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Orobanche dominae (Orobanchaceae), a new species described from Tunisia, North Africa

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Abstract. *Orobanche dominae* El Mokni (section *Orobanche* L.) is described and illustrated as a new species to science, endemic to central-eastern Tunisia, North Africa. The new species is known only from a single population within olive groves of Mahdia area, where it grows on sandy loam soil and parasiting on the Tuniso-Libyan endemic *Onopordum espinae* Bonnet. It is a medium almost brownish-purple plant characterized by a precocious and very short blooming period. It has a cylindrical, long inflorescence with erecto-patent and long sized flowers. The corolla exhibits varying colors along with short and long glandular hairs in addition to an almost glabrous style on the lower part. The macromorphological features suggest a closer relationship of this new species to the members of the subsections *Minores* Teryokhin and *Speciosae* Novopokr., in particular with *Or. crenata* Forssk., *Or. minor* Sm., and *Or. artemisiae-campestris* Gaudin s.l. (so far the only known *Orobanche* that was mentioned parasitizing one of the *Onopordum* species, *On. illyricum* L.). Relationships and discriminating morphological features of the new species with its closest species are examined. Data on its ecological and conservation status together with its main host(s) and distributive area are also presented.

Keywords: endemism, holoparasites, Lamiales, *Onopordum espinae*, taxonomy, Tunisia.

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Introduction

Orobanche L. (Orobanchaceae Vent.) is the most species-rich root holoparasitic genus worldwide and comprises ca. 150–200 species, with main centres of their diversity in the Mediterranean Basin, western and central Asia (Pusch & Günther, 2009).

North Africa (especially, central and western parts) is one of the globe's biodiversity hotspots (named "Mediterranean Basin" according to Myers *et al.*, 2000) and the whole coastal area was defined as a regional "hot-spot" of biodiversity, named "Kabylia-Numidia-Kroumiria", by Véla & Benhouhou (2007). This local hot-spot covers diverse countries such as Canary Islands, Mauritania, Morocco, Algeria, Tunisia, Lybia, and Egypt. Within this coastal area, Tunisian territory is since recent years under exhaustive investigations regarding on distribution, taxonomy and hosts diversity of holoparasitic (non-photosynthetic) plants (see e.g., Domina, 2011; Domina *et al.*, 2013; El Mokni *et al.*, 2015, 2016, 2022; El Mokni & Domina, 2019). In Tunisia, holoparasitic flora includes many families (El Mokni *et al.*, 2016) among which Orobanchaceae is the richest one.

The genus *Orobanche* (*Orobanche* sect. *Orobanche*) is represented in Tunisia by 18 species with no endemics or parasitizing endemic host-plants (Dobignard & Chatelain, 2013; El Mokni *et al.*, 2015, 2022; Domina & Raab-Straube, 2010+). *Orobanche* species are characterized by slight morphological diagnostic characters; hence, they are difficult to distinguish in terms of taxonomy (cf. Domina *et al.*, 2011; Zare & Dönmez, 2013; Zare *et al.*, 2014; Konarska & Chmielewski, 2019). Moreover, dried specimens lose colors and become brownish to blackish, making herbarium specimens difficult to identify (see e.g., Manen *et al.*, 2004; Piwowarczyk *et al.*, 2011, 2014, 2015). Therefore, the presence of the host-plant may facilitate to some extent identification of the *Orobanche* species growing nearby (see e.g., Hipkin, 1992; Carlón *et al.*, 2015; Konarska & Chmielewski, 2019).

Even though, some species of *Orobanche* may have different host plants (e.g., *Or. minor* Sm. on Apiaceae, Asteraceae and Fabaceae [see Beck-Mannagetta, 1930; Schneeweiss, 2007]), others are reported to be species-specific (e.g., *Or. ballotae* A. Pujadas on *Ballota hirsuta* Benth., *Or. salviae* F.W. Schultz on *Salvia glutinosa* L. or *Phelipanche rosmarina* (Welw. ex Beck) Banfi, Galasso & Soldano exclusively on *Rosmarinus officinalis* L.) and are only able to parasitize a single host species. Thus, host plants have always been used as an additional attribute to support the morphological features in species

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description and identification (Piwowarczyk, 2015; Sánchez Pedraja *et al.*, 2016a+, 2016b+; Piwowarczyk *et al.*, 2019).

During field investigations in Mahdia region in April 2017, a population of *Orobanche* parasitizing on the endemic host-plant *Onopordum espinae* Bonnet (Asteraceae) was discovered and here is described as a new species to science, *Orobanche dominae*, since showing some appropriate morphological characters which cannot be clearly ascribed to any other *Orobanche* species.

