

# New records of cacti (Opuntioideae, Cactaceae) for the non-native flora of Tunisia and North Africa with a key to the *Cylindropuntieae* tribe

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**Abstract.** Botanical surveys undertaken in Central and Northern Tunisia (North Africa), mostly between 2015 and 2020, have revealed three new allochthonous cacti. The reported taxa belong to the genus *Cylindropuntia* (Cactaceae, subfamily Opuntioideae, tribe *Cylindropuntieae*). *C. leptocaulis*, *C. prolifera* and *C. spinosior* are here reported for the first time from North Africa. Updated nomenclature, descriptions, general and national distributions are pointed out for each species. An analytical key and field photographs are also provided.

**Keywords:** Cactaceae; Tunisia; succulents; *Cylindropuntia*; new records; xenophytes.

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## Introduction

In the course of the last decade, the knowledge on the non-native flora of Tunisia and North Africa considerably increased (see e.g., El Mokni & El Aouni, 2011a, 2011b, 2012, 2013; El Mokni & Domina, 2018; El Mokni & Verloove, 2019a, 2019b; El Mokni *et al.*, 2012, 2013, 2016; El Mokni & Iamónico, 2018a, 2018b, 2019; El Mokni, 2018, 2019; Iamónico & El Mokni, 2016, 2017, 2019; Sakhraoui *et al.*, 2019a, 2019b). However, information about alien succulent plants, although increasing (see e.g., El Mokni & Sáez, 2019; El Mokni *et al.*, 2018, 2019a, 2019b, 2020), is still scarce.

As a continuation of our ongoing botanical research aiming at improving the knowledge on the Tunisian vascular succulent flora, field surveys allowed to find scattered populations of three new Cactaceae species (subfamily Opuntioideae; tribe *Cylindropuntieae*). The here reported species were not previously recorded in North Africa and belong to the genus *Cylindropuntia* (Engelm.) F.M. Knuth. This genus of terete-stemmed Opuntioideae (Tribus *Cylindropuntieae* sensu Hunt *et al.*, 2006) only had one species in Tunisia so far, *C. imbricata* (Haw.) F.M. Knuth (El Mokni *et al.*, 2020).

These three newly reported taxa are: *Cylindropuntia leptocaulis* (DC.) F.M. Knuth, *C. prolifera* (Engelm.) F.M. Knuth and *C. spinosior* (Engelm.) F.M. Knuth. The new North African populations are described and the distribution and habitat of the species are outlined. An

analytical key to the species of *Cylindropuntia* occurring in the wild in Tunisia with original photographs for each taxon are also provided.

## Materials and Methods

Botanical surveys were carried out in Central and Northern Tunisia (North Africa), between 2015 and 2020. All records here reported are documented with descriptions and field photographs of each of these species. Their actual status (casual, sub-naturalised, naturalised, and/or potentially locally invasive) was pointed out and commented upon. The identification of all species was based on Pinkava (2003), Hunt *et al.* (2006) and Walters *et al.* (2011).

The paper enumerates new taxa in alphabetical sequence. Nomenclature of the species presented is in accordance with recent databases such as APD (2020) and Korotkova & Raab-Straube (2017+).

## Results and Discussion

With the three newly reported species, the number of naturalised species within the genus *Cylindropuntia* in Tunisia becomes four. An analytical key to all species of the genus is provided.

*Cylindropuntia* (Engelm.) F. M. Knuth, *Nye Kaktusbog*: 102. 1930.

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*Opuntia* subg. *Cylindropuntia* Engelm. in Proc. Amer. Acad. Arts 3: 302. 1856.

Trees or shrubs, erect, much branched; branches articulate on ramification; branch segments cylindric to somewhat placate, glabrous, firmly attached to easily detached, distinctly to hardly tuberculate, furrow delimiting each tubercle broadly rounded, tubercles more or less elongated. Glochidia present, flattened at base. Spines with entire, papery, deciduous, epidermal sheaths. Flowers variously coloured, pink to dark purple. Inner tepals ligulate to spatulate. Fruit cylindric to subglobose or clavate, variously coloured, fleshy or dry, mostly sterile and/or proliferous. Seed usually thick-discoid or lenticular, 2.5–5 mm long, white to pale yellow or

beige; funicular envelope glabrous or with thin unicellular trichomes; girdle well-developed (Anderson, 2001; Pinkava, 2003; Hunt *et al.*, 2006).

