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More new geophytes for Tunisian and North African alien flora

Abstract

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This paper deals with ten bulbous species that are new to the Tunisian allochthonous flora, *Chasmanthe floribunda*, *Freesia alba*, *Gladiolus murielae*, *Hippeastrum puniceum*, *Hymenocallis littoralis*, *Narcissus papyraceus* subsp. *papyraceus*, *Nothoscordum gracile*, *Tulbaghia violacea*, *Zephyranthes candida* and *Z. rosea*. Moreover, six of them are new aliens to North Africa and one genus has not been reported before in the Mediterranean area. All reported plants have been introduced since many years mainly as ornamentals, subsequently escaped in the wild.

Key words: Xenophytes, Bulbous plants, Iridaceae, Amaryllidaceae, petaloid Monocots.

Introduction

Non-native plants, known also as exotic, introduced, alien, or non-indigenous, are those taxa whose presence in a given area is due to intentional or unintentional human involvement, or which have arrived there without the help of people from an area in which they are native (Pyšek & al. 2004a). In the past two decades and due to a better coverage of the Tunisian territory with floristic studies, the knowledge on the non-native flora of Tunisia and N Africa significantly increased (see e.g., El Mokni & Iamonico 2018a, 2018b, 2019, 2020; El Mokni & Verloove 2019; El Mokni & Domina 2020; Iamonico & El Mokni 2020; Médail & al. 2020). However, information about alien bulbous plants (geophytes) is mostly recent and still scarce (see e.g., El Mokni & El Aouni 2011, 2012; El Mokni & al. 2020; Médail & al. 2020). The present contribution aims at improving the botanical knowledge about Tunisian flora and updating data on its non-indigenous component.

Materials and Methods

Field work carried out by the authors in Central and Northern Tunisia (N Africa), mostly between 2008 and 2020, revealed new national and even N African records. All records here reported are amended by general information for each genus, including data on its

actual distribution worldwide. The actual status/degree of naturalization for each taxon is assessed based on numerous sources such as Richardson & al. (2000), Richardson & Pyšek (2006), Pyšek & al. (2004b). Further comments on distribution, habitats occupied and some field photographs are also presented. Vouchers are kept in the personal herbarium of Ridha El Mokni kept at the Faculty of Pharmacy of Monastir (Herb. El Mokni!).

The paper presents taxa in alphabetical sequence. Nomenclature of the presented taxa is mostly in accordance with recent sources (cf. APD 2020; Euro+Med PlantBase 2020; WCSP 2020).

Results: floristic records

Chasmanthe floribunda (Salisb.) N. E. Br. var. ***floribunda*** (***Iridaceae***) (Fig. 1. D & E)

New for the non-native flora of Tunisia and flora of the Maghreb (see e.g., GBIF 2020; APD 2020).

TUNISIA: Beja, Nefza, few individuals growing within a cultivated area of *Eucalyptus* spp. trees near the dam of 'Sidi Barrak', 50 m a.s.l., 11.05.2014, *R. El Monki s.n.* (Herb. El Mokni!), Bizerta, Jarzouna, one individual in a swampy area with *Juncus* spp., 05 m a.s.l., 08.03.2019, *R. El Monki s.n.* (Herb. El Mokni!); Bizerta-City (Bab Mateur), few juvenile individuals under walls, 30 m a.s.l., 04.03.2020, R. *El Monki s.n.* (Herb. El Mokni!); Jendouba, Tabarka towards Elhouemdeya, within roadsides, 30 m a.s.l., 04.03.2020, *R. El Monki s.n.* (seeds were colleced). (Herb. El Mokni!).

Chasmanthe N.E. Br. is a small genus of three species endemic to the south-western, southern and south-eastern Cape Province (cf. De Vos 1985). Early in the seventeenth century species of *Chasmanthe* were already cultivated in Europe and England, where it was known that they came from Africa (De Vos 1985; Duncan 2001). *C. floribunda* has a wide distribution in the south-western Cape from Caledon to the Gifberg south of Vanrhynsdorp (De Vos 1985). It is now cultivated in numerous south-western Cape gardens, including the National Botanic Gardens at Kirstenbosch where large stands of both varieties are in flowers from July to August (De Vos 1985). *Chasmanthe floribunda* var. *floribunda* is easily distinguished from closer *C. aethiopica* (L.) N.E. Br. and *C. bicolor* (Ten.) N.E. Br., by its longer upper segment of perianth tube and its distichous flower spike usually with 20-40 flowers. The typical variety shows orange-red flowers with dark purple anthers (De Vos 1985). In Europe, the species is reported from Portugal, France and Italy (Galasso & al. 2018; Domina & al. 2018; GBIF 2020). In North Africa, *Chasmanthe floribunda* var. *floribunda* is reported only in Canary Islands as "introduced" (APD 2020). It is here reported for the first time from Tunisia and the whole Maghreb, where the plant can be classified as a 'casual alien', since it currently appears only in sporadic individuals (not more than 20) in different regions in the country.