Materials and methods

Extensive field surveys were carried out since 2014 in the central-eastern Tunisia (Governorates of Mahdia, Monastir and Sousse). Specimens of the new species were collected in April 2017 and April 2020 and stored at the personal herbarium of the author (Herbarium of R. El Mokni!) deposited in the Faculty of Pharmacy of Monastir (not yet listed in Index Herbariorum; Thiers 2021). Morphological observations and measurements of the main characters of the new species were based on the examination of living specimens using a binocular stereomicroscope (KERN), a ruler and a micrometer. Host plant and accompanying species were identified in the field (names according to APD, 2021).

Literature data were also examined (see e.g., Pottier-Alapetite, 1981; Kreutz, 1995; Foley, 2001) as well as digital photographs (Sánchez Pedraja *et al.*, 2016b+). GPS coordinates and altitudes for sites were derived from the author's camera (Nikon-COOLPIX P520). The species' Extent of Occurrence (EOO) and Area of Occupancy (AOO) were calculated using the GeoCAT tool according to Bachman *et al.* (2011) with a 2×2 km cell fixed grid and its conservation status is proposed according to the criteria established by IUCN (IUCN, 2022).

Taxonomic treatment

***Orobanche dominae* El Mokni sp. nov.** (Figures 1–3)
Type: Tunisia. Mahdia governorate, Bouhlel-Ali South: ca. 7 km south of Kerker village towards El Jem, ca. 6.5 km west of Boumerdes village, ca. 13 km in the east of Essouassi village on the lower right side of the highway to El Jem, 35°24′38.9″N, 10°40′28.4″E, 150 m a.s.l., 26 April 2017, *El Mokni* [holotype: FPHM-11/26042017 (Figure 4); isotypes: FPHM-12/26042017, HFLA, PAL].

Etymology

The specific epithet "*dominae*" is named after Professor Gianniantonio Domina (University of Palermo, Italy) for his precious and continuous contribution to the systematics and taxonomy of the Orobanchaceae family and his exhaustive monography of the genus *Orobanche* within the Mediterranean area.

Description

Holoparasitic, achlorophyllous plant, (20–)40–70(–100) cm tall, purplish to brownish yellow. **Stem** simple (Figures 1A–B, 2A–B), ± slender (7.3–)8.0–10.0(–16.0) mm in diameter, slightly widening towards the base, coarsely bulbous at the base (Figure 2C); slightly striate (clearly striate when dry); densely glandular pubescent in the upper part, with whitish or pale yellow glandular hairs (0.3–)0.4–0.8 mm; stem brown-reddish or violet-purple (brown when dry). Basal **scale leaves**, dense, imbricate (19–)22–23(–25) mm x 8.3–10.2(–11.0) mm, elongated triangular, glabrous abaxially, shortly ciliate at the edge with hairs up to 3 mm (Figure 2C). Upper scales 18–20(–21) mm × 6.4–7.3(–8.0) mm, less dense, narrowly lanceolate, becoming sparse above, yellow-brown, changing early to brown when drying, especially at the top; sparsely glandular- and nonglandular pubescent, especially at the edge, with hairs 2–3 mm. **Inflorescence** 23–40(–70) cm × 3.9–5.2 cm, cylindrical to slightly ovate, more longer than the remaining stem; (37–)48–62(–100+)-flowered, ± dense (Figures 1C, 2A-B, E). **Flowers** are erecto-patent and long sized. **Bracts** 18–22(–23) mm × 6.3–7.1(–8.0) mm, shorter or rarely equal to the corolla, broad ovate-lanceolate, with dense white or pale-yellow glandular hairs, 1.4–1.8(–2.0) mm long, clearly darker than the leaves, brown (Figures 1D–C, 3B). **Bracteoles** absent. **Calyx** 14–18(–19) mm long, 2.6–3.8(–4.2) mm wide at the widest point, equal or little bit longer than half of the corolla tube; two unequally bidentate **halves**, teeth narrowly lanceolate to filiform at apex and with bases gently ovate, yellow-brown purplish at apex, with dense glandular-hairy, hairs ca. 1.2–1.6(–2.2) mm, white or pale yellow (Figure 3B). **Corolla** 23–26(–27) mm long, 8–9(–10) mm in diameter in the central part (Figure 1D); tubular to narrowly campanulate (widening towards the mouth), usually strongly inflated above the insertion of the filaments, and strongly constricted below; the dorsal line curved in the lower part, less curved or nearly straight in the middle part and ± flexed forwards or straight at the apex, externally glandular-pubescent with white or pale yellow glandular hairs of (1.1–)1.4–1.8 mm, more or less abundant, hair cover slightly denser at **upper lip**; corolla pale brownish-yellow, light yellow to very pale yellow at the base and reddish-brown or violet-purple above with brown to brownish-purple veins with short and long glandular hairs (Figure 3A); upper lip slightly emarginate with two broad lobes, porrect at first, later slightly patent, sparsely glandular hairy also in the inner part, hairs ca. (1.3–)1.4–2.0 mm; **lower lip** with almost equal 3-lobed or central lobe slightly larger than lateral lobes, lobes large, ovate, rounded, with crenate to irregularly dentate and glandular margin (Figures 1C, 3A). **Stamens** obliquely inserted, adaxial at 4.0–4.5 mm above the corolla base, and abaxial at 3.5–4.0 mm, all slightly widened at base. **Filaments** 9–12 mm long, 1.5–2.0 mm wide, white to pale yellow, clearly geniculate, hairy, hairs septate not glandular, almost glabrous above or glabrous at whole length, sometimes with scattered, short glandular hairs below the anthers. **Anthers**

