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Solanum torvum Sw. (Solanaceae): a new alien species for Europe

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2 *Solanum torvum* Sw. (Solanaceae): a new alien species for Europe

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9 Abstract

10 The largest family of *Solanaceae* counts many species widespread worldwide, either wild and cultivated. A lot of
11 cultivated species of this family represent an important part of the world of food. These and other spontaneous plants
12 have several ethnobotanical uses. In this paper, the author reports for the first time about the presence, as casual alien
13 species, of *Solanum torvum* Sw. in Europe (Calabria region, Southern Italy). Actually, it was reported in Italy by
14 mistake until then. This species is native of West Indies and naturalized in several tropical and subtropical regions
15 worldwide. *S. torvum*, also used as rootstock for cultivated *Solanaceae*, can escape and invade natural habitats,
16 replacing the natural vegetation and creating changes in relationships with other species. Twenty-three plants of *S.*
17 *torvum* are located in a stream, living together with other alien and synanthropic species. This work deals with its
18 geographical distribution and new location, with its morphological, ecological and taxonomic characteristics. *S. torvum*,
19 can be considered in Italy and in Europe as an alien casual species, but further field investigations on this species are
20 necessary to avoid its diffusion.

21
22 **Keywords:** alien plant, Calabria, invasive species, *Solanum torvum*, southern Italy, xenophytes.

24 Introduction

25 *Solanum* L. (*Solanaceae*) is an important genus of angiosperms that records approximately 1,200 species distributed
26 worldwide (Knapp 2019). Humans select important agricultural food species of common use around the world from
27 wild types belonging to this genus, such as: *S. tuberosum* L. (potato), *S. lycopersicum* L. (tomato), *S. melongena* L.
28 subsp. *melongena* (eggplant), *S. aethiopicum* L. (bitter tomato), *S. muricatum* Aiton (pepino), and so on (Hammer and
29 Laghetti 2006). Other species, used for decorative purposes only, are alien plants in southern Italy when they escape
30 from cultivation (Stinca et al. 2012, 2016, 2017). Europe hosts overall sixty-two species belonging to the genus
31 *Solanum* (Valdés 2012), while in Italy there are twenty-three in total, out of those twenty are alien (Galasso et al. 2018)
32 and three are native (Bartolucci et al. 2018).

33 Calabria is the most southern region of the Italian Peninsula. Recently it was studied from different points of view in
34 order to increase the lack of botanical knowledge (Bartolucci et al. 2019; Bernardo 2000; Bernardo and Puntillo 2002;
35 Bernardo et al. 2011; Brullo et al. 2001; Cano et al. 2017; Crisafulli et al. 2010; Musarella and Tripodi 2004; Musarella
36 et al. 2018; Panuccio et al. 2018; Signorino et al. 2011; Spampinato 2014; Spampinato et al. 2017, 2018, 2019; Stinca et
37 al. 2016b). In particular, many authors carried out some researches investigating ethnobotanical uses of *Solanaceae*
38 (Kunkar and Kunkar 2000; Leporatti and Impieri 2007; Lupia and Lupia 2013; Maruca et al. 2019; Musarella et al.
39 2019; Passalacqua et al. 2006, 2007; Perrino and Calabrese 2018; Tagarelli et al. 2010). Considering the importance of
40 ethnobotanical aspect thanks to the old uses of spontaneous and cultivated plants, they allow agriculture to become
41 more conservative and clearly in contrast with the industrial paradigm in order to avoid future pandemics (Perrino and
42 Calabrese 2018).

43 There are also several phytotoponyms related with plant species in the region (Spampinato et al. 2017). Recently,
44 several field surveys, with the aim of monitoring the presence of alien species in the Calabria region, allowed the author
45 to find some for use in agriculture (Galasso et al. 2019; Musarella et al. in press a; Musarella et al. in press b). In this
46 context, they can be considered as genetic resources (Hammer and Laghetti 2006). Furthermore, a new alien plant
47 species was recorded in Europe for the first time: *Solanum torvum* Sw. (*Solanaceae*).

48 The aim of this paper is to assess the invasive status of these species and to report further information about it.

50 Materials and methods

51 Plant material was georeferenced (datum WGS84), collected, herborised and recorded in an electronic database
52 available at the Herbarium of “Mediterranea” University of Reggio Calabria (REGGIO), together with herbarium
53 specimens. The identification of the species was based on the original description made by Swartz (1788) and
54 Vorontsova and Knapp (2014). Moreover, the study was also based on the analyses of herbaria specimens preserved at

REGGIO, BISH, HNBU, K, LINN, LISU, M, MO, MPU, RSA and S (acronyms according to Thiers 2019, continuously updated), available at JStor Global Plants (<http://plants.jstor.org/>).

