



Typifications and nomenclatural clarifications in South American *Tagetes* (Asteraceae, Tageteae)

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Abstract

During the course of the revision (in progress) of the South American species of *Tagetes*, we detected the need for nomenclatural clarifications and typifications in order to correct application of taxa's names. We analyzed protologues, biographies of authors and collectors, original and common materials, and morphological traits. As a result we clarified author citations of *T. anisata* and *T. pseudomicrantha*, and type localities of several taxa. In addition, we designated 12 lectotypes and two epitypes for the following plant names: *T. anisata*, *T. bonariensis*, *T. campanulata*, *T. dianthiflora*, *T. mandonii*, *T. maxima*, *T. microglossa*, *T. multiflora* var. *rupestris*, *T. peduncularis*, *T. porophyllum*, *T. pseudomicrantha*, *T. tenuifolia*, and *T. zyaquirensis*.

Key words: Compositae, epitype, lectotype, South America, *Tagetes*, nomenclature

Introduction

The genus *Tagetes* Linnaeus (1753: 887) includes between 50–55 species originally from the Americas (Neher 1966, Panero 2007). Moreover, some of them have been introduced around the world and become naturalized (e.g. “South American marigold” *Tagetes minuta* Linnaeus [1753: 887] and “French marigold” *Tagetes patula* Linnaeus [1753: 887] & *Tagetes erecta* Linnaeus [1753: 887] complex) since they have a weedy behavior or have commonly been worldwide used as food, medicine and ornamental plants (e.g. Neher 1968, Soule 1996, Vilà *et al.* 1999, Ariza Espinar 2006, Babu & Kaul 2007, Batish *et al.* 2007, Simpson 2009).

Native species of this genus are distributed from southwestern United States, throughout Central America to southern South America, reaching central Chile and northern Patagonia in Argentina (Neher 1966, Gutiérrez 2008, Gutiérrez & Stampacchio 2015). Particularly, in South America there are 30 species of *Tagetes* (Table 1). Historically, the greatest species richness was recorded in Mexico (Soule 1996); however, we recognized that the second high diversity area is tropical and subtropical Andes (mainly western and northwestern Argentina, Bolivia, Peru, Ecuador and Colombia), where the majority of South American species occur (Dillon & Hensold 1993, Robinson 1999, Robinson 2014, Gutiérrez & Stampacchio 2015, Avila *et al.* 2016).

Tagetes includes annual or perennial strongly aromatic herbs to shrubs, having opposite or alternate leaves with usually pinnately dissected laminae, radiate or subradiate commonly terminal capitula grouped in paniculiform cymes, phyllaries fused in one series, few or many ray and tubular florets with white, yellow or orange corollas, black and sparsely pubescent cypselae, and pappus of few scales or awns. Moreover, one of the most conspicuous traits is the presence of secretory cavities embedded in the mesophyll of leaves and phyllaries (e.g. Simon *et al.* 2002, López *et al.* 2009). On the other hand, *Tagetes* possesses the high ¹³C:¹⁴C ratio typical of Kranz syndrome (Smith & Turner 1975), however, its species do not show the C₄ anatomy (Peter & Katinas 2003).

Based on DNA molecular studies, *Tagetes* was recently found sister to Mexican *Hydropectis* Rydb. and circumscribed including the genera *Adenopappus* Benth. and *Vilobia* Strother (Loockerman *et al.* 2003), as it was proposed by previous botanists (i.e. Robinson 1973, Turner 1996). Nowadays, there is no agreement on the

species number and taxonomic treatment of the South American species of *Tagetes* (e.g. Soule 1993, Robinson 2014, Gutiérrez & Stampacchio 2015, Avila *et al.* 2016). During the revision of these species (in progress by the first author), nomenclatural clarifications and typifications of taxa's names need to be made in order to assure the correct assignment of specimens.

TABLE 1. South American species of *Tagetes* per country.

	Argentina (Gutiérrez 2008, Gutiérrez & Stampacchio 2015)	Brazil (Nakajima 2015, Nakajima on line (access 2017)	Bolivia (Hind 2011, Robinson 2014)	Chile (Gutiérrez 2008, Moreira- Muñoz <i>et al.</i> 2016)	Colombia (Avila <i>et al.</i> 2016)	Ecuador (Robinson 1999)	Paraguay (Gutiérrez 2008)	Peru (Dillon & Hensold 1993)	Uruguay (Gutiérrez 2008)	Venezuela (Badillo 2001)
<i>T. apetala</i>					x					
<i>T. argentina</i>	x									
<i>T. biflora</i>	x			x						
<i>T. campanulata</i>	x		Hind with doubts							
<i>T. daucooides</i>			x							
<i>T. dianthiflora</i>						x		x		
<i>T. elliptica</i>								x		
<i>T. erecta</i>		x	x			x		x		x
<i>T. erythrocephala</i>	Synonym of <i>T. multiflora</i>		Synonym of <i>T. multiflora</i>					x		
<i>T. filifolia</i>	x		x		x	x		x		x
<i>T. gracilis</i>			Synonym of <i>T. multiflora</i>					x		
<i>T. iltisiana</i>			x							
<i>T. laxa</i>	x									
<i>T. mandonii</i>			x							
<i>T. mendocina</i>	x									
<i>T. micrantha</i>			x		x					
<i>T. minuta</i>	x	x	x	x	x	x	x		x	
<i>T. multiflora</i>	x		x	x		x		x		
<i>T. ostenii</i>		x							x	
<i>T. patula</i>		x								
<i>T. pectinata</i>								x		
<i>T. perezii</i>	x									
<i>T. praetermissa</i>			x							
<i>T. riojana</i>	x									
<i>T. rupestris</i>	x									
<i>T. subulata</i>					x					x
<i>T. tenuifolia</i>					x					
<i>T. terniflora</i>	x		x		x	x		x		x
<i>T. verticillata</i>					x	x				x
<i>T. zypaquirensis</i>					x	x				
Total number of species	12	4	10	3	9	8	1	9	2	5

Material and methods

We analyzed the protologues, and specimens (types and non-types) and photographs from the following herbaria: B, BA, BAB, BM, BR, CORD, G, F, G, GH, GOET, HAL, K, L, LIL, LP, M, MA, MICH, NY, P, RB, S, SI, US (Thiers 2013).