Freesia alba (G.L. Mey.) Gumbl. (≡ *F. refracta* var. *alba* G.L. Mey.) (***Iridaceae***) (Fig. 1. B & C)

New for the non-native flora of Tunisia and of N Africa. (see e.g., GBIF 2020; APD 2020).

TUNISIA: Bizerta, three individuals growing near a public garden where the species could be cultivated around or some bulbs were brought within the soil from some evacu-

ated pots in this garden, 10 m a.s.l., 22.02.2012, *R. El Monki s.n.* (Herb. El Mokni!), *ibidem* 21.02.2013, *R. El Monki s.n.* (Herb. El Mokni!).

The genus *Freesia* Klatt characterized morphologically mainly by its sharply deflexed or horizontal flower spike, deeply divided style branches and verrucose or papillate capsules, comprises 16 species distributed through sub-Saharan Africa, with a marked centre of diversity in the winter rainfall region of the southwestern Cape (Manning & Goldblatt 2010). Many species are widely cultivated as ornamentals where *Freesia alba* (G.L. Mey.) Gumbl. and its horticultural hybrids with *F. corymbosa* N.E.Br. and *F. leichtlinii* Klatt, are often erroneously attributed to *F. refracta* (Jacq.) Klatt (Goldblatt & Manning 2008; Galasso & al. 2018). In fact, *F. refracta* is known to rarely cultivated (Goldblatt 1982). *F. alba* is easily distinguished by its bracts green; tepals predominantly white, often with yellow markings on lower tepals (Goldblatt 1982; Manning & Goldblatt 2010).

In Europe, *F. alba* was reported from Spain (Balearic Islands) (Sáez & al. 2016), France, Sardegna and Cyprus (GBIF 2020). In N Africa, the taxon is here reported for the first time from Tunisia (APD 2020). The plant can be classified as 'casual alien' at the time it appears only with few naturalising individuals within one region (NE Tunisia). In Bizerta, among other bulbous plants, *F. alba* is highly cultivated as ornamental, in villas balconies in the city center and along the corniche road.

Gladiolus murielae Kelway (≡ *Acidanthera murielae* Hoog) (***Iridaceae***) (Fig. 1. G)

New for the non-native flora of Tunisia and N Africa. (see e.g., Euro+Med PlantBase 2020; GBIF 2020; APD 2020).

TUNISIA: Bizerta, six flowering individuals growing near the coast. The species could be cultivated around or some bulbs were brought within the soil from some evacuated pots in the area, 5 m a.s.l., 31.12.2018, *R. El Monki s.n.* (Herb. El Mokni!).

Gladiolus L. includes over 270 species (Goldblatt & al. 2014; IPNI 2020). It occurs in Africa, Madagascar, Mediterranean Europe and the Middle East as far east as Afghanistan and throughout the world (Lewis & al. 1972). The genus is centered in southern Africa (Goldblatt 1994) but widely cultivated for cut flowers. About 22 species occur wildly in the Mediterranean area (Euro+Med PlantBase 2020), among them only two species occur in Tunisia (*G. dubius* Guss [incl. *G. reuteri* Boiss., *G. illyricus* var. *reuteri* (Boiss.) Font Quer, *G. communis* auct.] and *G. italicus* Mill. [incl. *G. segetum* Ker Gawl.]) (Dobignard & Chatelain 2010). *Gladiolus murielae* Kelway grows natively in the highlands in rocky, partly shaded places, on cliffs, rocky outcrops, and in forest margins between 1800 and 2400 m a.s.l. in Tigray, Gonder, Shewa, and Wellega floristic regions (IPNI & WCSP 2020). It also occurs in Burundi, Tanzania, Malawi and Mozambique (Geerinck 2005). The main flowering period in Ethiopia is from July to September (Demissew & Nordal 2010). The plant is distinguished from closer species (mainly *G. candidus* (Rendle) Goldblatt and *G. gunnisii* (Rendle) Marais, with a perianth tube twice as long as the tepals) by the white flowers with prominent dark purple streaks and tepals 35–45 mm long (Demissew & Nordal 2010). In Europe, the species has been reported from Belgium, France, Germany and Sweden (GBIF 2020). This seems the first report of *Gladiolus murielae* for North Africa. We propose it as 'casual alien' at the time it appears only with few naturalising individuals within one region (NE Tunisia).