1.8–2.3 mm long, 1.1–1.2(–1.5) mm wide, oblongoid, mucronate, light brown to brownish. **Ovary** 11–14 mm × 5.2–6.8(–7) mm, glabrous or nearly, yellow-reddish to pale purple (Figure 3B); lateral opening by two longitudinal slots (once dry). **Style** (8–)10–11 mm long, yellow reddish near stigma, glabrous or nearly on the lower part (half-two thirds) with very sparse short and glandular hairs on the upper part (half-third). **Stigma**, widely bilobed to disciform, with elongated-flattened distal surface; yellowish-orange to purplish (Figures 1D, 2D, 3A). **Seeds** dark ovoid to oblongoid.

Figure 1. *Orobanche dominae* El Mokni sp. nov. A, Type locality (scale bar = 15 cm); B, Habit on its host species, *Onopordum espinae* (scale bar = 10 cm); C, Lax glandular hairy inflorescence (scale bar = 1 cm); D, Details of semi-opened flowers (scale bar = 1 cm). Photographed by R. El Mokni (26.04.2017).

Phenology

Flowering (blooming) time: end-March to April; fruiting time: April to May.

Habitat, ecology, distribution and hosts

Orobanche dominae grows within spontaneous vegetation used for grazing, on opened areas of olive groves laying on sandy loam substrate, at an altitude of about 150 m a.s.l., associated within an area of 400 m^2 mainly with species as *Cynara cardunculus* L. subsp. *cardunculus*, *Hyoseris scabra* L., *Lolium rigidum* Gaudin subsp. *rigidum*, *Marrubium alysson* L., *M. vulgare* L., *Nasturtiopsis coronopifolia* (Desf.) Boiss. subsp. *coronopifolia*, *Pergularia tomentosa* L., *Schismus arabicus* Nees, *Stipa capensis* Thunb. and *Teucrium polium* L.

So far, the species is known only from the type locality (Bouhlel-Ali South), located in the central-eastern part of Tunisia, within Mahdia governorate, 7 km South of Kerker towards El Jem, 6 km West of village Boumerdes, 15 km in the East of Essouassi on the lower right side of the highway to El Jem (Figure 5). Parasiting amply on *Onopordum espinae* (Figures 1A-B, 2A-B), species native and endemic to Lybia and Tunisia, more rarely on *Cynara cardunculus* L. subsp. *cardunculus* very abundant in the region.

Taxonomic notes

Orobanche dominae sp. nov. newly-described can be included in the sect. *Orobanche* with high affinities to members of the subsections *Minores* Teryokhin and *Speciosae* Novopokr. It is mainly distinguished from related taxa by its long inflorescence, color and length of corolla, elongated scale leaves and glabrous or nearly on the lower part (half-two thirds) with very sparse short and glandular hairs on the upper part (half-third) of the style. With regards to the flowering period, blooming of the new species appears noteworthy earlier and shorter than *Or. artemisiae-campestris* Gaudin s.l., *Or. crenata* Forssk. (= *Or. speciosa* DC.), *Or. minor* Sm. (distinguished characters between these four species are summarized in Table 1).

Figure 2. *Orobanche dominae* El Mokni sp. nov. A-B, Habit on its favorite host species, *Onopordum espinae*; C, Stem coarsely bulbous at the base with two juvenile specimens (scale bar = 10 cm); D, Juvenile specimen with lax inflorescence; E, Specimen with length up to 100 cm. Photographed by R. El Mokni (23.04.2020).

Orobanche dominae resembles in its calyx length and filament insertion level to *Or. artemisiae-campestris* (incl. *Or. picridis* F. W. Schultz and *Or. scolymi* Pomel), a species occurring in Tunisia and the only species of *Orobanche* known to have a host within the genus *Onopordum* (Domina *et al*., 2011). However, it is easily distinguished from *Or. artemisiae-campestris* by its thick stem [*vs.* thin to medium stem], long and larger inflorescence [*vs.* medium and thinner inflorescence], calyx with two longer segments [*vs.* unevenly divided], pale brownish-yellow, light yellow to very pale yellow corolla [*vs.* whitish cream corolla], upper lip slightly emarginate with two broad lobes [*vs.* bilobed], and style with glabrous or nearly lower part (half-two thirds) with very sparse short and glandular hairs on the upper part (half-third) [*vs.* densely glandular-pubescent style]. Furthermore in *Or. dominae*, lower lip of the corolla shows almost equal 3-lobed or rarely central lobe slightly larger than lateral lobes, lobes large, ovate, rounded, with crenate to irregularly dentate and glandular margin (Table 1).