1. *Cylindropuntia leptocaulis* (DC.) F.M. Knuth in Backeberg & Knuth, *Kaktus-ABC*: 122. 1936. (Figure 1).

New for the non-native flora of Tunisia and North Africa (see e.g., Korotkova & Raab-Straube, 2017+; APD, 2020). TUNISIA, Monastir, scattered individuals growing on a sun-exposed clayey slope in the Monastir coastal area, 20 m asl, 11.07.2019; *ibidem*, 05.10.2019, R. El Mokni *s.c.*

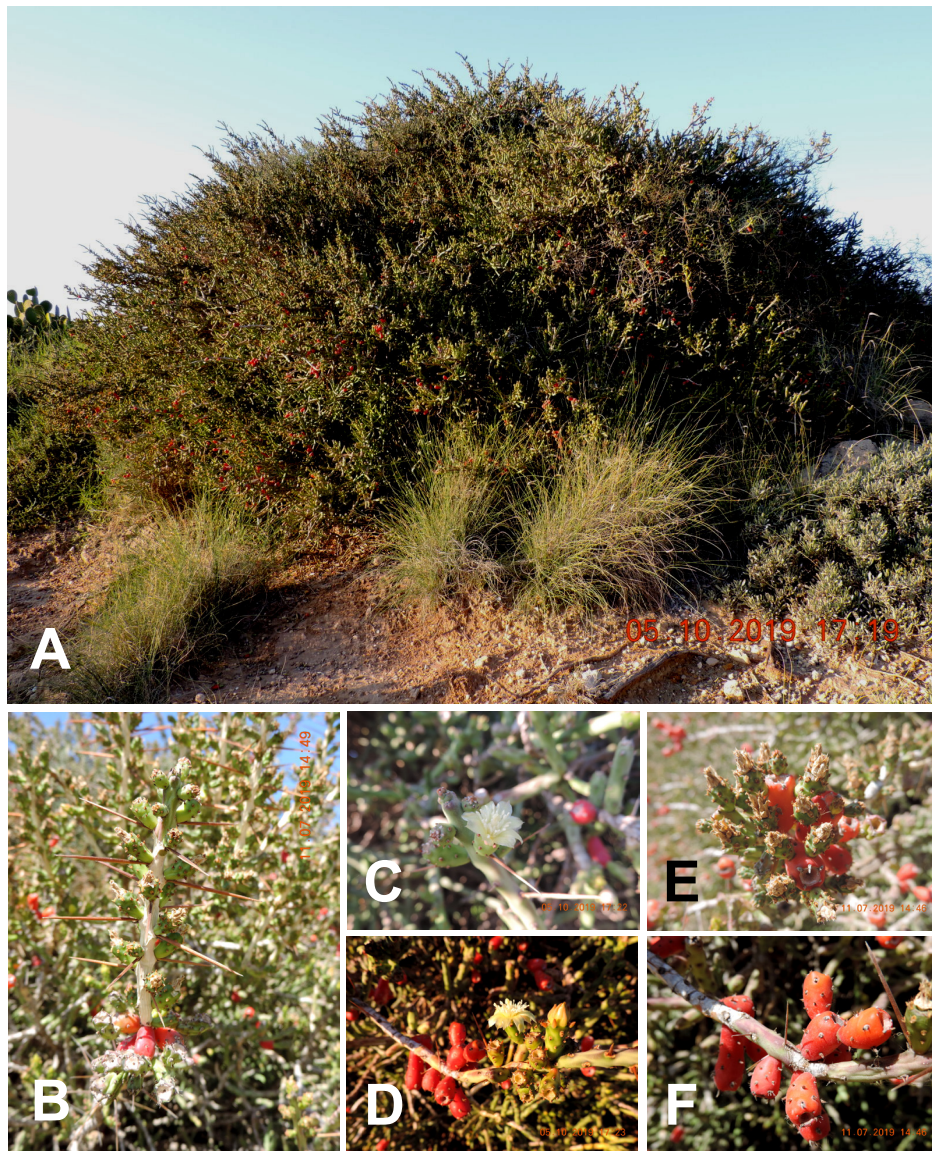


Figure 1. *Cylindropuntia leptocaulis*. A, habit on a sun-exposed clayey slope; B, Spiny stem; C-D, flowers; E-F, fruits, fleshy, smooth, spineless. All photographs were taken by R. El Mokni in Monastir (CE of Tunisia, North Africa), 11 July and 05 October 2019.

Description (from Flora of North America, www.eFloras.org): Shrubby or small treelike (Figure 1A), sparingly to densely branched, 0.5–1.8 m, usually bearing similar, commonly spineless terminal branchlets arranged at right angles along major axes. Stem segments usually alternate, gray-green or purplish, 2–8 × 0.3–0.5 cm; tubercles linear (Figure 1B), drying

as elongate, riblike wrinkles, 1.1–2(–3) cm; areoles broadly elliptic, (1–)1.5–3.5 × 0.7–2 mm; wool white to yellow, aging gray. Spines 0–1(–3) per areole, usually in apical areoles to well distributed, erect, flexible, straight or arching upward or downward, red-brown with gray to whitish coat, tips yellow, aging red-brown, terete, angular-flattened basally, the longest (4–)14–45 mm;