Hippeastrum puniceum (Lam.) Voss (***Amaryllidaceae***) (Fig. 1. A)

New for the non-native flora of Tunisia and North Africa (see e.g., Govaerts & al. 2020; APD 2020).

TUNISIA: Bizerta, Corniche, four flowering individuals growing within road side escaped from some cultivated individuals of the other side of the road towards Nadhour, 11.04.2018, *R. El Monki s.n.* (Herb. El Mokni!); Bizerta, Jarzouna, one individual in a swampy area with Juncus spp., 05 m a.s.l., 08.03.2019, *R. El Monki s.n.* (Herb. El Mokni!); Jendouba (Fernana), only three flowering individuals under walls, 30 m a.s.l., 04.03.2008, *R. El Monki s.n.* (Herb. El Mokni!); Monastir (Monastir-City), five flowering individuals under walls, 30 m a.s.l., 17.03.2020, *R. El Monki s.n.* (Herb. El Mokni!).

Hippeastrum Herb. is essentially a genus with neotropical distribution that can be found in wild from Mexico and the West Indies to Argentina, the majority in eastern Brazil, the Peruvian Andes and Bolivia (de Andrade & al. 2012; Büneker & Bastian 2017). It comprises approximately 70 species (Judd & al. 1999), 34 being found in Brazil with 22 endemics (Dutilh 2010). Due to its great beauty, *H. puniceum* (Lam.) Voss., a native to the Caribbean and to South America (Glenn 2002), is used as ornamental plant worldwide, whereas in some countries it is cultivated for medicinal purposes (Hanelt 2001). Probably by escape from cultivation, the species has been naturalized outside its natural range, mainly in the tropics and subtropics, including Africa (Wester 1992; Hosking & al. 2003; Velayos & al. 2013). In Europe, *H. puniceum* is reported only from Spain (Govaerts & al. 2020). In N Africa, it is here its first report from Tunisia (APD 2020). The species (distinguished by its 2–4-flowered inflorescences; flowers slightly zygomorphic; perianth reddish to salmon, with whitish midstripe on adaxial surface of each outer tepal; bracts up to 5 cm) can be classified as 'casual alien' since it appears only with few flowering individuals (ca. 4+2+1 in an area that cannot exceed 40 m^2) within three regions (NE, NW and CE Tunisia).

Hymenocallis littoralis (Jacq.) Salisb. (≡ *Pancratium littorale* Jacq.) (***Amaryllidaceae***) (Fig. 1. F)

New for the non-native flora of Tunisia and the Maghreb (see e.g., Euro+Med PlantBase 2020; GBIF 2020; APD 2020).

TUNISIA: Monastir, two flowering individuals growing within the sidewalks of a cultivated area. The species could be cultivated around or some bulbs were brought with their soil from florists selling bulbs, 20 m a.s.l., 08.10.2016, *R. El Monki s.n.* (bulbs were collectd). (Herb. El Mokni!).

The genus *Hymenocallis* Salisb., with around 40 species, is native to warmer regions of the New World, from the north of Brazil to the south east of the United States (Flory 1976; Smith & Flory 1990); many of them are endemic to Mexico (Tapia-Campos & al. 2012) and one species (*H. senegambica* Kunth & Bouché [= *H. littoralis* (Jacq.) Salisb.] to West Africa (Singh 2019). This latter with its faintly fragrant, white flowers with extremely long, narrow, hanging petals and with a central membranous cup stretched between the stamens is commercially important and is being cultivated on large scale in western India, especially in Gujarat and Maharashtra, and it occupies a premium position in the flower market of Mumbai (Singh 2019). In Europe, no report seems to be mentioned till now (see e.g., Euro+Med PlantBase 2020; GBIF 2020). In North Africa, the plant is reported only

