0.75)	equal to or longer than the cypsela (pappus/cypsela ratio 1–1.25)
Pappus scales (shape)	subulate, wider at the base	subulate, wider at the base	subulate, wider at the base	oblanceolate or ensiform, the widest part in the distal two-fifths
Pappus scales (margin)	barbellate, lateral projections much shorter than the width of the scale base	barbellate, lateral projections much shorter than the width of the scale base	barbellate, lateral projections much shorter than the width of the scale base	plumose, lateral projections longer than the width of the scale base

Key to *Tagetes* species from Peru and Bolivia

1. Limb of ray florets 8–15 mm long 2
1'. Limb of ray florets 0.5–5 mm long 3
2. Leaf blade segments linear-lanceolate, 1–3(–4) mm wide, margin sharply serrate ..... *Tagetes campanulata*
2'. Leaf blade segments elliptic-ovate, 5–10 mm wide, margin entire or very softly serrate ..... *Tagetes elliptica*
3. Involucres covered with punctiform glands, apex of phyllaries truncated, bearing a small tooth. Plants with anise-like odor..... *Tagetes filifolia*
3'. Involucres covered with linear to elliptic glands, apex of phyllaries acute or obtuse but not truncated, mutic. Plants odorless or with marigold-like odor, not aniseed 4
4. Most of pappus scales 3–5-awned at the apex (few not divided, 1-awned scales often present) ..... *Tagetes praetermissa*
4'. All pappus scales truncated or ending in a single long awn at the apex, never divided into 3–5 awns 5
5. Capitulescence with few uniflorous and several multiflorous capitula ..... *Tagetes terniflora*
5'. Capitulescence with all multiflorous capitula 6
6. Pappus equal to or longer than the cypsela (ratio pappus/cypsela 1–1.25)... 7
6'. Pappus shorter than the cypsela (ratio pappus/cypsela 0.25–0.75) 8
7. Scale pappus subulate (the widest part at the base) and barbellate (lateral projections much shorter than the width of the scale base). Leaves discolorous, leaf blade segments 2.5–5.5 mm wide ..... *Tagetes dombeyi*
7'. Scale pappus oblanceolate to ensiform (the widest part at the distal two-fifths) and plumose (lateral projections equal to or longer than the width of the scale base). Leaves concolorous, leaf blade segments 1–2 mm wide ..... *Tagetes multiflora*
8. Capitula (10–)20–50(–60) arranged in dense capitulescences, peduncles 2–8 mm long..... 9
8'. Capitula (1–)2–3(–8) arranged in lax capitulescences, peduncles 10–30(–40) mm long 10
9. Ray florets 2–3, limb 0.5–1.5 mm long, white-yellowish. Disc florets 3–8 ..... *Tagetes minuta*
9'. Ray florets 5, limb 2–5 mm long, yellow. Disc florets 10–18 . ..... *Tagetes mandonii*
10. Phyllaries 3(–4). Leaves discolorous, leaf blade segments 2–4 mm wide ..... *Tagetes iltisiana*
10'. Phyllaries 5–7. Leaves concolorous, leaf blade segments 1–1.5 mm wide ..... *Tagetes imbricata*

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Data availability statement

In accordance with Open Science communication practices, the authors inform that all data are available within the manuscript.

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