When physical specimens were not available, their photographs were obtained from JSTOR (2016), virtual herbaria (B [<https://www.bgbm.org/en/herbarium>], BM [<http://www.nhm.ac.uk/research-curation/scientific-resources/collections/botanical-collections/index.html>], BR [<http://www.br.fgov.be/RESEARCH/COLLECTIONS/HERBARIUM/simplesearch.php>], E [<http://elmer.rbge.org.uk/bgbase/vherb/bgbasevherb.php>], F [<http://emuweb.fieldmuseum.org/botany/Query.php>], G [<http://www.ville-ge.ch/musinfo/bd/cjb/chg/?lang=en>], GH [<http://huh.harvard.edu/pages/gray-herbarium-gh>], GOET [<https://www.uni-goettingen.de/de/157034.html>], HAL [<http://www.botanik.uni-halle.de/herbarium/?lang=en>], K [<http://apps.kew.org/herbcat/navigator.do>], L [], M [[176 • *Phytotaxa* 326 \(3\) © 2017 Magnolia Press](http://www.</p>
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botanischestaatssammlung.de/general/herbarium.html], MA [<http://www.rjb.csic.es/jardinbotanico/jardin/index.php?Cab=109&len=en>], MICH [<http://lsa.umich.edu/herbarium/>], NY [<http://sciweb.nybg.org/science2/hcol/allvasc/index.asp.html>], P [<https://science.mnhn.fr/all/search>], S [<http://www.nrm.se/en/forskningochsamlingar/botanik/samlingar.565.html>], US [<http://collections.nmnh.si.edu/search/botany/>] or digital images were requested from curators of the herbaria and then analyzed.

All the protologues were cross-checked with the label information of the type materials. Typified names are listed alphabetically.

Typifications and nomenclatural clarifications

1. *Tagetes anisata* Lillo in Zelada (1918: 8). Type:—ARGENTINA: Tucumán province, Taquí department, “cumbre de [cerro] San Javier”, “Villa Nougues, a 1200 m”: [icon] Zelada 1918: 6, fig. 3 (lectotype, here designated). Epitype (here designated):—ARGENTINA: Tucumán province, Taquí department, San Javier, 1300 m, 10 March 1949, R. Rocha 789 (LIL 331452!).

= *Tagetes filifolia* Lagasca (1816: 28). Type:—MEXICO. “Imperio Mexicano. Culta fui in Reg. M. H. ab an. 1804 ad 1808. Ex seminibus à cel. D. D. Sessé et Mociño allatis” [seed cultivated in Madrid], 1804–1808, M. Sessé & J. M. Mociño 3929 (holotype MA 606013 [photo!]).

Nowadays, *Tagetes anisata* Lillo in Zelada (1918: 8) is a synonym of *T. filifolia* Lagasca (1816: 28), an accepted species distributed along the Americas, in grasslands and dry valleys, from Mexico and Central America (e.g. Williams 1976, Serrato Cruz 2010) to South America: Colombia and Venezuela (Badillo 2001, Avila *et al.* 2016) throughout the Andes up to central Argentina on the south of the Pampean Hills (Dillon & Hensold 1993, Robinson 1999, Gutiérrez 2008, Robinson 2014, Gutiérrez & Stampacchio 2015). This species was named because of its anise odor.

Several botanists (e.g. Gutiérrez & Stampacchio 2015, Pruski 2015) indicated that this species name [and, also, *T. pseudomicrantha* Lillo in Zelada (1918: 7)] was published by Lillo; however, on the contrary, other botanists (e.g. Ariza Espinar 1967, Cabrera 1978, Hind 2011) cited this species name as published by Zelada. According to The Plant List (<http://www.theplantlist.org/tpl1.1/record/gcc-1280?ref=tpl1>) it is an unresolved name.

Zelada credited this species name to Lillo in his work on plant oils but it is not enough since the complete work was authored by him and ascribed to him. The third paragraph of the protologue can subtly clarify this controversy: “la clasificación corresponde al doctor Miguel Lillo” ... [quien] “le ha dado el nombre de *Tagetes anisata*”; su abundante material bibliográfico como de herbario hanle permitido diferenciarla ...” (i.e. “classification corresponds to doctor Miguel Lillo” ... [who] “has given to it the name *Tagetes anisata*; his abundant bibliographic and herbarium materials have allowed him differentiate it” ...). For this reason we undoubtedly determined that this species was actually described by Lillo. Thus, the validating description can be ascribed to Lillo, and Zelada was the author of the whole publication in which the plant name and description appear, then authorship would be “Lillo” (ICN, Art. 46.2) followed by “in Zelada” in a full bibliographic citation (Art. 46 Note 1).

In the protologue, Zelada indicated that the original specimen was collected in Villa Nougues at an altitude of 1200 m, at the summit of San Javier Mountain. This locality is in Tucumán province. Zelada worked at the National University of Tucumán, in the Industrial Researches Department (Alderete & Vaca 2008: 211). There is no information on where his type specimens were deposited (see Index herbariorum LIL). On the other hand, type and non-type specimens of Lillo are kept at LIL, and further material at SI (Stafleu & Cowan 1981). There is no original specimen of this species kept at LIL (Nora Muruaga, pers. comm.) or any other herbaria. However, there is a photograph in the protologue that belongs to *T. anisata* (Fig. 1). Under the current rules (Art. 9.3), an illustration in the protologue can be original material only if it can be shown that the description or diagnosis validating the name was based on it. For this reason, we designated herein the illustration in Zelada (1918: 6, fig. 3) as lectotype. In addition, the sheet LIL 331452 (Fig. 2) collected by R. Rocha is herein designated as the epitype of the name *T. anisata* since it is a complete and well-preserved specimen that fits accurately with the original description and was collected in San Javier, the original locality from Tucumán province.



FIGURE 1. Lectotype of *Tagetes anisata* Lillo.



FIGURE 2. Epitype of *Tagetes anisata* Lillo.

2. *Tagetes bonariensis* Persoon (1807: 459). Type:—ARGENTINA. “Hab. in Bonaria” [Buenos Aires city and surrounding area], “Commers.” [*P. Commerson*] *s.n.* (lectotype here designated, L 1589044 [photo! “Buenos Ayres”])

= *Tagetes minuta* Linnaeus (1753: 887). Type:—CHILE. [icon] J. J. Dillenius, *Horti Elthamensis* 2: 374, tab. 280, fig. 362. 1732 (lectotype designated by Delgado-Montañó 1998: 368).

Tagetes bonariensis is currently a synonym of *T. minuta* Linnaeus (1753: 887). This South American native species is widely distributed throughout the Americas from southeastern United States to northern Patagonia in Argentina (Dillon & Hensold 1993, Robinson 1999, Gutiérrez 2008, Strother & Wetter 2006, Serrato Cruz 2010, Robinson 2014, Gutiérrez & Stampacchio 2015, Avila *et al.* 2016). In addition, this species has been introduced and naturalized

around the World: e.g., Australia, New Zealand, and the Old World (e.g. Webb *et al.* 1988, Vilà *et al.* 1999, Sigh *et al.* 2003, Boekea *et al.* 2004, Hulina 2008). It inhabits mainly prairies and grasslands, and also agroecosystems as a weed (Cabrera 1974, Gutiérrez & Stampacchio 2015).