Results and discussion

Swartz (1788) described *Solanum torvum* (turkey berry) for “*India occidentalis*” (West Indies). As a result of a thorough research in scientific literature (Cambria et al. 2015; Galasso et al. 2018; Sobrino Vesperinas and Sanz Elorza 2012), it is possible to affirm that it represents the first report of *S. torvum* in Europe. In the past, Raimondo and Orlando (1978) in Italy and Mallol and Maynés (2008) in Spain, reported this species by mistake. According to Cambria et al. (2015), the record of Raimondo and Orlando (1978) must be referred to *S. lanceolatum*, while that of Mallol and Maynés (2008) to *S. chrysotrichum*. Many farmers use the plant as compatible rootstock for eggplants and tomato, because it withstands to several diseases (Bilotta et al. 2006; Daunay 2008; Gisbert et al. 2011; Gousset et al. 2005; King et al. 2010; Petran and Hoover 2014). However, also *S. torvum* has its pests, such as *Phthorimaea operculella* (Zeller) (Lepidoptera: Gelechiidae) (Rondon 2010). The first record in Europe is here referred, in the Metropolitan city of Reggio Calabria (southern Italy).

Study area

The Metropolitan city of Reggio Calabria is the southernmost part of Calabria region (southern Italy), it also has several municipalities. One of these, Villa San Giovanni, is located in the northern part of the Strait of Messina (Figure 1).

Fig. 1 Map of the northern part of the Strait of Messina (Stretto di Messina) and its location in southern Italy (in black box). In red, the site of the new record of *Solanum torvum* Sw.

According to the Bioclimatic map of Europe (Rivas-Martinez et al. 2004) and the updated one of Blasi and Michetti (2005), Calabria region has both zones with Pluvioseasonal Oceanic Mediterranean bioclimate, and zones with Submediterranean Oceanic Temperate bioclimate. Taking into account the nearest thermopluviometric station of Reggio Calabria and according to the Worldwide Bioclimatic Classification System proposed by Rivas-Martínez and Rivas-Saenz (1996–2017), the bioclimate of Villa San Giovanni is “Mediterranean type pluviseasonal oceanic” with a thermo-Mediterranean thermotype and lower dry ombrotype.

According to the geological map of Calabria (VV.AA. 1967), this part of region is characterized by siliceous substrates having two possible origins: metamorphic (schist, gneiss) and intrusive (granites).

***Solanum torvum* Sw., Nova Genera & Species Plantarum seu Prodrum: 47. 1788**

Typus: Swedish Museum of Natural History Department of Botany (S), S-R-5814, lecto, designated by Vorontsova & Knapp (2016)

Synonyms: *Solanum ferrugineum* Jacq.; *Solanum ficifolium* Ortega; *Solanum mayanum* Lundell.

Knapp (2009) refers that it is possible to find *S. torvum* in Bahamas, Greater and Lesser Antilles. According to Witt and Luke (2017), this species has its origin in the following countries: Belize, Brazil, Colombia, Costa Rica, Ecuador, French Guiana, Guatemala, Guyana, Honduras, Mexico, Nicaragua, Panama, Venezuela and the Caribbean. Its usefulness in agriculture conditioned its current distribution throughout the tropics and subtropics (CABI 2019).

Description

Using personal observations, and according to Vorontsova and Knapp (2014) and CABI (2019), the author provides the following update description of *S. torvum*. It is an erect shrub, 1 up to 3 (4,5) m tall, with a prickly stem. The young stem and the branches are green and pubescent with trichomes, while the bark of older stems is brown to dark grey. The leaves are evergreen, simple, broadly ovate, 5-21 cm long and 4-13 cm wide, entire or with up to seven broad triangular lobes. Both surfaces are covered with fine stellate hairs and have scattered prickles along the main veins. The upper surface is darker than the lower one. The base of the lamina is truncate and oblique, the apex acute up to acuminate. The leaves have densely stellate-pubescent petioles, 1 up to 5.5 cm long, with some prickles up to 10 mm long, curved. Dense and compact inflorescences up to 6 cm long, 1-4 times branched, consisting of 50-100 flowers, densely pubescent with trichomes similar to those of the stems. Pentamerous flowers with slender and hairy sepals, 2-3 mm long forming a calyx of 4-6 mm long. White to cream petals of about 1 cm long forming a stellate corolla of 1.5-2 cm in diameter (Figure 2). Androecium consisting of yellow connivent stamens with anthers 6-8 mm long and about 1 mm wide. Gynoecium made up of conical ovary, glandular, surmounted by a 10-12 mm style, glabrous, ending with a capitate stigma protruding over the androecium. The fruits are globular berries 1-1.5 cm across, pale grayish green when ripe, producing few to several flat woody seeds, 1.5 to 2 mm long (Figure 3).

Fig. 2 Inflorescence of *Solanum torvum* Sw.

Fig. 3 Fruits of *Solanum torvum* Sw.