Figure 3. *Orobanche dominae* El Mokni sp. nov. A, Lax glandular hairy inflorescence with details of bilobed violet to purple stigma on the upper part of an opened flower within a juvenile specimen (scale bar = 1 cm); B, Details of mature yellow-reddish ovary with bidentate, narrowly lanceolate halve within a mature specimen (scale bar = 1 cm). Photographed by R. El Mokni (23.04.2020).

Orobanche dominae shows also affinities with *Or. minor*, a widespread and highly variable species from Europe to North Iraq, Macaronesia to Arabian Peninsula and South Tropical Africa (POWO, 2022a-onward), which mainly differs by its later flowering period (later spring to early summer), its shorter corolla, its lower position of filaments insertion and the aspect of filaments' indumentum, often pubescent at the line of fusion of anthers [*vs.* glabrous to slightly pubescent at the line of fusion] and never hosting on *Onopordum* species (more in Table 1). In addition, *Or. dominae* shows as well few similarities with *Or. crenata*, other species widely present in the Mediterranean area and northern Africa which despite its long, stout, and erect stem and its numerous flowers mainly in a dense, cylindrical spike, it can be easily distinguished from *Or. dominae* by its later flowering period, almost glabrous scale leaves, glandular-pubescent styles. It is moreover associated largely with species of the Fabaceae family (Kojić *et al.*, 2001) (more in Table 1).

Last but not least, the main host, *Onopordum espinae* is an endemic species from Tunisia and it is not hosted by any other *Orobanche* taxa.

Despite that *Orobanche dominae* is difficult to confuse with other taxa of the *Orobanche* sect. *Orobanche* subsect. *Glandulosae* Teryokhin due to its non-dark glandular hairs, distinctively crowded cylindrical spike longer than the remaining stem, narrowly lanceolate to filiform calyx segment entire (up to 19 mm). Similarities in habit and range of host-plants from Asteraceae could be noticed mainly with *Orobanche minor* group, some variants of the *Or. minor* s.l., *Or. grisebachii* Reut., *Or. palaestina* Reut., *Or. calendulae* Pomel, *Or. australis* Moris ex Bertol., and also with *Or. reticulata* Wallr. s.l. [incl. *Or. pallidiflora* Wimm. & Grab., *Or. reticulata* subsp. *pallidiflora* (Wimm. & Grab.) Hayek, *Or. reticulata* subsp. *reticulata* (Wallr.) Hayek], and *Or. elatior* Sutton s.l.

In fact, within the *Orobanche minor* group (incl. *Or. amethystea* Thuill., *Or. canescens* C. Presl,

Figure 4. The holotype of *Orobanche dominae* El Mokni sp. nov.

Or. litorea Guss., *Or. pubescens* d'Urv.), *Or. dominae* could be easily distinguished by its conspicuous habit and relatively large brown-reddish or violet-purple stem with (7.3–)8.0–10.0(–16.0) mm in diameter, and its glabrous or nearly on the lower part (half-two thirds) with very sparse short and glandular hairs on the upper part (half-third) [*vs*. yellow or yellowish stem with only 4–7 mm in diameter and a glabrous style in *Or. canescens*]. As compared to *Or. litorea*, *Or. dominae* shows an inflorescence much longer and dense with 23–40(–70) cm × 3.9–5.2 cm [vs. 3–16 × 2.3–3.4 cm in *Or. littorea*]. The new species seems to be closer to *Or. pubescens* with which shares some characters as reddish-brown stem, filaments up to 12 mm long and a pubescent style but it is easily distinguished from it at least by its wide stem with (7.3–)8.0–10.0(–16.0) mm in diameter [vs. 3–5 mm in diameter] and its ample corolla with 23–26(–27) mm long, 8–9(–10) mm in diameter [vs. 13–18 × 5 mm in diameter in *Or. pubescens*].

Despite that *Orobanche dominae* shows remarkable uniformity of some discriminating characteristics compared with *Or. amethystea*, it can differ mainly by its

specific host-plant, *Onopordum espinae* [vs. *Eryngium campestre* L. in *Or. amethystea*], its lanceolate glandular hairy bracts up to 8.0 mm wide, shorter or rarely equal to the corolla [vs. only up to 5 mm wide with shorter than corolla in *Or. amethystea*]. Moreover, *Or. dominae* has longer corolla with 23–26(–27) mm and anthers with 1.8–2.3 mm long [vs. 15–22 mm for corolla and only 1.4–1.7 mm for anthers in *Or. amethystea*] (see more in El Mokni *et al.*, 2015).