The South African botanist C. H. Persoon indicated, in the protologue of *Tagetes bonariensis* (1807: 459), that its original material was collected in “Bonaria”. Bonaria referred to the old Buenos Aires city and its surrounding area. Nowadays, the old city, the harbor, and several old countyside cities form the current Buenos Aires city. Type specimen was picked up by the French naturalist P. Commerson during a scientific expedition (1766–1769) led by admiral and explorer L. A. de Bougainville (Bougainville 1771, Stafleu & Cowan 1976).

According to Stafleu & Cowan (1983), original material of the species described by Persoon is mainly deposited in L, and also in BM, E, G, GOET, H, LD, LG, NY, PC, and STR. On the other hand, the main collection of Commerson is kept at P and its duplicates reached G, LINN, UPS and secondarily B, BM, CGE, FI, L, MO, MPU, NY, S, and W (Stafleu & Cowan 1976).

Five specimens that fit with the original data were found kept at L (L 1589044 and L 1589068) and P (P 00673393, P 02509500 and P 02686607). The specimen L 1589044 is labeled as “*Tagetes bonariensis*” and “Buenos Ayres”. Thus, this specimen is herein designated as lectotype since it is a complete and well-preserved specimen that fits with the original description. On the other hand, the specimens in P (P 00673393, P 02509500 and P 02686607) are recognized as original material (they fit morphologically with this species description and were collected by Commerson in 1767) but the type since their locality is Montevideo (Uruguay). Furthermore, the specimen L 1589068 was also recognized as original material but it lacks any data.

3. *Tagetes campanulata* Grisebach (1874: 188). Type:—ARGENTINA. Tucumán province: “in rupibus supra Ciénega” [Ciénaga], 25 March 1872, P. G. Lorentz 139 (lectotype here designated, GOET 002090 [photo!]; isolectotypes, B [destroyed, Field Museum photo negatives collection 15486!], BA 24795!, CORD 00006345 [photo!], CORD 00006351 [photo!]).

Tagetes campanulata is a currently accepted species that inhabits mountains and high altitude grasslands, distributed from southern Bolivia to northwestern Argentina (Robinson 2014, Gutiérrez & Stampacchio 2015). This species was published by Grisebach (1874) based on specimens collected by P. G. Lorentz. According to Hunziker (1960: 285 footnotes), at that time Lorentz used to separate his plant collections in two sets: one set (more complete and more important) was sent to Göttingen where Grisebach worked, and another one was kept at the Academia de Ciencias de Córdoba (Sciences Academy of Córdoba, Argentina). For this reason, nowadays these specimens are deposited in CORD and GOET (Hunziker 1960, Stafleu & Cowan 1976). It is important to mention that Grisebach never traveled to Argentina (Burkart 1939) and, therefore, he only analyzed specimens kept at GOET.

Two different localities were mentioned in the protologue of *Tagetes campanulata*: (1) “Tucuman: in rupibus supra Ciénega” and (2) “Catamarca, in alpinis Vayas altas, alt. 9-11000”. “Ciénega” (in Tucumán province) is actually a place called La Ciénaga (26° 46' 51'' S, 65° 039' 10'' W) that belongs to Tafí del Valle department, and Vayas (in Catamarca province) is probably Las Vallas (27° 33' 51'' S, 067° 09' 14'' W), a locality that belongs to Belén department. Hunziker (1960: 390) cited in detail the data from the labels of these specimens. In the case of Ciénega, he transcribed: “Tucumán: An Felsen etc. des oestl. Berhangs ueber der Ciénega, Sierra de Tucumán, Lorentz 139, 25-III-1872” and, on the other hand, from Las Vallas indicated “Catamarca: Vayas Altas, Lorentz 616, med. I-1872”.

As a result of our analysis, seven original specimens were found that fit accurately with the protologue: five from La Ciénaga (i.e., B [destroyed, Field Museum photo negatives collection 15486], BA 24795, CORD 00006345, CORD 00006351, and GOET 002090) and two from Las Vallas (i.e., CORD 00006344 and GOET 002089). Since Grisebach never visited Argentina, both original materials in GOET (syntypes) have priority for choosing as lectotype against CORD (isosyntypes). Among them, we selected herein the specimen GOET 002090 from La Ciénaga as the lectotype of the name *T. campanulata* because is a complete and well-preserved specimen and has more duplicates that are herein considered as isolectotypes (i.e., BA 24795, CORD 00006345, CORD 00006351, and the photo kept at the Field Museum).

4. *Tagetes dianthiflora* Kunth in Humboldt, Bonpland & Kunth (1818: 154). Type:—ECUADOR. Loja department: “inter flumen Catamayo” [Catamayo river] “et villam Lucarque”, A. J. A. Bonpland & F. W. H. A. Humboldt s.n. (lectotype, here designated, P 00135024 [Bonpland & Humboldt 3462] [photo!]; isolectotypes, P 00320193 [Bonpland & Humboldt 3462] [photo!], P 00135023 [Bonpland & Humboldt s.n.] [photo!])

Tagetes dianthiflora is a currently accepted species distributed from southern Ecuador to southern Peru that inhabits shrublands in Andean mountain slopes, between 1500 and 3500 m (Dillon & Hensold 1993, Robinson 1999). There are contradictory data about its presence in Venezuela (Neher 1966, Badillo 2001).

In the protologue of *T. dianthiflora*, Kunth (1818) indicated that the original material was collected in Peru from Catamayo river up to Lucarque (04° 10' 00" S 079° 51' 00" W). Nowadays, both the river and the locality belong to southern Ecuador, Loja department. Original specimens of species published by Kunth collected by Humboldt and Bonpland in the Americas are deposited mainly in P and some materials in B, BM, and K (Stafleu & Cowan 1976, 1979, Hind & Jeffrey 2001). We found three specimens kept at P that fit accurately with the protologue of *T. dianthiflora*. Because it is necessary to choose one specimen (McNeill *et al.* 2012, McNeill 2014), we designated herein as lectotype the specimen P 00135024. It is labeled "Bonpland" "3462", and is a complete and well-preserved specimen that fits with the original description. In addition, the specimen P 00320193 (labeled "Lucarque"), and the specimen P 00135023 ("3462") are recognized as isolectotypes.