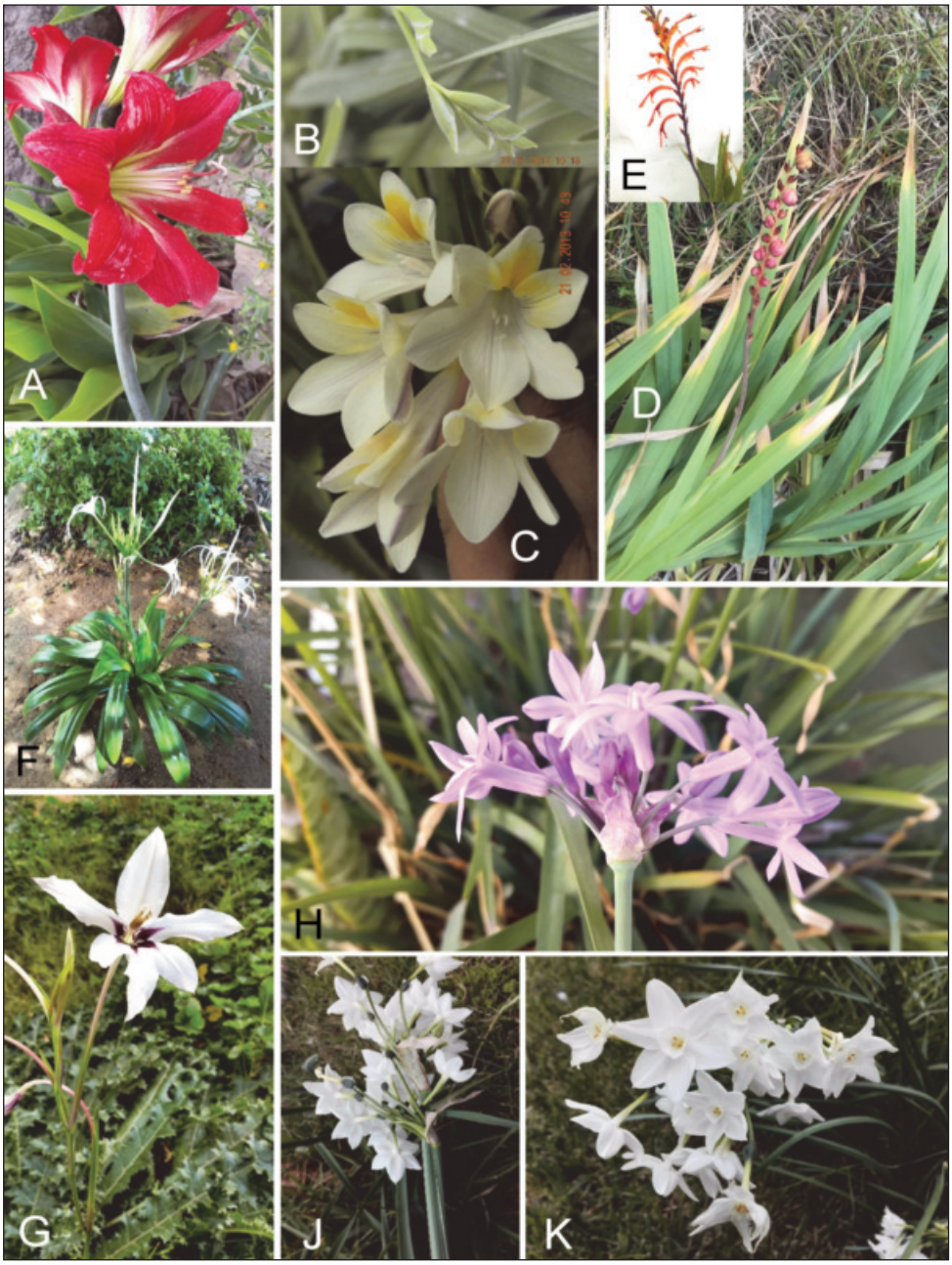

Fig 1. A. *Hippeastrum puniceum* (Monastir); B. & C. *Freesia alba* (Bizerta); D. & E. *Chasmanthe floribunda* var. *floribunda* (Jendouba/Bizerta); F. *Hymenocallis littoralis* (Monastir); G. *Gladiolus murielae* (Bizerta); H *Tulbaghia violacea* (Monastir); J. & K. *Narcissus papyraceus* subsp. *papyraceus* (Monastir). Photos credits: Ridha El Mokni (A, B, C, D, E, F, G & H) and Kawther Hadj Khalifa **(**J & K).

from Canary Islands (GBIF 2020). This is the second report from the Mediterranean area and the first one from Tunisia and the Maghreb. The plant can be classified as 'casual alien' as it appears only with few escaped individuals within one region (CE Tunisia).