Although that studied specimens of *Orobanche dominae* can show remarkable uniformity with some variants in the *Or. minor* s.l. (mainly *Or. minor* var. *compositarum* Pugsley for its specific host-plants family) it can be at least easily distinguished by its longer corolla with 23–26(–27) mm [vs. less than 20 mm long in at most all variants of *Or. minor*; 15–17 cm in var. *maritima*, 10–18 mm in var. *minor*]. More recently, Thorogood & Rumsey (2020: 231) reported that host-plants for *Or. minor* var. *compositarum* are usually *Crepis* spp.

Compared to *Orobanche grisebachii* Reut. [≡ *Or. minor* subsp. *grisebachii* (Reut.) Nyman, *Or. minor* var. *grisebachii* (Reut.) Hadidy], an eastern Mediterranean native taxon (not recognized in the Euro+Med PlantBase (Domina & Raab-Straube, 2010+) as an independent species, but is treated there as a synonym of *Or. minor* Sm.), *Or. dominae* can be distinguished by its longer, tubular to narrowly campanulate (widening towards the mouth) corolla with 23–26(–27) mm long [vs. not lanate-pilose, cylindrical corolla with 10–20 mm in *Or. grisebachii*], its oblongoid, mucronate anthers [vs. narrow, elongate-mucronate anthers in *Or. grisebachii*] and the aspect of its style [glabrous or nearly on the lower part (half-two thirds) with very sparse short and glandular hairs on the upper part (half-third) in *Or. dominae* whereas glandular-pilose in *Or. grisebachii*] (Gilli, 1982). In addition, the type of *Or. grisebachii* (barcode G00192005, https://www.ville-ge.ch/cjbjpg/cjb3/img_76/G00192005.jpg) is indicated with a specific host-plant of the Leguminosae family (on ?*Securigera parviflora* (Desv.) Lassen syn. *Coronilla parviflora* Willd., Sánchez Pedraja *et al.*, 2016b+) whereas *Or. dominae* has a specific host-plant(s) of the Asteraceae family (commonly on *Onopordum espinae* and more rarely on *Cynara cardunculus* subsp. *cardunculus*).

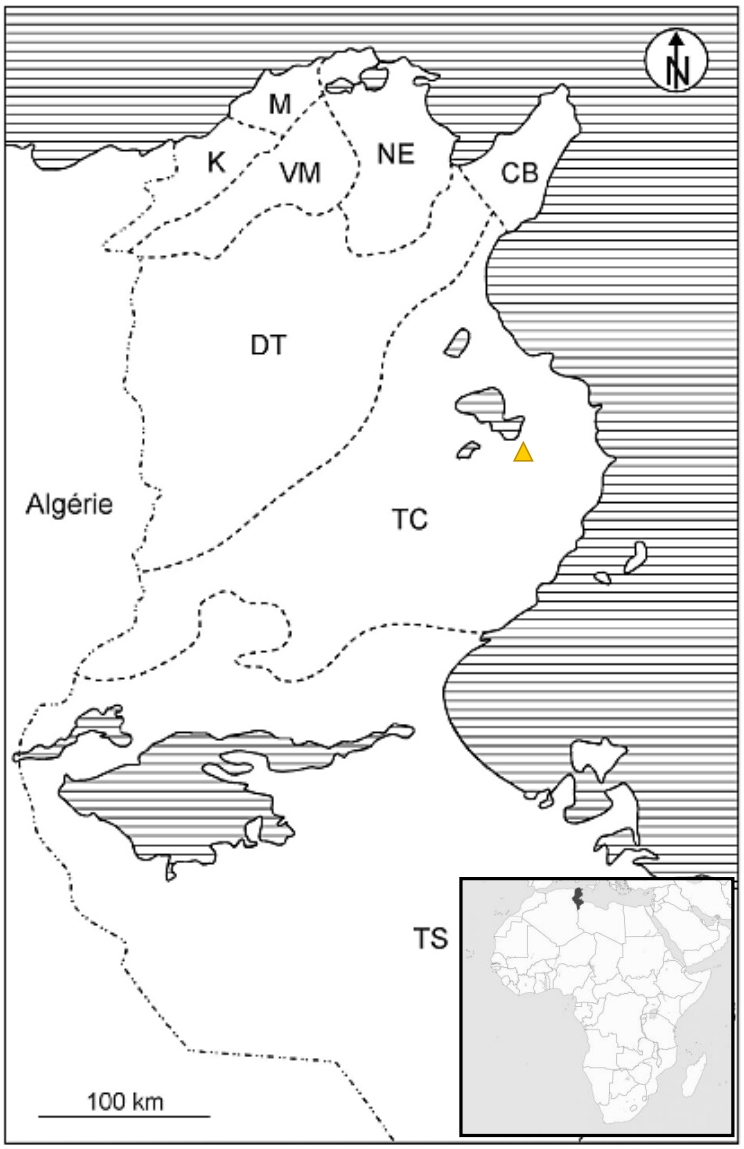

Figure 5. Actual limited area distribution of *Orobanche dominae* (brownish-yellow triangle) within central Tunisia (TC).