5. *Tagetes mandonii* Sch. Bip. ex Klatt (1889: 109); Schultz-Bipontinus (1865: 529), nom. nud. Type:—BOLIVIA. La Paz department, "viciniis Sorata in incultis, sylvulis, undique" "*G. Mandon 68*" (lectotype here designated, GH 00052469 [photo!]; isolectotypes, BM 001024135 [photo!], BR 0000005533985 [photo!], F 0051596F [photo!], GH 00002830 [photo!], GOET 002093 [photo!], K 000502342 [photo!], MICH 1107775 [photo!], NY 00546782 [photo!], NY 00546783 [photo!], NY 00546785 [photo!], NY 00546786 [photo!], S-R-6050 [photo!], US 00124923 [photo!]).

Tagetes mandonii Sch. Bip. ex Klatt (1889: 109) is a currently accepted species distributed in Bolivia and Peru on rocky slopes and dry soils from 2000 to 3600 m (Neher 1966, Hind 2011, Robinson 2014). Dillon & Hensold (1993) did not record this species in Peru.

Tagetes mandonii was published by Klatt who used an invalidly published name that was proposed as *nomen nudum* by Schultz-Bipontinus (1865). In the protologue, it was indicated that the original material has been collected by G. Mandon with number 68. Mandon was a plant collector in Bolivia, Madeira and the Canary islands, and his specimens were mainly deposited in B (currently destroyed) with duplicates in many herbaria (Stafleu & Cowan 1981). However, his type specimens are mainly kept at GH, and also at CGE, HBG, K, and SAM (Stafleu & Cowan 1979).

We found two specimens of *Mandon 68* kept at GH (GH 00052469 and GH 00002830) that fit with the protologue. These materials were previously considered holotype and isotype, respectively (Hind 2011, Robinson 2014). However, a lectotype needs to be designated from these specimens because no such designation was made in the protologue and there is more than one specimen in the original material. Thus, the sheet GH 00052469 is herein designated as the lectotype of the name *T. mandonii*. This is a well-preserved specimen, with many drawings and hand scripts made by Klatt. The sheet GH 00002830 is an isolectotype.

6. *Tagetes maxima* Kuntze (1898: 181). Type:—BOLIVIA. [Cochabamba] Cerro Tunari, 3000 m, 4 May 1892, *O. Kuntze s.n.* (lectotype here designated: NY 00260287 [photo!]; isolectotype US 00124924 [photo!]).
= *Tagetes mandonii* Sch. Bip. ex Klatt (see above).

Currently *Tagetes maxima* Kuntze is a synonym of *T. mandonii* Sch. Bip. ex Klatt (1889: 109) (see observations under the latter species). In the protologue of *T. maxima*, Kuntze (1898) mentioned that the original material was collected by himself from two places of Bolivia: (1) "Tunarigebirge [Tunari mountain], 3000 m", and (2) "Cuchicanchipass [Cuchicanchi pass], 3600 m". Tunari mountain (17°17'08" S, 066°23'30" W) belongs to the Tunari mountain range of the Bolivian Andes in Cochabamba department.

Kuntze's type collections are kept at NY (Stafleu & Cowan 1979) and we found both syntypes deposited there: NY 00260287 from Tunari, and NY 00260288, possibly from Cuchicanchi since it has only the label "Bolivien", "3600 m" and "13/20 April 1892". In addition, we analyzed a duplicate of the former deposited in US (US 00124924). A duplicate from Cuchicanchi was destroyed in B during WWII; a negative of this specimen is in F (Field Museum photo negatives collection 15489).

The specimen NY 00260287 is herein designated as the lectotype of the name *T. maxima* because it fits accurately with the protologue, is well-preserved, has more information about the original location, and its duplicate (an isolectotype) is in US (US 00124924).

7. *Tagetes microglossa* Benth (1844: 118). Type:—ECUADOR. Malabí province, “Salango”, *Sinclair s.n.* (lectotype here designated: K 000502340 [photo!]; isolectotype K 000502339 [photo!])
= *Tagetes tenuifolia* Cav. (see below).

According to recent floristic works (i.e. Pruski 2015, Avila *et al.* 2016), *Tagetes microglossa* Benth. is a synonym of *T. tenuifolia* Cavanilles (1793: 54) (see taxonomic observations on this species below).

Tagetes microglossa was published based on the original material collected by A. Sinclair in the British expedition of the H.M.S. Sulphur during 1836–1842 (Benth 1844, Stafleu & Cowan 1985). In the protologue, Benth cited only “Salango” that is located on the shores of the Pacific, in the western Manabí Province of Ecuador. The original material of Benth’s is kept at K (Stafleu & Cowan 1976) as many of Sinclair’s specimens. In addition, further plants collected by Sinclair in South America are deposited in B (mainly destroyed), BM, CGE, E, FI, GL, MO, NY, OXF and W (Stafleu & Cowan 1985). We found two specimens in K that match with the protologue: K 000502340 and K 000502339, and designated K 000502340 as the lectotype of the name *T. microglossa* because it fits accurately with the original description, is well-preserved, and shows more capitula.

8. *Tagetes multiflora* var. *rupestris* Weddell (1855[1856]: 72). Type:—PERU. Puno department, “Ayapata” in ruderat, June 1854, “*W. Lechler 1922*” (lectotype here designated: P 02686691 [photo!])

= *Tagetes multiflora* Kunth (1818: 154). Type:—ECUADOR. Pichincha “Crescit prope Quito in radicibus montis Pichincae, alt. 1500 hex. Floret Junio”. *F. W. H. A. von Humboldt & A. J. A. Bonpland s.n.* (holotype, P 00320192 [photo!]; probably isotype, B [destroyed, Field Museum photo negatives collection 15490!])

Currently, the variety *rupestris* Weddell (1855[1856]: 72) is included in the synonymy of *Tagetes multiflora* Kunth (1818: 154) (e.g. Ferraro 1955, Neher 1966, Gutiérrez & Stampacchio 2015), which is distributed from northern Ecuador throughout Peru and Bolivia to northern Chile and northwestern Argentina (Dillon & Hensold 1993, Robinson 1999, Robinson 2014, Moreira-Muñoz *et al.* 2016). According to Hind (2011), this species also occurs in Brazil and Colombia, and according to Gutiérrez & Stampacchio (2015) in Colombia, but it has not been recorded from these countries (Nakajima 2015, Avila *et al.* 2016, Flora do Brasil 2017). It inhabits dry, rocky and sandy places, mainly in high Andes and Puna environments, between 1000 and 4500 m.

In the protologue Weddell cited three original places, each with a different collector: one from Ecuador (1) “au pied du mont Pichincha!, à une hauteur de 2900 mètres (Humb. et Bonpl.)”, and two from Peru (2) “lieux sablonneux et rocaillieux autour du lac de Titicaca, hauteur 3900 mètres (Wedd.)” and (3) “Agapata (ou Ayapata?)! (Lechler, *exsicc.*, n° 1922)”. Weddell’s type specimens are kept at P (Stafleu & Cowan 1988), and secondly in other herbaria. We found one specimen deposited in P 02686691 that matches with the third original locality. Ayapata (not Agapata) (13° 46' 40" S 070° 19' 21" W) is a Peruan district in the southeast of the country, belonging to Carabaya province in the Puno department. We designate herein this specimen as the lectotype of the name *Tagetes multiflora* var. *rupestris*.

