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Euphorbia hypericifolia L. (Euphorbiaceae), a new Alien Species for Italy

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The presence of *Euphorbia hypericifolia* is reported for the first time in Italy, it is a neophyte native to tropical and sub-tropical Americas. Its occurrence in the Mediterranean area is very scattered and circumscribed to a few countries, such as Spain and Greece. Morphological, ecological features and taxonomic notes are discussed, considering also its occasional misidentification. The invasion risk of this species is assessed.

Keywords: pest risk analysis; Sicily; Subgen. *Chamaesyce*; xenophytes

Introduction

The Taormina territory (eastern Sicily) belongs to the southern part of the Peloritani Mountains, which represent an important area for plant species diversity (Blasi et al. 2010; Brullo et al. 2010; Sciandrello et al. 2015). In this area, the long-lasting human presence has favoured the spread of many alien species whose occurrence may negatively affect the structure and functioning of natural habitats (Sciandrello et al. 2013; Sciandrello and D'Agostino 2014). In the framework of monitoring activities on the occurrence of alien species carried out in the Nature Reserve “Isola Bella” (nowadays managed by CUTGAN), two populations of *Euphorbia hypericifolia* were found. In the past, Pignatti and Wikus (1954) and Pignatti (1982) recorded *E. hypericifolia* subsp. *indica* (Lam.) Pignatti for Lombardy (northern Italy), but it was recently attributed by Hügin (1998) to *Euphorbia nutans* Lag., as also confirmed by Banfi and Galasso 2010. Therefore, *E. hypericifolia* (Euphorbiaceae) is recorded for the first time for Italy. Its morphological, ecological, invasion status and taxonomic features are examined.

Study area

The investigated area is characterized by the presence of relatively steep hills facing the sea, featured either by cliffs or narrow pebbly beaches. From the geological viewpoint, the study area mainly belongs to the Longi-Taormina Unit (Lentini et al. 2000). The lower subunit is formed by an epimetamorphic basement, topped by a Mesozoic–Cenozoic sedimentary cover formed from continental red beds, evolving upwards to platform carbonates (Catalano 2010). Concerning the climatic features, Taormina (215 m above sea level) has an annual average temperature of 17.0°C with annual average precipitation

of 678 mm, whereas Giardini Naxos, at sea level, has 18.2°C and 655 mm (Climate-Data Org 2016). According to the bioclimatic classification proposed by Rivas-Martinez (1993), Rivas-Martínez et al. (2004) and Bazan et al. (2015), the investigated territory falls within the Mediterranean pluviseasonal oceanic bioclimate, with lower Thermomediterranean thermotype and upper dry to lower subhumid ombrotypes.

Materials and methods

The identification of the species was made on the basis of Pahlevani and Riina (2011), Silva et al. (2014), von Raab-Straube and Raus (2015) and Yang (2016). Moreover, the study is based on the analyses of herbarium specimens preserved at CAT, PAL, LINN, NY, DAV (acronyms according to Thiers 2016, continuously updated), as well as on specimens available at JStor Global Plants (<http://plants.jstor.org/>), and Webster Virtual Herbarium Specimen of UC Davis Center for Plant Diversity (<http://herbarium.ucdavis.edu>). Seeds were examined using a scanning electron microscope (Zeiss EVO LS10) according to the protocol reported by Stork et al. (1980). In-depth surveys of the Italian literature were carried out to find any existing records of the species in Italy (e.g. Pignatti 1982; Conti et al. 2005, 2007; Giardina et al. 2007; Banfi and Galasso 2010; Celesti-Grappow et al. 2010, etc.). For each stand where the plant was found the following data were recorded: 1) geographical coordinates, 2) altitude, 3) surface (m²), 4) number of individuals per population, and 5) floristic assemblage.

Results and discussion

Euphorbia hypericifolia was named by Linnaeus, and lectotypified by Fosberg and Mazzeo (1965). It is native

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Figure 1. Herbarium specimen of *Euphorbia hypericifolia* from Villagonia – CAT. Taormina (Messina, Sicily).

to the tropical and subtropical New World (i.e. USA, Mexico, Central and South America). The name has been loosely applied to an aggregate of closely related species with a much wider distribution, such as *Euphorbia parviflora*, *Euphorbia reniformis*, *Euphorbia braeolaris* and *Euphorbia indica* and now treated as separate species (Raju and Rao 1979).