Compared to *Orobanche palaestina* Reut. (≡ *Or. minor* var. *palaestina* (Reut.) Pau), an endemic east Mediterranean taxon, the new North African endemic *Orobanche* is easily distinguished by its longer calyx 14–18(–19) mm, corolla with 23–26(–27) mm and filaments with 9.0–12 mm long [vs. only 8–12 mm for the calyx, 15–17 mm for the corolla and ca. 8 mm long in *Or. palaestina*], besides the presence of two unequally bidentate halves [vs. undivided or unequally 2-lobed halves in *Or. palaestina*].

In fact, *Orobanche palaestina* is very similar to *Or. grisebachii* but is remarkably different from both *Or. grisebachii* and *Or. minor* by having slightly shorter flowers and the calyx segments that are often deeply divided in two unequal teeth. In contrast to this, the segments of calyx in *Or. palaestina* are entire and Beck-Mannagetta (1890) claims that *Or. palaestina* is distinguishable by stigma with deep yellow color (see more in Domina *et al.*, 2022; Table 1, column 6: 93 and Figure 1d: 94).

Table 1. Diagnostic characteristics, host and distribution of *Orobanche dominae* El Mokni sp. nov. and the most closely related species belonging to the subsections *Minores* Teryokhin and *Speciosae* Novopokr. Measurments of morphological features of the new species were analysed on 8 living mature plants whereas data presented for its closest relatives derived only from literature (e.g., Pottier-Alapetite, 1981; Rumsey & Jury, 1991; Kreutz, 1995; Foley, 2001; El Mokni *et al.*, 2015).

Features/hosts	*Orobanche dominae*	*Or. artemisiae-campestris*	*Or. crenata*	*Or. minor*
Stem (cm)	(20–)40–70(–90) × (0.7–)0.8–1.0(–1.6) Stout, erect	(10–)20–30(–50) × 0.3–0.6 Slender, sometimes stout	15–50(100) Stout, rarely slender, erect	10–70 Slender sometimes stout, erect or slightly curved
Inflorescence (cm)	23–40(–70) × 3.9–5.2 Flowered, usually lax or rarely dense, cylindrical, much longer than the remaining stem	5–20 Dense spike becoming ± lax at the base	Numerous flowers mainly in a dense, cylindrical spike	Numerous flowers in a dense, cylindrical spike in the beginning, later lax and elongated
Flowering period	End of Marsh to April (very short)	Mid-June to end of July	May to end July in Europe, mid-April in the Mediterranean region	Mid-May to end of August
Scale leaves (mm)	(19–)22–23(–25) × 8.3–10.2(–11) Elongated, triangular-lanceolate, becoming sparse above, glandular hairy	12–15 × 3–5 The lowers are triangular-oval and glabrous, the higher are lanceolate to elongated, glandular pubescent	Oval-elongated to lanceolate, almost glabrous	The lowers are triangular-oval, the higher are lanceolate to elongated, glandular pubescent and erect to spreading
Bracts (mm)	18–22(–23) × 6.3–7.1 (–8) Shorter or as long as the corolla, brownish-yellow with glandular hairs	10–20 × 3–5 Lanceolate, of a yellowish or darker cream, with glandular hairs	As long as corolla Lanceolate dark brown-glandular-pubescent, deflexed at the tip	As long as the corolla Lanceolate, light to dark brown, richly glandular-pubescent and usually slightly deflexed
Calyx (mm)	14–18(–19) (2/3–3/4 length of corolla)	10–15	2/3 to 3/3 length of corolla	About 1/2 length of corolla, sometimes as longer as or longer than the corolla
Calyx segments	Two unequally bidentate halves, teeth narrowly lanceolate to filiform	Whole or unevenly divided segments, illuminated with filiform apex	Two bifid or unequally bidentate halves or totally separated, narrowly filiform	Usually entire or unequally bidentate, usually deeply bifid, oval at the base and filiform at the tip
Corolla (mm)	23–26(–27) × 8–9(–10)	(14–)16–20(–22)	25–30 (10–20 in small plants)	10–19
Corolla – dorsal line	Curved in the lower part, less curved or nearly straight in the middle part and a little bit flexed forwards or straight at the apex	Erect-patent, ± tubular, curved	Clearly curved in the middle, often erect near the lip	Curved entirely or slightly geniculate in the lower part, almost straight in the middle and upper part and slightly raised near the upper lip
Corolla – upper lip	Slightly emarginate with two broad lobes, porrect at first, later slightly patent	Almost entire to bilobed, with recurved lips	Rounded emarginate with very broad, porrect, spreading or deflexed lobes	Almost entire or bilobate with emarginate, porrect lobes