9. *Tagetes peduncularis* Cavanilles (1802: 201). Type:—VENEZUELA. Sucre state, “Cumaná”, September 1801, *A.J.A. “Bonpland” s.n.* (lectotype here designated: MA 476407 [photo!])

= *Tagetes tenuifolia* Cav. (see below)

Tagetes peduncularis Cavanilles (1802: 201) is taxonomically a controversial species (Neher 1966, Williams 1976). According to a recent Colombian plant checklist (i.e. Avila *et al.* 2016), it is treated as a synonym of *T. tenuifolia* Cavanilles (1793: 54) (see *T. microglossa* above and *T. tenuifolia* below for more information). However, *T. peduncularis* was not included in the Mesoamerican Flora (Pruski 2015). On the other hand, this name was not treated in a Venezuelan checklist (Badillo 2001).

Another difficulty is its original material. In the protologue of *T. peduncularis*, Cavanilles (1802) cited “se cría en Cumaná, de donde envié las semillas el ciudadano Bonpland. Floreció por Setiembre y Octubre en nuestro Jardín Botánico” [It grows in Cumaná, from where citizen Bonpland sent seeds. It bloomed during September and October in our Botanical Garden]. Cumaná (10° 27' 23" N, 064° 10' 3" W) is the capital of Venezuela’s Sucre State.

Herbarium and types of Cavanilles are deposited in MA; however, many names in the “Dissertationes” were based on material in P, and other material of plants from the Madrid Garden are in BM, C, G, LD, LINN, MO and UPS (Stafleu & Cowan 1976, Garilleti 1993). We found two specimens kept at MA: MA 476406 (cultivated in the Garden in 1802) and MA 476407 (apparently collected from Cumaná in 1801). Both specimens could be recognized as original material. We selected the specimen MA 476407 as the lectotype of the name *Tagetes peduncularis* because it fits accurately with the protologue’s data, is well-preserved, and was possibly used for describing this species.

10. *Tagetes porophyllum* Vellozo (1881: 336). Type:—BRAZIL. [icon] Flora Fluminensis Icon. 8, tab. 116 (1831) (lectotype designated by D. G. Gutiérrez & M. L. Stampacchio, Flora Argentina 2015: 125). Epitype (here designated):—BRAZIL. Rio de Janeiro state. Petropolis, Pedro do Rio, Rocinha. *D. Sucre 2643* [P. J. S. Braga 484] (RB 00430057 [photo!]; duplicates K 001103922 [photo!], MO 1998069 [photo!], NY 00788609 [photo!]).
 = *Tagetes minuta* L. (see under *Tagetes bonariensis*).

Tagetes porophyllum is a synonym of *T. minuta* (e.g. Neher 1966, Gutiérrez & Stampacchio 2015). *Tagetes porophyllum* was originally an invalid name (Vellozo 1831), validated later (Vellozo 1881). Gutiérrez & Stampacchio (2015) designated an original illustration (Vellozo 1831) as lectotype. For the purposes of precise application of the name of this species, an epitype is here designated. This specimen, kept at RB (Fig. 3), fits accurately with the diagnosis and illustration of the species.



FIGURE 3. Epitype of *Tagetes porophyllum* Vell.

11. *Tagetes pseudomicrantha* Lillo in Zelada (1918: 7 [in table]). Type:—ARGENTINA: Tucumán, Burruyacú, Cerro del Campo, 2000 m, Jan 1918, *E. Bailetti* 76 (lectotype here designated: LIL 26162a!; isolectotypes, LIL 26162b!, LIL 26162c!).

= *Tagetes filifolia* Lag. (see under *Tagetes anisata*).

Nowadays, *Tagetes pseudomicrantha* is a synonym of *T. filifolia* (e.g. Ariza Espinar 1967, Gutiérrez & Stampacchio 2015).

Concerning the author citation of *T. pseudomicrantha*, we followed the same analysis as for *T. anisata* (see above), and considered it was described by Lillo as indicated by Zelada.

On the other hand, the typification of *T. pseudomicrantha* was a more complex case because this species was poorly described. In fact, it was only twice mentioned in the protologue: in a table with its distinct traits and in the caption of Figure 2. In spite of this, the protologue satisfied the requirements of the International Code of Nomenclature and the name is considered validly published.

In the protologue, Lillo cited only that he saw this species in Tucumán, “procedente del norte de la provincia” [from the north of the province]. Fortunately, the protologue included a photo identified as *T. pseudomicrantha*. Herbarium and types of Lillo are kept at LIL (Stafleu & Cowan 1981). We analyzed in detail and checked non-type materials, and could find one specimen (LIL 26162a, Fig. 4) of *Tagetes* labeled as “Tipo” with Lillo’s handwriting. This specimen is identical to the photo of figure 2 in the protologue taken by Zelada. Without doubt Lillo based his description on this specimen that was collected by Bailetti in the Burruyacú, a department located on the northeastern Tucumán province as it was cited in the protologue. We designated here this original specimen as the lectotype of name *T. pseudomicrantha*. In addition, the specimens LIL 26162b and LIL 26162c are recognized as isolectotypes.

12. *Tagetes tenuifolia* Cavanilles (1793: 54, pl. 169). Type:—WITHOUT COUNTRY. “Habitat in Peru” “Vidi floridam in Regio horto Metritense mense Decembri”, 1792, without collector (lectotype here designated: MA 476409 [photo!]).

This currently accepted species occurs from Mexico throughout Central America to central Colombia. Despite this species was mentioned as present in Brazil (Avila *et al.* 2016), it could be a mistake since *T. tenuifolia* was not actually recorded from that country (Nakajima 2015, Flora do Brasil 2017). It grows on open fields at (300–)700–2130(–2700) m (Pruski 2015, Avila *et al.* 2016).

In the protologue, Cavanilles cited Peru as the original locality; however, this citation is probably erroneous because of the currently known distribution of the species. He cited that he saw this species bloomed during December in the Royal Botanical Garden of Madrid. The herbarium and types of Cavanilles are deposited in MA (Stafleu & Cowan 1976, Garilleti 1993). We found two specimens labeled as *T. tenuifolia* that fit with the original description: MA 476408, without date, and MA 476409, with date “1792” written by Cavanilles (Garilleti 1993). The label of this latter specimen points to Chile as the country of origin; however it is probable that it was an error in labeling of the specimen. In spite of this, we designated the specimen MA 476409 as the lectotype of the name *T. tenuifolia*, because it was collected prior to the date of its publication.