sheaths gray to purple-gray with yellow to red-brown tips or yellow throughout. Glochids in adaxial tuft or crescent to encircling areole, yellow or reddish brown, 1–3(–5) mm. Flowers: inner tepals pale yellow to greenish yellow (Figure 1 C-D), sometimes tipped red, narrowly obovate, 5–8 mm, acute, apiculate; filaments greenish yellow; anthers yellow; style yellow; stigma lobes greenish yellow. Fruits occasionally proliferating, yellow to scarlet (rarely green, sometimes tinged purple, becoming yellow), sometimes stipitate, obovoid, 9–15(–27) × 6–7(–12) mm, fleshy, smooth, spineless (Figure 1E, 1F); umbilicus 2–4 mm deep; areoles 16–20. Seeds pale yellow, suborbicular to squarish and crenate in outline, warped, 3–4.5 mm diam., sides smooth, each with 1–3 large depressions; girdle smooth or with very narrow ridge (cf. Anderson, 2001; Pinkava, 2003; Hunt *et al.*, 2006).

Widespread in the deserts, grasslands, shrublands and woodlands of the southern USA from Arizona to coastal Texas, and in Mexico from Sonora to Zacatecas and Tamaulipas (Pinkava, 2003). The species is locally naturalised on the North East coast of Spain: Guillot Ortiz *et al.* (2009), Aymerich & Gustamante (2015), Aymerich (2016), Gomez-Bellver *et al.* (2019), Aymerich & Sáez (2019). It is here reported for the first time for the flora of Tunisia and North Africa (Korotkova & Raab-Straube, 2017+; APD, 2020). In Tunisia, *Cylindropuntia leptocaulis* can be classified as casual to sub-naturalised as it appears in only one subpopulation but with shrubby individuals (not more than 10 within an area of about 1 ha). However, like other species within this genus, it certainly has the potential to spread and become an invasive alien.

2. *Cylindropuntia prolifera* (Engelm.) F.M. Knuth in Backeberg & Knuth, *Kaktus-ABC*: 126. 1936. (Figure 2).  
 ≡ *Opuntia prolifera* Engelm. in *Amer. J. Sci. Arts*, ser. 2, 14: 338. 1852.