Features/hosts	*Orobanche dominae*	*Or. artemisiae-campestris*	*Or. crenata*	*Or. minor*
Corolla – lower lip	Almost equal 3-lobed or rarely central lobe slightly larger than lateral lobes, lobes large, ovate, rounded, with crenate to irregularly dentate and glandular margin	Rounded lobes, slightly denticulated	Three deeply crenate, rounded and plicate lobes the middle lobe usually larger than the side lobes	Three rounded, plicate, unevenly crenate, deflexed lobes of almost equal size
Corolla – colour	Pale brownish-yellow, light yellow to very pale yellow at the base and reddish-brown or violet-purple above with brown to brownish-purple veins with short and long glandular hairs	Whitish cream with violet veins, with some glandular hairs	White (pale) or yellowish-white; tinged with violet or pink, especially near the upper lip. The entire flower has light or dark violet veins	Yellowish, yellow-white to dark yellow, violet or with violet-reddish veins near the upper lip with light, short glandular hairs
Filaments – insertion (mm)	Abaxial at 3.5–4.5 above the base of corolla-tube	3.0–4.0 above the base of corolla-tube	2.0–5.0 above the base of corolla-tube	2.0–3.0 above the base of corolla-tube
– indumentum	Hairy, hairs septate glandular, almost glabrous above or glabrous at whole length, sometimes with scattered, short glandular hairs below anthers	Lower half hairy, glandular above or rarely glabrous towards the apex	Densely pubescent at the base and sparsely pubescent up to anthers, rarely glabrous	Sparsely glandular-pubescent up to the anthers
Anthers (mm)	1.8–2.3 × 1.1–1.2(–1.5) Glabrous to slightly pubescent at the line of fusion	Glabrous or pubescent at the line of fusion	Often pubescent at the line of fusion	Often pubescent at the line of fusion
Style	Glabrous or nearly on the lower part (1/2 – 2/3) with very sparse short and glandular hairs on the upper part (1/2 –1/3)	Densely glandular-pubescent	Glandular-pubescent	Sparsely glandular-pubescent or glabrous
Stigma	Widely bilobed to disciform, with elongated-flattened distal surface; yellowish-orange to purplish-violet, darker in the upper part	Two hemispherical lobes; red-violet, red-brown or reddish to dark purple-brownish, brighter in the upper part	Two elongated, spherical lobes, which are white, orange, yellowish-white, pink or light violet	Two hemispherical lobes, pink, brown-violet, purple, purple-brown, brown-violet, red-violet, rarely white or yellow
Host	Asteraceae: mainly on *Onopordum espinae* (a Tuniso-Libyan endemic species) and more rarely on *Cynara cardunculus* subsp. *cardunculus*	Asteraceae: mainly on *Artemisia campestris* but also on *Picris hieracioides, P. echioides, Onopordon illyricum, Rhagadiolus stellatus, Scolymus* spp.	Mainly on Fabaceae species, more rarely on *Pelargonium* species. Among cultivated plants, it prefers *Vicia faba*, *Daucus carota*, *Cicer arietinum*, *Pisum sativum*, *Lens culinaris*. In Tunisia, known only on cultivated Fabaceae!	Parasitic on hundreds of species in taxonomically diverse families from the Ranunculaceae to the Poaceae, but with a clear preference for the Fabaceae and Asteraceae
Distribution	North Africa (Tunisia)	Europe, Caucasus, North Africa. In Tunisia, historical records (as *Or. scolymi* Pomel) are only from some localities in the North East and in the Cap Bon	Southern Europe to the Caucas, Northern Africa and the Canary Islands. In Tunisia, historical records are from the North East, Cap Bon and only Sousse in the Centre	Originally, a plant of the Mediterranean countries, it became widely distributed in large parts of Africa, North America and New Zealand. In Tunisia,

With regard to *Orobanche calendulae* Pomel (synonymized homotypically to *Or. mauretanica* subsp. *calendulae* (Pomel) Cout. and *Or. artemisiae-campestris* subsp. *calendulae* (Pomel) O. Bolòs, Vigo, Masalles & Ninot) where *Or. calendulae* was markedly distinguished from *Or. mauretanica* and *Or. artemisiae-campestris* by the shapes of its calyx and corolla (Domina *et al.*, 2013; Figure 2b: 761). The species is native to the Iberian Peninsula (south Portugal to south-western Spain) and North Africa from the Canary Islands (Madeira) to Morocco and Algeria (Domina & Raab-Straube, 2010+; Domina *et al.*, 2013). It is recently reported in Tunisia along northern coast of Tabarka in north-western of Tunisia parasitizing only on *Calendula suffruticosa* Vahl. (El Mokni *et al.*, 2023). *Orobanche dominae* shares some characters with *Or. calendulae* including mainly a long flowered more or less dense inflorescence and a purple or purplish brown to purplish violet stigma, it is obviously distinguished by its shorter or rarely equal bracts to the corolla [vs. bracts exceedingly more or less the corolla in *Or. calendulae*] and its longer corolla with 23–26(–27) mm [vs. 10–20 mm long in *Or. calendulae*]. Over and above these morphological

characters, the specific parasitism on *Onopordum espinae* and the geographic isolation (center eastern vs. north western Tunisia) from *Or. calendulae* support the recognition of *Or. dominae* as a different taxon.