13. *Tagetes zypaquirensis* Bonpl. in Humboldt & Bonpland (1808: 18). Type:—COLOMBIA. Cundinamarca department, “juxta urbem Zypaquira” [Zipaquirá], *F. W. H. A. Humboldt & A. J. A. Bonpland s.n.* (lectotype here designated: B-W 16125 [*Humboldt s.n.*, photo!]; isolectotypes, F 972169 [*Bonpland s.n.*, photo!], HAL 0110969 [*Humboldt & Bonpland s.n.*, photo!], P 00135016 [*Bonpland s.n.*, photo!], P 00135017 [*Bonpland s.n.*, photo!], P 00320189 [*Humboldt & Bonpland s.n.*, photo!]).

Tagetes zypaquirensis Bonpland (1808: 18) is a currently accepted species that occurs from northern Colombia to southern Ecuador (Neher 1966, Robinson 1999, Avila *et al.* 2016). In the protologue of this species Bonpland indicated that the original location was in “regno Novæ Granatæ, juxta urbem Zypaquira”. Currently Zipaquirá is a Colombian city belongs to Cundinamarca department.

According to Stafleu & Cowan (1976, 1979), the original collections of Bonpland and Humboldt from the Americas are kept at B and P. We found several specimens that fit with the protologue of *T. zypaquirensis* deposited in B (B-W 16125), F (F 972169, namely a fragment of P), HAL (HAL 0110969), and P (P 00135016, P 00135017 and P 00320189). The specimen kept at B (B-W 16125) is herein designated as lectotype since it is a more complete and well-preserved specimen that fits accurately with the original description and, also, the original location is indicated on its label.

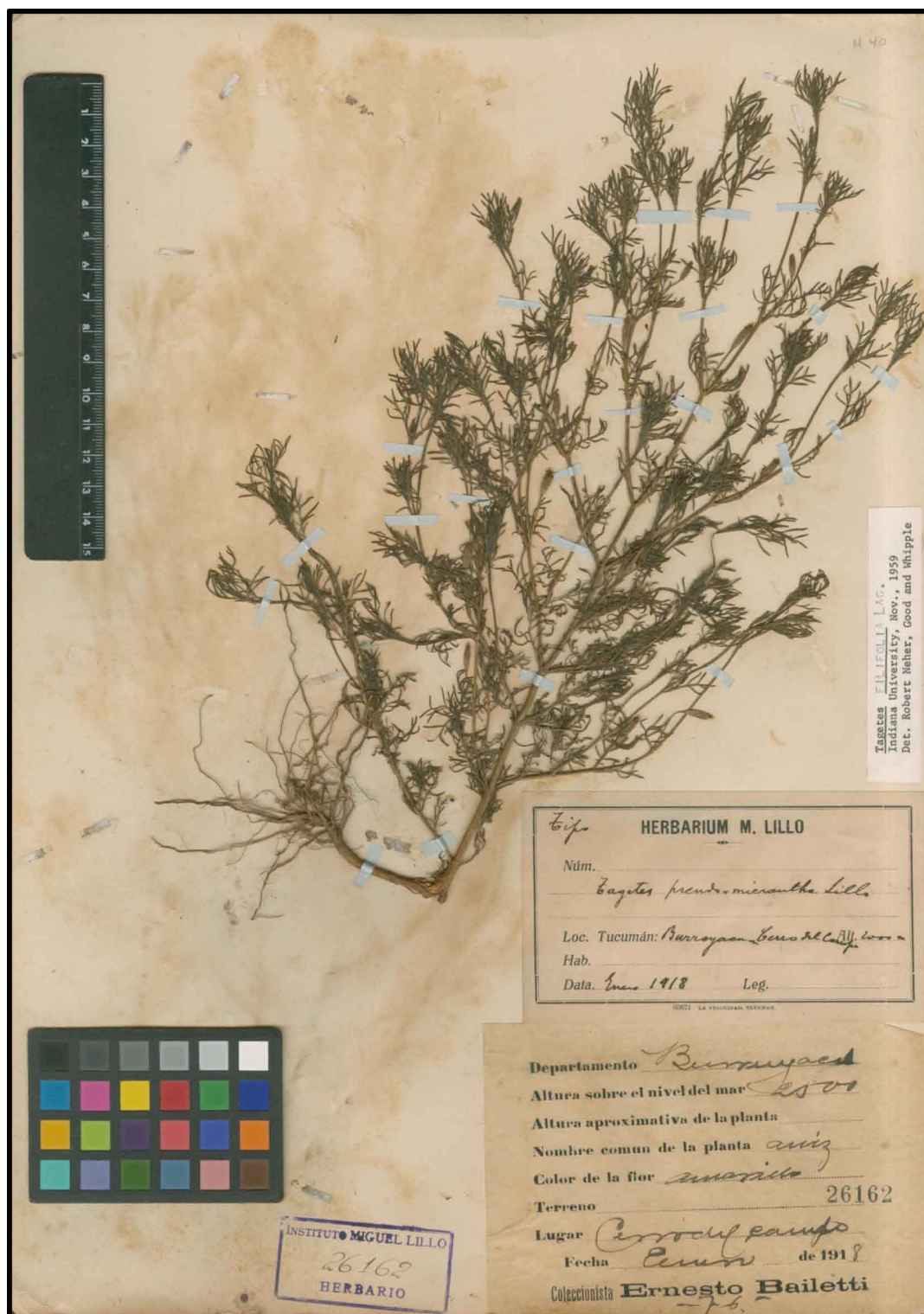


FIGURE 4. Lectotype of *Tagetes pseudomicrantha* Lillo.