New for the non-native flora of Tunisia and the Maghreb (see e.g., Korotkova & Raab-Straube, 2017+; APD, 2020). TUNISIA, Monastir, scattered individuals growing on a sun-exposed clayey slope in the Monastir coastal area, 10–15 m asl, 24.04.2018; *ibidem*, 30.05.2019, R. El Mokni *s.c.*

Description (from Flora of North America, [www.eFloras.org](http://www.eFloras.org)): Shrubs or small trees, erect, 0.6–2.5 m (Figure 2A, 2C). Stem segments easily detached, whorled or sub-whorled, green-gray, 4–15 × 3.5–5 cm; tubercles prominent, broadly oval, 1.5–2.5 cm, 4–9 mm high; areoles subcircular to obovate, 4–7 × 3–5 mm; wool tan, aging brown to black. Spines 6–12 per areole, in all but proximal most areoles, spreading, usually deflexed in abaxial ones, pale red-brown to dark brown, acicular, the longest to 2 cm; sheaths pale yellow-brown, shiny. Glochids in adaxial crescent and few along margin of areole, yellow to brown, 0.5–2.5 mm. Flowers: inner tepals rose to magenta, to 20 mm; filaments yellow-green to distally tinted pink to magenta (Figure 2B, 2F); anthers yellow, sometimes bearing stigma-tipped, style

like appendages; style greenish yellow to often pink distally; stigma lobes yellow to white. Fruits usually sterile, often proliferating into short erect chains of 2–5 fruits, green, broadly ovoid to top-shaped, 21–25(–35) × 20–32 mm, fleshy, smooth to shallowly tuberculate, spineless (Figure 2D, 2E); umbilicus broadly shallow, 5–7 mm deep; areoles (20–)25–35. Seeds rare, globose; girdle smooth (cf. Baker *et al.*, 2014).

This species is restricted to a relatively small area in Mexico (Baja California) and the USA (California). It is said to be a hybrid of two Mexican species, *Cylindropuntia alcahes* (F.A.C. Weber) F.M. Knuth and *C. cholla* (F.A.C. Weber) F.M. Knuth (Pinkava, 2003). Outside its native area it is planted as an ornamental, although perhaps not widely so. It is mentioned as naturalised only from the Canary Islands (see e.g., Verloove & Guiggi, 2013; Verloove *et al.*, 2017; Korotkova & Raab-Straube, 2017+). The species is here reported for the first time in the flora of Tunisia and the Maghreb, second report in the flora of North Africa and for the third time for the flora of the whole Mediterranean area (Laguna Lumbreras *et al.*, 2015; Korotkova & Raab-Straube, 2017+; Verloove & Guiggi, 2019; Aymerich & Sáez, 2019; APD, 2020). In Tunisia, *Cylindropuntia prolifera* can be classified as naturalised to potentially locally invasive as it appears in only one extended population but with many colonies of very branched shrubby individuals (more than 35 within an area of about 10 ha). However, like other species of this genus, it certainly has the potential to become a national invasive alien if disseminated elsewhere.

3. *Cylindropuntia spinosior* (Engelm.) F.M. Knuth in: Backeberg & Knuth, *Kaktus-ABC*: 122. 1936. (Figure 3).

New for the non-native flora of Tunisia and for the flora of North Africa (see e.g., Korotkova & Raab-Straube, 2017+; APD, 2020). TUNISIA, Beja, scattered individuals growing on a sun-exposed clayey slope between Medjez El Bab and Beja, 160 m asl, 09.04.2019, R. El Mokni *s.c.*

Description (from Flora of North America, [www.eFloras.org](http://www.eFloras.org)): Trees, compact, widely branching, 0.4–2 m (Figure 3A, 3D). Stem segments firmly attached, whorled or subwhorled, green to purple, 5–23 cm long, 1.3–3.5 cm in diameter; tubercles crowded, pronounced, oval to narrowly oval, 0.5–1.2(–1.5) cm; areoles broadly obdeltate to elliptic, 4.5–7 × 2–4 mm; wool yellow to tan, aging gray to black. Spines (4–)6–18(–24) per areole, at most areoles, interlacing with spines of adjacent areoles, pale tan (rarely yellowish), pinkish to red-brown; abaxial spines erect to usually deflexed, terete, often flattened basally, 8–19 mm; adaxial spines erect or spreading, subterete; ± bristlelike spines at areole abaxial margins; sheaths persisting, uniformly whitish, not baggy. Glochids in inconspicuous adaxial tuft, yellow to tan, aging gray, 1–2 mm. Flowers: Tepals spatulate, rose to red-purple, bronze-purple, or yellow, sometimes pale greenish yellow or whitish, spatulate, 18–35 mm, emarginate-apiculate; filaments deep purple