Euphorbia hypericifolia L., Sp. Pl. 1: 454. 1753. (Figure 1)

Typus: Herb. Linn. 630.4 (LINN), lecto, designated by Fosberg and Mazzeo (1965)

Syn.: *Anisophyllum hypericifolium* (L.) Haw., *Ditritra obliqua* Raf., *Euphorbia hypericifolia* var. *maculata* Klotzsch, *Euphorbia papilligera* Boiss., *Chamaesyce hypericifolia* (L.) Millsp., *Euphorbia glomerifera* (Millsp.) L.C. Wheeler (based on Yang 2016).

Description

Herbs, annual, glabrous, branched, more or less erect, 15–46(–70) cm tall, apex of branches drooping. Leaves opposite, simple; stipules triangular, 1.5–2.5 × 1.2–1.8 mm, one pair often fused, hairy at margins; petiole 1–3 mm long; blade elliptical-oblong to oblong, 1.5–3 × 0.8–1.8 cm, base cuneate, asymmetric, apex obtuse to bluntly acute, margin obscurely toothed. Cyathia axillary, densely clustered into a head 1–1.5 cm in diameter; peduncle 0.5–2 cm long; cyathia almost sessile, c. 1 mm long, with a cup-shaped involucre, lobes



Figure 2. *Euphorbia hypericifolia* from Villagonia (A) and from the coast facing Isola Bella (B) (Taormina, Messina).

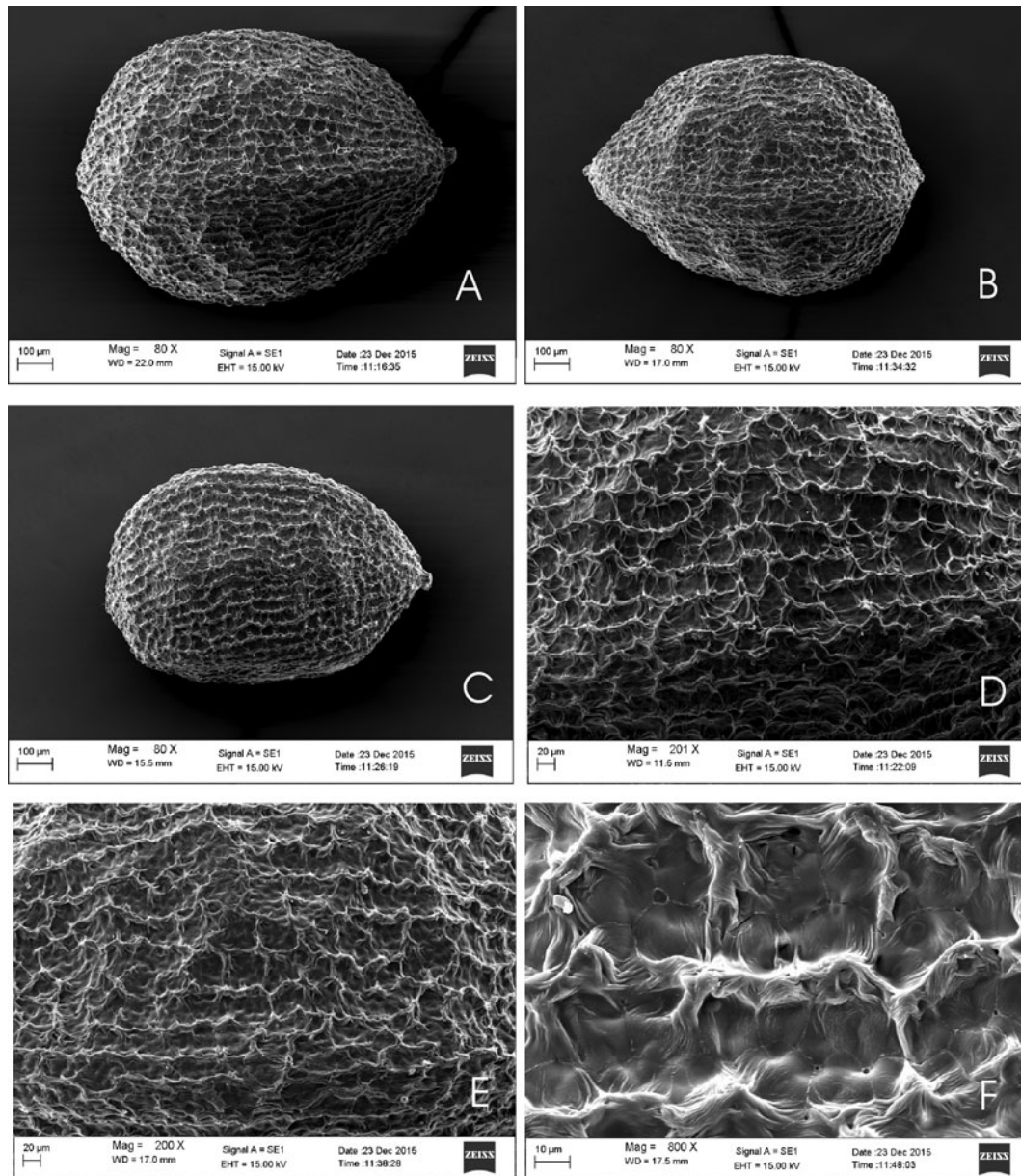


Figure 3. Seeds of *Euphorbia hypericifolia* (scanning electron micrographs). (A, B) Dorsal view. (C) Lateral view. (D–F) Details of the seed testa ornamentation at different magnifications.