Narcissus papyraceus Ker Gawl. subsp. ***papyraceus*** (***Amaryllidaceae***) (Fig. 1. J & K)

New for the non-native flora of Tunisia and North Africa (see e.g., Euro+Med PlantBase 2020; GBIF, 2020; APD 2020).

TUNISIA: Monastir, few flowering individuals growing within sidewalks. The species could be cultivated around and escaped from pots, 10 m a.s.l., 03.01.2020, *R. El Monki s.n.* (Herb. El Mokni!).

The genus *Narcissus* L. with more than 50 species of herbaceous bulbous plants which are native of Europe, N Africa and W Asia. It has a mainly Mediterranean distribution, where the centre of diversity is the Iberian Peninsula (see e.g., Webb 1980; Grey-Wilson & Mathew 1981) with thousands of cultivars available worldwide (Kington 1998). Among all known taxa, many introduced have escaped from cultivation and became naturalized elsewhere (cf. Spaulding & Barger 2014). In North America, six species (*N. bulbocodium*, *N. jonquilla*, *N. papyraceus*, *N. poeticus*, *N. pseudonarcissus*, *N. tazetta*) and four hybrids (*N.* ×*incomparabilis*, *N.* ×*intermedius*, *N.* ×*medioluteus*, *N.* ×*odorus*) from different origins occur actually in the wild (Spaulding & Barger 2014). In Europe, *N. papyraceus* subsp. *papyraceus*, native to France, Greece, Spain, Italy, Portugal, Sicily and Malta, is reported as alien (status unknown) only from Corse and the Azores (GBIF 2020). In N Africa, *N. papyraceus* subsp. *pachybolbus* (Durieu) D.A. Webb is reported as native only to Morocco and Algeria (APD 2020). In Tunisia, it is here that *N. papyraceus* subsp. *papyraceus* is reported for the first time from North Africa. The subspecies (distinguished by glaucous leaves; compressed 2-edged scape and usually crenulate corona, Webb 1980) can be classified as 'casual alien' since it appears only with few flowering individuals (ca. 26 in an area of 400 m^2) within only one region (CE Tunisia).

Nothoscordum gracile (Aiton) Stearn (≡ *Allium gracile* Aiton) (***Amaryllidaceae***)

New for the non-native flora of Tunisia (see e.g., Euro+Med PlantBase 2020; GBIF 2020; APD 2020).

TUNISIA: Bizerta, Bizerta City, many individuals (ca. 30 in 10 m^2) growing within roadsides near the Bus/Taxi Station, 05 m a.s.l., 02.05.2014, *R. El Monki s.n.* (Herb. El Mokni!); Monastir, Monastir City, many individuals (ca. 60 in 200 m^2) growing within roadsides near the market and the Post Office, 15 m a.s.l., 08.04.2019, *R. El Monki s.n.* (Herb. El Mokni!).

Nothoscordum Kunth is a small genus native to southern Mexico and western South America, with over than 30 recognised species most of them widely naturalised in many parts of the world (Ravenna 1991). All known species of *Nothoscordum* are native to America; *N. borbonicum* Kunth has become naturalized in Europe, Africa, Asia and Australia, for it spreads rapidly by seeds and persists by prolific bulblets production (Stearn 1986). Plants of this genus are much like *Allium* but do not have an oniony smell in the flowers or leaves. *Nothoscordum* also differs from *Allium* in that the perianth segments are joined at the base, and in certain species they are fused about halfway (Pyke 2019). In Europe, *N. gracile* is reported as alien with status "unknown" from the Azores,

Cyprus, France, Greece, Spain, Italy, Portugal, Madeira, Sicily and Malta (Euro+Med PlantBase 2020; GBIF 2020). In N Africa, *N. gracile* is reported only from Canary Islands and Algeria (APD 2020; GBIF 2020). In Tunisia, it is here firstly reported and can be classified as a 'casual alien' since it appears only with few flowering individuals (ca. 90 in an area around 210 m^2) within only two regions (NE & CE Tunisia).

Tulbaghia violacea Harv. (≡ *Omentaria violacea* (Harv.) Kuntze) (***Amaryllidaceae***) (Fig. 1. H).

New for the non-native flora of Tunisia (see e.g., APD 2020; Euro+Med PlantBase 2020; GBIF 2020).

TUNISIA: Monastir, Monastir-City, few individuals growing under walls and within roadsides not far away from some big pots where the plant was cultivated as ornamental., 20 m a.s.l., 03.07.2019, *R. El Monki s.n.* (Herb. El Mokni!).