to pink-purple, sometimes green; anthers pale yellow; style white or pink to purple distally; stigma lobes white to cream. Fruits rarely proliferating, yellow, sometimes tinged reddish to purplish, broadly cylindrical, 20–50 × 17–30 mm, fleshy, strongly tuberculate, spineless with 28–50 or more areoles (Figure 3B-C); tubercles longer

in distal portion of fruit, yellow to almost orange when ripe, sometimes tinged with purple; umbilicus to 10 mm deep. Seeds pale yellow, suborbicular to oval in outline, flattened to warped, 4–5 × 3–4 mm, sides with 0–3 large depressions; girdle smooth (cf. Hunt *et al.*, 2006).

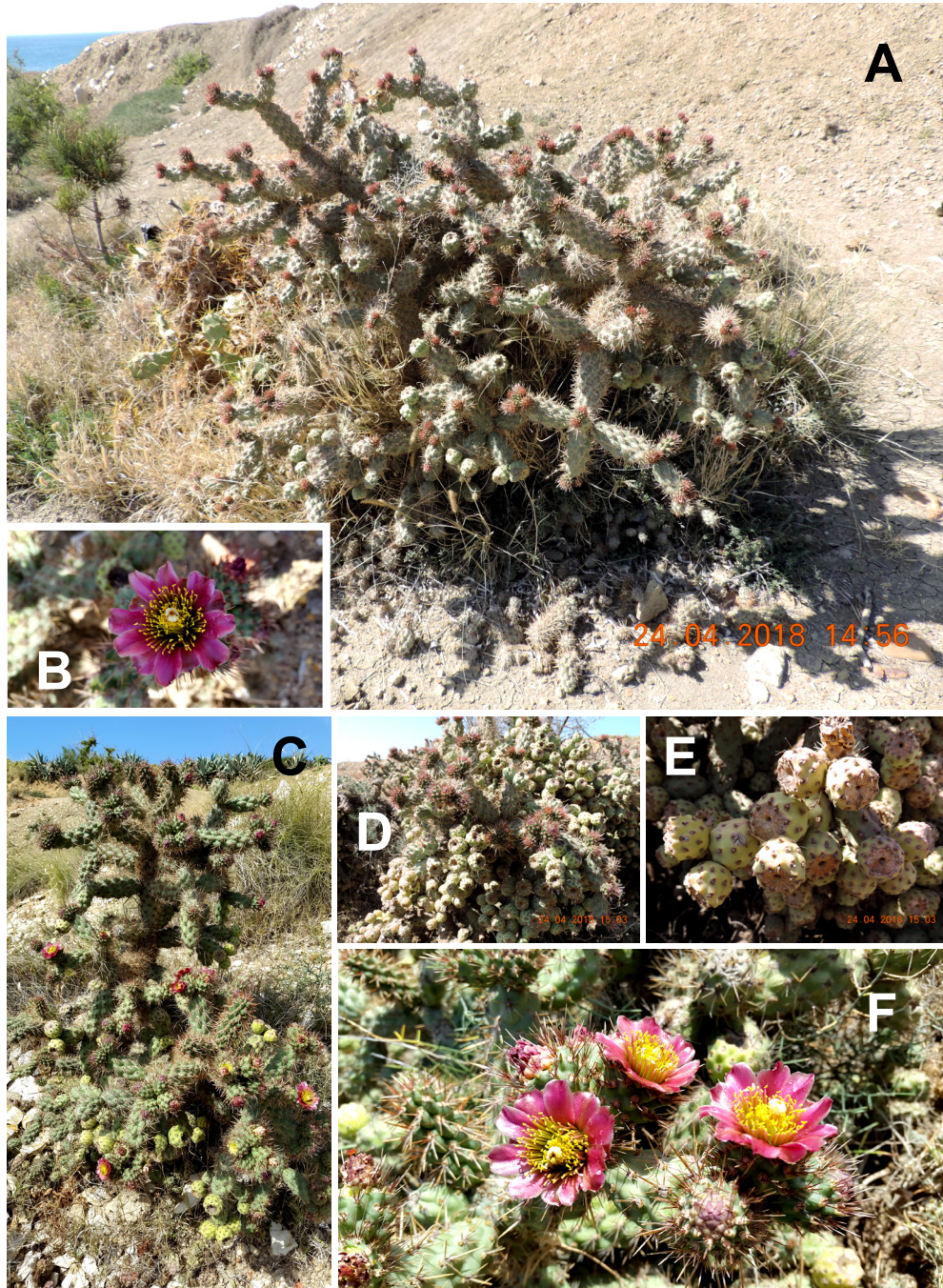


Figure 2. *Cyllindropuntia prolifera*. A, C: Habit on a sun-exposed clayey slope; B, F: Flowers; D, E: Fruits, tuberculate, spineless in fleshy chains. All photographs were taken by R. El Mokni in Monastir (CE of Tunisia, North Africa), 24 April 2018 and 30 May 2019.

The species occurs in dry grassland and desert in a range from the west (Sonoran Desert) to the east (Chihuahuan Desert), also from Arizona and New Mexico (USA) to Sonora and Chihuahua (Mexico) (Pinkava, 2003; Hunt, 2006). Hybrids are formed in the overlapping areas, particularly with *C. imbricata* (Pinkava, 2003). It is sometimes cultivated in South

Africa, and has now been found to be naturalised near Hopetown and Pofadder (Northern Cape Province) and east of Beaufort West (Western Cape Province) (Walters *et al.*, 2011). In Europe, it is known in Spain (Sanz Elorza *et al.*, 2004; Guillot Ortiz *et al.*, 2009; Aymerich, 2015; Aymerich & Sáez, 2019), in France (Tison *et al.*, 2014) and in Italy (Guiggi, 2010). The species is here reported



for the first time in the flora of Tunisia and North Africa (Korotkova & Raab-Straube, 2017+; APD, 2020). In Tunisia, *Cylindropuntia spinosior* can be classified as naturalised to potentially locally invasive as it appears in only one extended population but with many colonies of

very branched individuals (more than 25 within an area of about 2–3 ha). However, like other species from this genus, it certainly has the potential to become a national invasive alien if disseminated elsewhere by the activities of man and livestock.