triangular, minute, glands 4, tiny, almost round, stipitate, with appendage variable (round to somewhat elliptical), white to pale pink, each involucre containing 1 female flower surrounded by many male flowers (2–20). Flowers unisexual; male flowers sessile, bracteoles linear, perianth absent, stamen c. 0.5 mm long; female flowers with short pedicel, ovary superior, glabrous, 3-celled, styles 3, c. 0.4 mm. Fruit a 3-lobed capsule, 1.3–1.4 × 1.1–1.5 mm, 3-seeded. Seeds ovoid-triangular, 0.8–1.1 × 0.5 mm, slightly wrinkled, brownish, without caruncle.

Site location and ecology

Euphorbia hypericifolia was found in two coastal areas close to the town of Taormina (eastern Sicily). The first

population comprised 40 mature individuals, and was observed near Villagonia along the roadsides (altitude 12 m above sea level, 37°50'51.76" N, 15°17'05.50" E) where it roughly occupies an area of 20 m² (Figure 2A), whereas the second one was located close to the Nature Reserve “Isola Bella” (23 m above sea level, 37°51'10.73" N, 15°17'56.97" E), where about 20 mature individuals were scattered distributed over 15 m² (Figure 2B). This species grows on flat surfaces featuring very superficial and poor soils associated with several synanthropic plants, such as *Anisantha sterilis* (L.) Nevski, *Oxalis corniculata* L., *Sonchus asper* (L.) Hill subsp. *asper*, *Sonchus oleraceus* L., *Senecio vulgaris* L., *Cynodon dactylon* (L.) Pers., *Portulaca oleracea* L. subsp. *oleracea*, *Boerhaavia repens* L. subsp. *viscosa*

(Choisy) Maire, *Galactites elegans* (All.) Soldano, *Erodium malacoides* (L.) L'Hér. in Aiton, *Nothoscordum gracile* (Aiton) Stearn, *Euphorbia canescens* L., *Euphorbia peplus* L., *Solanum nigrum* L. subsp. *nigrum*, *Bidens pilosa* L. var. *minor* (Blume) Sherff, *Bidens bipinnata* L., *Medicago polymorpha* L., *Polygonum arenastrum* Boreau, *Setaria adhaerens* (Forssk.) Chiov, *Setaria parviflora* (Poir.) Kerguelen, *Erigeron canadensis* L., *Amaranthus deflexus* L., etc.

Geographic distribution

Euphorbia hypericifolia is native to the tropical and subtropical New World, and is regarded as an invasive weed in many of the Pacific Islands. Its occurrence in tropical Africa is not certain since it was confused with *Euphorbia indica* Lam (CABI 2016). Conversely, it occurs with certainty in West Africa, Burundi and Mauritius (Prota 2013), as well as Singapore and Taiwan (CABI 2016). As concerns the Mediterranean–Macaronesian area, it was recorded by Greuter et al. (1986) from Egypt and Israel, by Verloove (2002, 2005) from Belgium and Spain, by Gregor and Meierott (2013) from Crete, by Otto and Verloove (2016) from the Canary Islands (where it is definitely widespread), and finally by von Raab-Straube and Raus (2015) from the northern Peloponnese. Therefore, it seems that the species in the Mediterranean area has a limited capacity to naturalize, but its punctiform distribution is progressively widening. Therefore, according to Pyšek et al. (2004) this species can be considered in Italy as naturalized. Actually, the Pest Risk Analysis (PRA), following the EPPO protocol (Brunel et al. 2010; EPPO 2012) was performed on *E. hypericifolia*. The result of the assessment (evaluation of spread, impacts, and uncertainty degree) is as follows:

Known occurrence (in EPPO countries): ES (incl. Canary Islands), BE, IT, GR, CR, EG, IR
 Spread potential (A.5): medium
 Impact on the environment (A.6): low
 Impact on agriculture and forestry (A.7): low
 Additional impacts (A.8): low
 Uncertainty: low

Therefore, combining spread potential and adverse impacts, *E. hypericifolia* should be listed as “minor concern”.