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References

- Alderete, M.C. & Vaca, Y. (2008) Contribución de la Universidad Nacional de Tucumán al conocimiento geológico del Noroeste Argentino. Periodo 1930 a 1950. *Serie Correlación Geológica* 24: 207–230.
- Avila, F., Funk, V.A., Diazgranados, M., Díaz-Piedrahita, S. & Vargas, O. (2016) Asteraceae. In: Bernal, R., Robber Gradstein, S. & Celis, M. (Eds.) *Catálogo de plantas y líquenes de Colombia*, vol. 1. Universidad Nacional de Colombia, Bogotá, pp. 795–908.
- Ariza Espinar, L. (1967) Las especies de *Tagetes* (Compositae) de la región central argentina. *Kurtziana* 4: 51–71.
- Ariza Espinar, L. (2006) *Tagetes*. In: Barbosa, G.E., Cantero, J.J., Nuñez, C.O. & Ariza Espinar, L. (Eds.) *Flora medicinal de la provincia de Córdoba (Argentina): Pteridófitas y Antófitas silvestres o naturalizadas*. Museo Botánico, Córdoba, pp. 463–467.
- Babu, K.G.D. & Kaul, V.K. (2007) Variations in quantitative and qualitative characteristics of wild marigold (*Tagetes minuta* L.) oils distilled under vacuum and at NTP. *Industrial Crops and Products* 26: 241–251.
<https://doi.org/10.1016/j.indcrop.2007.03.013>
- Badillo, V.M. (2001) Lista actualizada de las especies de la familia Compuestas (Asteraceae) de Venezuela. *Ernstia* 11: 147–215.
- Batish, D.R., Aroraa, K., Singhb, H.P. & Kohli, R.K. (2007) Potential utilization of dried powder of *Tagetes minuta* as a natural herbicide for managing rice weeds. *Crop Protection* 26: 566–571.
<https://doi.org/10.1016/j.cropro.2006.05.008>
- Bentham, G. (1844) Compositae. In: Hinds, R.B. (Ed.) *The Botany of the Voyage of H. M. S. Sulphur, under the command of Captain Sir Edward Belcher, during the years 1836–42*. Smith, Elder & Co., London, pp. 109–122.
- Boeke, S.J., Baumgarta, I.R., van Loona, J.J.A., van Huisa, A., Dickea, M. & Kossoub, D.K. (2004) Toxicity and repellence of African plants traditionally used for the protection of stored cowpea against *Callosobruchus maculatus*. *Journal of Stored Products Research* 40: 423–438.
[https://doi.org/10.1016/S0022-474X\(03\)00046-8](https://doi.org/10.1016/S0022-474X(03)00046-8)
- Bougainville, L.A. de (1771) *Voyage Autour du Monde, par la Frégate La Boudeuse et la Flûte L'Étoile*. Saillant & Nyon, Paris, (10) + 417 + (3) pp.
- Burkart, A. (1939) Augusto Grisebach. Sexagésimo aniversario de su fallecimiento. *Darwiniana* 3: 89–91.
- Cabrera, A.L. (1974) Compositae. In: Burkart, A. (Ed.) *Flora Ilustrada de Entre Ríos. Colección Científica del Instituto Nacional de Tecnología Agropecuaria* 6(6): 106–538.
- 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.
- Cavanilles, A.J. (1793) *Icones et descriptiones plantarum, quae aut sponte in Hispania crescunt, aut in hortis hospitantur*, vol. 2(2). Ex Regia typographia eius operas dirigente Lazaro Gayguer, Madrid, pp. 33–54, plates 140–170.
- Cavanilles, A.J. (1802) *Descripción de las Plantas*. Real Imprenta, Madrid, 625 pp.
- Delgado-Montaña, R.E. (1998) *Tagetes minuta* L. In: Jarvis, C. E. & Turland, N. J. (Eds.) *Typification of Linnaean specific and varietal names in the Compositae (Asteraceae)*. *Taxon* 47: 347–370.
<https://doi.org/10.2307/1223764>
- Dillon, M. & Hensold, N. (1993) Asteraceae. In: Brako, L. & Zarucchi, J.L. (Eds.) *Catalogue of the Flowering Plants and Gymnosperms of Peru. Monographs in Systematic Botany from the Missouri Botanical Garden* 45: 103–189.
- Ferraro, M. (1955) Las especies argentinas del género *Tagetes*. *Boletín de la Sociedad Argentina de Botánica* 6: 30–39.
- Flora do Brasil 2020 (2017) *Flora do Brasil 2020 em construção*. Jardim Botânico do Rio de Janeiro. Available from: <http://floradobrasil.jbrj.gov.br/> (access 23 May 2017)
- Garilleti, R. (1993) Herbarium Cavanillesianum: seu enumeratio plantarum exsiccatarum aliquo modo ad novitates Cavanillesianas pertinentium, quae in Horti Regii Matritensis atque Londinensis Societatis Linnaeanae herbariis asservantur. *Fontqueria* 38: 6–248.
- Grisebach, A.H.R. (1874) *Plantae Lorentzianae. Abhandlungen der Königlichen Gesellschaft der Wissenschaften zu Göttingen, Physikalische Classe* 19: 49–280.
- Gutiérrez, D.G. (2008) *Tagetes*. In: Zuloaga, F.O., Morrone, O. & Belgrano, M.J. (Eds.) *Catálogo de las Plantas Vasculares del Cono Sur (Argentina, Sur de Brasil, Chile, Paraguay y Uruguay)*. *Monographs in Systematic Botany from the Missouri Botanical Garden* 107

(2): 1519–1520.