Regarding *Orobanche australis* Moris ex Bertol., a taxon with a native limited area of distribution within the northern shore of the Mediterranean area (France, Sardinia, Italy and Sicily) that seems to be closer to *Or. dominae* in some characters including mainly, a very robust stem; a curved corolla basally and on the upper lip, straight in the middle part and hairy stamen filaments basally, glabrous above. The new North African species can be easily distinguished from *Or. australis* by having usually lax or rarely dense inflorescence [vs. dense inflorescence in all its length], shorter or rarely equal floral bracts to the corolla [vs. distinctly longer floral bracts than the corolla], filaments insertion at ca. 3.5–4.5 mm above the base of corolla-tube [vs. ca. 2 mm above the base of corolla tube] and a yellowish-orange to purplish-violet, darker in the upper part stigma [vs. a yellow stigma in *Or. australis*] (see more in Domina *et al.*, 2022; Table 1, column 2: 93 and Figure 1a: 94).

Additionally, *Orobanche dominae* shows affinities with *Or. reticulata* s.l., a widespread group in altitudinal regions of Europe among which *Or. reticulata* s. str. suspected present in northern Africa but without any confirmation (see e.g., Meusel *et al.*, 1978; Hultén & Fries, 1986; Kreutz, 1995; POWO, 2022b- onward), which mainly differs in the color of the corolla, lower lip of the corolla with three crenate lobes, where the middle one is little longer, and sparsely pubescent anthers at the line of fusion. *Or. reticulata* hosts on Asteraceae: mainly on *Cirsium* sp. but also on *Cardus* sp. [on *Carduus hamulosus* Ehrh. (Bauer, 2021) and others (Sánchez Pedraja *et al.*, 2016a+)], casually on *Achillea pectinata* (Stoyanov, 2006), more seldom species of the genus *Scabiosa* (see e.g., Mądalski, 1967; Chater & Webb, 1972; Kreutz, 1995; Zázvorka, 2000; Piwowarczyk *et al.*, 2010).

Along with, *Orobanche dominae* shows few similarities with *Or. elatior* s.l. [incl. *Or. centaurina* Bertol. (*Or. kochii* F.W. Schultz; *Or. ritro* Gren.), *Or. leptantha* Pomel (*Or. icterica* Pau) and *Or. loscosii* L. Carlón *et al.* (*Or. ritro* auct. hisp.)], a species of the subsect. *Curvatae* (Beck) Piwow., Ó. Sánchez & Moreno Mor. (Piwowarczyk *et al.*, 2017: 133) which native range is Europe to north west and central China and north Iran with no occurrence in the African continent (Domina & Raab-Straube, 2010+). Despite its long curved, clearly bent forward in the middle corolla (15–28 mm) and very often glabrous anthers, it can be easily distinguished from *Or. dominae* by the color of its corolla and stem (yellowish to ochre to light-brown or dirty-pale-pink), dense spike, shorter calyx-segments of two unequally halves, and the level of stamen filaments insertion (4.0–6.0 mm above the base of corolla-tube) (see more in Carlón *et al.*, 2011: 94–95 and 98–99). *Orobanche elatior* hosts on Asteraceae: mainly *Centaurea* spp., *Echinops ritro* L. subsp. *ritro* and more rarely on *Scabiosa* species (see e.g., Kreutz, 1995; Carlón *et al.*, 2011).

Conservation status

Orobanche dominae is known only from one locality where it is growing within an opened area of olive groves not far some local villages using spontaneous vegetation for grazing. The number of mature individuals was low (about 18 in 2017 and ca. 50 in 2020) but they grow well producing abundant flowers and fruits. EOO is 0.4 km^2. By the application of the criterion B1 of IUCN (2019), the new species is here assessed as "Critically Endangered" (CR).

Additional specimens examined (paratypes)

The same locality as holotype, 26 April 2017, R. El Mokni (FPHM-11/26042017); 23 April 2020, R. El Mokni (FPHM-31/23042020, FPHM-32/23042020, FPHM-33/23042020, FPHM-34/23042020, FPHM-35/23042020).

Conclusion

Morphological features such as biological (specific host) indicate that *Orobanche dominae* is a new species to science, endemic to Tunisia and North Africa and extremely localized on the area where grows naturally its main host, *Onopordum espinae*. Its originality and rarity make it a species that deserves protection at the national and international levels. Further studies (counting molecular data) should be conducted in the future to search for more eventual populations (including Libyan territory) and to better understand the ecological characteristics of this species.

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Conflict of interests

None

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