Tulbaghia L. is a small genus endemic to southern Africa and includes about 30 species (Vosa 2000; Lyantagaye 2011). The plants are, however, cultivated in different countries for their medicinal properties and horticultural importance (Benham 1993). Members of *Tulbaghia* are self-incompatible, and possess distinct alliaceous smell for which they are commonly known as 'wild garlic' (Lakshmi 1988). In Africa, *T. violacea* is the most prevalent species of the genus (Vosa 2000). In Europe, the plant has been reported in Portugal, France, Italy and Malta (GBIF 2020). In N Africa, the taxon is only reported from Morocco (GBIF 2020). This is the first record from Tunisia, where it can be classified as a 'casual alien' as it appears only with few flowering individuals within very restricted area in Monastir region (CE Tunisia).

Zephyranthes candida (Lindl.) Herb. (≡ *Amaryllis candida* Lindl.) (***Amaryllidaceae***)

New for the non-native flora of Tunisia and N Africa (see e.g., Euro+Med PlantBase 2020; GBIF 2020; APD 2020).

TUNISIA: Bizerta, Bizerta-Sidi-Salem, few individuals (ca. 10 in 4 m^2) growing within roadsides near the apartments of Sidi Salem area, 05 m a.s.l., 23.08.2014, R. *El Monki s.n.* (Herb. El Mokni!); Tunis, few individuals in ornamental flowerpots, 19.10.2019, *P. Leboulenger, s.c.*

The genus *Zephyranthes* Herb. is a genus of about 70 species originating from warm temperate, subtropical, and tropical areas of the New World including Argentina, the Caribbean, Mexico and North America (see e.g., Bateman & al. 2004; Chowdhury & Hubstenberger 2006; Spurrier & al. 2015). Due to their great beauty and vigor, several species have become established throughout the warmer climates of the world including parts of Africa, Asia, Australia and even many south Pacific Islands. A number of species are cultivated due also to their gorgeous flowers, and are known by plant breeders as "rain lilies" owing this name to their tendency to flower after a rain period (Fernández & al. 2004). Among these we can find *Z. candida* and *Z. rosea* Lindl. The former with distinguished white perianth, very short to indistinct tube, spathe covering the ovary and semi-cylindrical leaves non-exceeding 4 mm in width is originally from southern South America – Argentina, Uruguay, Paraguay, and southern Brazil (Siddiqui & al. 2007). Used as an ornamental plant in gardens and cultivated in many countries, the species has become naturalized over much of the world from the southeastern USA, the West Indies, southern Africa, southern Asia including China, Korea, Japan, as well as Australia (Queensland), a

number of south Pacific Islands and even in Bangladesh (cf. Siddiqui & al. 2007). In the Mediterranean area, the plant was reported only from Italy and Syria (GBIF 2020). No records are available from North Africa (Euro+Med PlantBase 2020; GBIF 2020; APD 2020) before the present record; in Tunisia we consider it as a 'casual alien' since it appears only with few flowering individuals (10 in an area of 4 m^2) within only one region (NE Tunisia).

Zephyranthes rosea Lindl. (≡ *Amaryllis rosea* (Lindl.) Spreng. ≡ *Atamasco rosea* (Lindl.) Greene) (***Amaryllidaceae***)

New for the non-native flora of Tunisia, North Africa and Mediterranean area (see e.g., Euro+Med PlantBase 2020; GBIF 2020; APD 2020).

TUNISIA: Bizerta, Bizerta-Corniche, few individuals in nursery ornamental flowerpots, 15 m a.s.l., 12.09.2014, *R. El Mokni s.n.* (Herb. El Mokni!); Tunis, few individuals in ornamental flowerpots, 02.09.2019, *P. Leboulenger, s.c.*

Zephyranthes rosea, characterized by clear-red to pink perianth, well open flowers with short tube, erect stamens, all with same size and declined style, is considered native to Central America and the Caribbean, but is spontaneous also in southern and southeastern Brazil (Raina & Khoshoo 1971). In the Mediterranean area, the plant seems not to have been recorded from either Europe or N Africa (Euro+Med PlantBase 2020; GBIF 2020; APD 2020). So, this is the first record for the whole Mediterranean region, where it can be regarded as a 'casual alien', since it appears only with few flowering individuals within very restricted nursery ornamental pots in Bizerta and Tunis (NE Tunisia).

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