- 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 (2). Estudio Sigma SRL, Buenos Aires, pp. 118–129.
- Hind, D.J.N. (2011) *An annotated preliminary checklist of the Compositae of Bolivia* 2. Available from: <http://www.tropicos.org/> (access 7 April 2017)
- Hind, D.J.N. & Jeffrey, J. (2001) A checklist of the Compositae of vol. IV of Humboldt, Bonpland and Kunth's *Nova genera et species plantarum*. *Compositae Newsletter* 37: 1–84.
- Hulina, N. (2008) Wild Marigold – *Tagetes minuta* L., new weed on the island of Hvar, and new contribution to the knowledge of its distribution in Dalmatia (Croatia). *Agriculturae Conspectus Scientificus* 73: 23–26.
- Humboldt, F.W.H.A. & Bonpland, A.J.A. (1808) *Plantae aequinoctiales*, vol. 2 (9). F. Schoell, Paris & J.G. Cotta, Tübingen, pp. 1–20, pls. 66–68 (69).
- Humboldt, F.W.H.A., Bonpland, A.J.A. & Kunth, C.S. (1818) *Nova genera et species plantarum quas in peregrinatione ad plagam aequinoctialem orbis novi collegerunt, descripserunt, partim adumbraverunt (folio ed.)*, vol. 4. Apud N. Maze, Bibliopolam, Paris, 247 pp. +111 pls.
- Hunziker, A.T. (1960) Catálogo de los tipos “grisebachianos” conservados en Córdoba. *Boletín de la Academia Nacional de Ciencias* 41: 283–421.
- JSTOR (2016) *Global Plants*. Available from: <http://plants.jstor.org/> (access 28 September 2016)
- Klatt, F.W. (1889) Beitrage zur Kenntniss der Compositen. *Leopoldina* 25: 104–109.
- Kuntze, O. (1898) *Revisio Generum Plantarum*, vol. 3 (3). Arthur Felix, Leipzig, 576 pp.
- Lagasca y Segura, M. (1816) *Genera et species plantarum, quae aut novae sunt aut nondum recte cognoscuntur*. Madrid, 35 pp.
- Linnaeus, C. von (1753) *Species Plantarum*. L. Salvius, Stockholm, 1200 pp.
- Loockerman, D.J., Turner, B.L. & Jansen, R.J. (2003) Phylogenetic relationships within the Tageteae (Asteraceae) based on nuclear ribosomal ITS and chloroplast *ndhF* gene sequences. *Systematic Botany* 28: 191–207.
- López, M.L., Bonzani, N.E. & Zygadlo, J.A. (2009) Allelopathic potential of *Tagetes minuta* terpenes by a chemical, anatomical and phytotoxic approach. *Biochemical Systematics and Ecology* 36: 882–890.
<https://doi.org/10.1016/j.bse.2008.11.003>
- McNeill, J. (2014) Holotype specimens and type citations: General issues. *Taxon* 63: 1112–1113.
<https://doi.org/10.12705/635.7>
- 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 1 October 2017)
- Moreira-Muñoz, A., Muñoz-Schick, M., Marticorena, A. & Morales, V. (2016) Catálogo de Asteraceae (Compositae) de la Región de Arica y Parinacota, Chile. *Gayana Botánica* 73 (2): 226–267.
<https://doi.org/10.4067/S0717-66432016000200226>
- Nakajima, J.N. (2015) *Tagetes* in *Lista de Espécies da Flora do Brasil. Jardim Botânico do Rio de Janeiro*. Available from: <http://floradobrasil.jbrj.gov.br/jabot/floradobrasil/FB16340> (access 23 May 2017)
- Neher, R.T. (1966) *Monograph of the genus Tagetes*. Ph.D. thesis, Indiana University, Bloomington, Indiana, 306 pp.
- Neher, R.T. (1968) The ethnobotany of *Tagetes*. *Economic Botany* 22: 317–325.
<https://doi.org/10.1007/BF02908126>
- Panero, J.L. (2007) Tribe Tageteae. In: Kadereit, J.W. & Jeffrey, C. (Eds.) *The Families and Genera of Vascular Plants*, vol. 8. Springer, Berlin, pp. 420–431.
- Persoon, C.H. (1807) *Synopsis Plantarum*, vol. 2. Treuttel & Würtz, Paris, 656 pp.
- Peter, G. & Katinas, L. (2003) A new type of Kranz anatomy in Asteraceae. *Australian Journal of Botany* 51: 217–226.
<https://doi.org/10.1071/BT02080>
- Pruski, J.F. (2015) *Tagetes* L. In: Pruski, J.F. & Robinson, H. (Eds.) *Flora Mesoamericana*, vol. 5 (2). Available from: <http://www.tropicos.org/> (accessed 28 September 2016)
- Robinson, H. (1973) Additions to the genus *Tagetes* (Helenieae, Asteraceae). *Phytologia* 26: 378–380.
- Robinson, H. (1999) *Tagetes*. In: Jørgensen, P.M. & León-Yáñez, S. (Eds.) Catalogue of the Vascular Plants of Ecuador. *Monographs in Systematic Botany from the Missouri Botanical Garden* 75: 310–311.
- Robinson, H. (2014) *Tagetes*. In: Jørgensen, P.M., Nee, M.H. & Beck, S.G. (Eds.) Catálogo de las plantas vasculares de Bolivia. *Monographs in Systematic Botany from the Missouri Botanical Garden* 127: 290–382.
- Schultz-Bipontinus, C.H. (1865) Enumeratio Cassiniacearum a cl. G. Mandon in Bolivia a. 1857–1861 lectarum. *Linnaea* 34: 527–536.

- Serrato Cruz, M. (2010) *Información documental sobre el taxa Tagetes para dimensionar su centro de origen y diversidad genética en México*. Área Metodología de Investigación, Departamento de Fitotecnia, Universidad Autónoma Chapingo, 63 pp.
- Singh, V., Singh, B. & Kaule, V.K. (2003) Domestication of wild marigold (*Tagetes minuta* L.) as a potential economic crop in western Himalaya and north Indian plains. *Economic Botany* 57: 535–544.
[https://doi.org/10.1663/0013-0001\(2003\)057\[0535:DOWMTM\]2.0.CO;2](https://doi.org/10.1663/0013-0001(2003)057[0535:DOWMTM]2.0.CO;2)
- Simón, P.M., Katinas, L. & Arambarri, A.M. (2002) Secretary structures in *Tagetes minuta* (Asteraceae, Helenieae). *Boletín de la Sociedad Argentina de Botánica* 37: 289–297.
- Simpson, B.B. (2009) Economic importance of Compositae. In: Funk, V.A., Susanna, A., Stuessy, T.F. & Bayer, R.J. (Eds.) *Systematics, evolution, and biogeography of Compositae*. International Association for Plant Taxonomy, Vienna, pp. 45–58.
- Smith, B.N. & Turner, B.L. (1975) Distribution of Kranz syndrome among Asteraceae. *American Journal of Botany* 62: 541–545.
<https://doi.org/10.2307/2441964>
- Soule, J.A. (1993) *Biosystematics of Tagetes*. Unpublished Doctoral Dissertation. University of Texas. Austin.
- 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. (1976–1988) *Taxonomic Literature (2nd edition)*. Bohn, Scheltema & Holkema, Utrecht. Available from: <http://www.sil.si.edu/DigitalCollections/tl-2/> (access 22 May 2017)
- Strother, J.L. & Wetter, M.A. (2006) *Tagetes*. In: Flora of North America Editorial Committee (Eds.) *Flora of North America & North of Mexico, vol. 21*. Oxford University Press, Oxford, pp. 235–236.
- 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 1 September 2016)
- Turner, B.L. (1996) The Comps of Mexico—A systematic account of the family Asteraceae, vol. 6, Tageteae and Anthemideae. *Phytologia Memoirs* 10: 1–93.
- Vellozo, J.M.C. (1827 [1831]) *Florae Fluminensis, Icones Fundamentales* 8. Senefelder, Paris, 164 pp.
- Vellozo, J.M.C. (1881) *Florae Fluminensis, Descriptionum Plantarum*. *Archivos do Museu Nacional do Rio de Janeiro* 5: 1–461.
- Vilà, M., Meggaro, Y. & Weber, E. (1999) Preliminary analysis of the naturalized flora of northern Africa. *Orsis* 14: 9–20.
- Webb, C.J., Sykes, W.R. & Garnock-Jones, P.J. (1988) *Flora of New Zealand. Vol. IV. Naturalised Pteridophytes, Gymnosperms, Dicotyledons*. Botany Division, Department of Scientific and Industrial Research, Christchurch, 1365 pp.
- Weddell, H.A. (1855) *Chloris Andina, vol. 1*. P. Bertrand, Paris, 231 pp.
- 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.