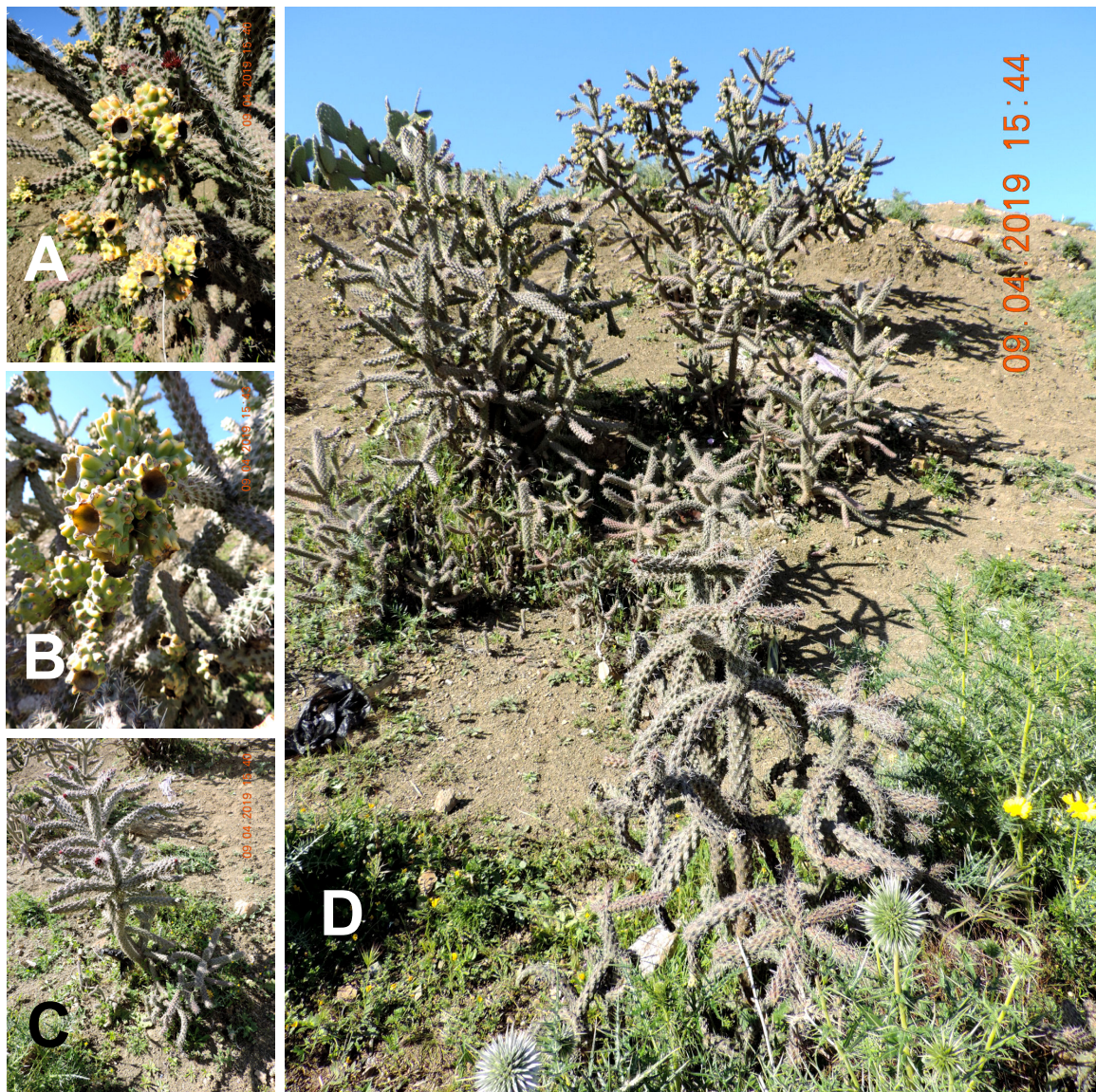


Figure 3. *Cylindropuntia spinosior*. A, B: Fruits, yellow and tinged reddish, broadly cylindrical, fleshy, strongly tuberculate, spineless; C, D: Habit on a sun-exposed clayey slope. All photographs were taken by R. El Mokni between Medjez El Bab and Beja (NW of Tunisia, North Africa), 09 April 2019.

**Analytical key to species belonging to the genus *Cylindropuntia* occurring in the wild in Tunisia** (including *C. imbricata*).

1. Stem tubercles inconspicuous; large spines 0–2(–3) per areole; flowers yellow to greenish yellow, 5–8 mm; fruits smooth, red at maturity, usually 9–15 mm ..... *C. leptocaulis*
- 1' Stem tubercles conspicuous, thick, usually 2–5 cm diam; large spines usually (0–)2–4 per areole; flowers white, yellow, salmon, rose to magenta or purple-red .....2
2. Shrubs or small trees; stem segments greenish gray, 3.5–5 cm diam.; tubercles 1.5–2.5 cm; perianth rose

- to magenta or purple-red; fruits smooth to shallowly tuberculate ..... *C. prolifera*
- 2' Trees openly branched, medium to large; stem segments firmly attached; perianth rose to magenta, white or whitish, yellow, or salmon; fruits strongly tuberculate .....3
3. Tubercles of stems usually 0.5–1.5 cm, crowded; fruits with 28–50 areoles, tubercles longer in distal portion of fruit ..... *C. spinosior*
- 3' Tubercles of stems usually 2–5 cm, widely spaced; fruits with 18–30 areoles, tubercles nearly equal in length or longer in proximal portion of fruit ..... *C. imbricata*



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