Taxonomic notes

Euphorbia hypericifolia belongs to the subgenus *Chamaesyce* Sect. *Hypericifoliae*. This section comprises erect annual species with clustered cyathia and obvious stipules (Yang and Berry 2011). Within this section, two species are recognized as naturalized in Europe: *E. hypericifolia* and *E. nutans*. These species could be confused, although they both feature several differentiating characters (Pahlevani and Riina 2011; von Raab-Straube and Raus 2015), among which are those related to the

seed micro-morphology (Figure 3) (Pahlevani and Akhiani 2011; Silva et al. 2015). In particular, *E. hypericifolia* is completely glabrous with stipules joined into a clearly visible membranous sheath, fruits are not longer than 1.4 mm, and seeds are 0.8 mm long with often poorly defined transverse ribs. Whereas, *E. nutans* is hairy at least on the internodes, and hairs could also be present on leaves, especially towards the base, stipules are inconspicuous and reddish, fruits 1.5–2 mm long, and seeds 1–1.3 mm long with usually prominent transverse ribs. *Euphorbia hypericifolia* is also similar to another worldwide tropical and subtropical weed, i.e. *Euphorbia hyssopifolia* (Silva et al. 2014). As concerns the Mediterranean area, this species is known only for Egypt (Boulos 2000). *Euphorbia hyssopifolia* can be distinguished from *E. hypericifolia* by the lax and few-flowered inflorescences (versus contracted and many flowered inflorescences) and fruits 1.5–1.6 × 1.7–1.8 mm (versus 1.3–1.4 × 1.1–1.5 mm).

Conclusions

The finding of this species confirms, as already highlighted by Sciandrello et al. (2014), that Taormina territory is an area particularly rich in alien species, some of them becoming invasive, such as *Opuntia ficus-indica*, *Kalanchoe daigremontiana*, *Aeonium arboreum*, *Agave americana*, all rather common in rocky habitats, *Rhus coriaria*, *Lantana camara* in dry grasslands and shrublands, *Boerhaavia repens* subsp. *viscosa*, *Bidens bipinnata* along the roadsides, and *Ricinus communis* and *Ailanthus altissima*, quite frequent in synanthropic stands. The occurrence of many alien species is mainly the result of the past agricultural practices, as well as the realization of several gardens with exotic plants since the late nineteenth century. In some cases, some species, e.g. *Opuntia ficus-indica*, may represent a serious threat for the natural habitats hosting endemic chamaephytes (Sciandrello and D'Agostino 2014). As concerns the finding of *E. hypericifolia* in Italy, it would be desirable to implement monitoring plans aimed at evaluating its spread and invasiveness, also considering its very early occurrence in the surveyed area.

Specimens examined

Euphorbia hypericifolia L

ITALY: Sicily: Villagonia (Taormina), 29.11.2015, Sciandrello (CAT); Riserva Naturale Orientata Isola Bella, zona B, La Plage Resort (Taormina), 13.12.2015, Sciandrello s.n. (CAT); **USA:** Texas, Lawn in State Capitol, Austin, 30°16'38" N, 97°44'19" W; T.R. Van Reven-der 96–267; G. Travis County 01.07.1996; 1997, A. L. Reina (DAV); **BAHAMAS:** Inagua, Smith's Hatch Pond., 2.11.1904, G.V. Nash 1406 (NY). **JAMAICA:** Cowic Park, near Troy. Alt. 548.64 m. (1800 ft.), 19.10.1917, W.H. Harris 12,646 (NY)

***Euphorbia hyssopifolia* L**

BRAZIL: Goiás Município de Nova Roma, Fazenda Santa Clara (localidade denominada Sucuri ou Pinga) Altitude 495 m Coord 13°45'13" S; 46°51'31" W; 4277, 29.02.2000, M. Aparecida da Silva, M.C. Mendonca, D. Alvarenga (IBGE), Det. M. Aparecida da Silva sub *Chamaesyce thymifolia* (L.) Millsp.; 2002 Det. GLW sub *E. hyssopifolia* (L.) Small; 2012 Det. The UC Davis Center for Biodiversity (DAV).

***Euphorbia nutans* L**

ITALY: Sicily, presso la foce dell'Irminio, 18.08.1983 S. Brullo 026,364 (CAT); Sicily, Orto Botanico di Catania, 22.12.1982, S. Brullo 026,365, (CAT). **USA:** Kentucky, Madison County, SR. 21 & I75 North West section, road margin, waste place, clay soil, Berea coll. Deborah Johnson 281 09.04.1994 Moore Herbarium (HSCH) University of South Carolina – Columbia; Det. P. Berry and J Peirson (MICH).

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Disclosure statement

No potential conflict of interest was reported by the authors.

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