Site location and ecology

Solanum torvum was collected in the Fiumara Santa Trada, a stream in the Municipality of Villa San Giovanni, in the metropolitan city of Reggio Calabria (southern Italy). The population consists of twenty-three plants, sixteen tall between 1.7 and 4.5 m with flowers and fruits, seven ones lower and not mature. All the plants are located along the stream, between 33S 559178 E- 4232610 N (36 m a.l.m.) and 33S 559294 E- 4232588 N (48 m a.l.m.), on the banks and in the riverbed (Figure 4), with exposure to NW. *S. torvum* grows in disturbed habitats associated to a mixture of species in which other aliens predominate (*Eucalyptus camaldulensis* Dehnh. subsp. *camaldulensis*, *Ricinus communis* L., *Oxalis pes-caprae* L., *Arundo donax* L.), synantropics (*Rubus ulmifolius* Schott, *Bituminaria bituminosa* (L.) C.H. Stirt., *Dittrichia viscosa* (L.) Greuter subsp. *viscosa*, *Foeniculum vulgare* Mill. subsp. *piperitum* (Ucria) Bég., *Galactites tomentosus* Moench, *Parietaria judaica* L., *Brassica fruticulosa* Cirillo subsp. *fruticulosa*, *Convolvulus althaeoides* L., *Euphorbia terracina* L., *Geranium robertianum* L., *Geranium rotundifolium* L., *Lathyrus clymenum* L., *Lobularia maritima* (L.) Desv., *Oloptum thomasi* (Duby) Banfi & Galasso, *Silene latifolia* Poir., *Scrophularia peregrina* L., *Sonchus oleraceus* L.) and others (*Hypericum hircinum* L. subsp. *majus* (Aiton) N. Robson, *Ampelodesmos mauritanicus* (Poir.) T. Durand & Schinz, *Asparagus acutifolius* L., *Cytisus villosus* Pourr., *Dactylis glomerata* L. subsp. *glomerata*, *Galium aparine* L.) (Figure 5).

Fig. 4 Young plant of *Solanum torvum* Sw. along the riverbed

Fig. 5 Flowering plant of *Solanum torvum* Sw. on the bank of the stream, among other invasive and synantropic species

Taxonomic notes

Solanum torvum belongs to the section *Torva* of subgenus *Leptostemonum*, also known as the “spiny Solanums” (Stern et al. 2011). *S. torvum* is the original name given by Swartz (1788). Knapp (2011) proposed it for conservation with a conserved type, but his proposal was not accepted because unnecessary (Applequist 2013). Therefore, Vorontsova and Knapp (2016) selected a lectotype from the Swartz herbarium in S (S-R-5814). *S. torvum* could be confused with other species of its genus, such as *S. anguivi* Lam.. However, the characteristics of *S. torvum* are pale grayish green fruits at maturity, inflorescences with simple, small gland-tipped trichomes, perfect flowers, and leaves from broadly elliptic up to ovate (Vorontsova and Knapp 2014). Lots of authors reported variously about its chromosome number: $n = 12$ (Fedorov 1969), $n = 24$ (Randell and Symon 1976), $n = 12$ (Vorontsova and Knapp 2014). Nowadays, in Europe, there are four species belonging to the section *Torva*, according to this new record: *S. bonariense* L., *S. chrysotrichum* Schltdl., *S. lanceolatum* Cav. and *S. torvum* Sw.. The following key, made up with personal observations and adapted from Cambria et al. (2015) and Knapp et al. (2019), could be useful to avoid confusions among these four species:

1. Stem and leaves sparsely stellate hairy, glabrescent with age, unarmed or rarely with very sparse prickles 0.5-2 mm long. Orange-red fruits.....*Solanum bonariense*
1. Stem and leaves, densely stellate hairy, usually armed with prickles 2.5-10 mm long. Green up to yellow fruits.....2
2. Whitish stem indumentum. Purplish-blue corolla *S. lanceolatum*
2. Ferruginous stem indumentum. White corolla3
3. Shrub up to 4,5 m tall. Young stems and pubescent green up to brownish leaves. Trichomes on the inflorescences and pedicels glandular. Curved prickles..... *S. torvum*
3. Shrub up to tree 1.5–9 m tall. Young stems and densely ferruginous pubescent leaves. Trichomes on the inflorescences and pedicels not glandular. Straight prickles up to slightly curved *S. chrysotrichum*

Invasiveness and impacts

Solanum torvum, used as rootstock for *S. melongena* in Italy, can escape from cultivated fields, replacing native vegetation and rapidly overtopping most herbs, grasses and other shrubs: however, it cannot survive under a closed forest canopy (CABI 2019). Moreover, its prickly stem and leaves, can damage people, livestock and wildlife, and its consumption in traditional meals also caused poisoning in humans (CABI 2019).

According to Pyšek et al. (2004) and Galasso et al. (2018), *Solanum torvum* can be considered as alien casual species in Italy and Europe. However, the population is made up of sixteen mature plants that bloom and bear fruit along a stream. This suggests that the plants occurring in the new site have already produced new individuals in the past: this could lead us to think that the species it can be considered as a naturalized alien.

Conclusions

This paper reports the presence of *S. torvum* in Europe for the first time, confirming that several authors reported its presence by mistake at first. Thanks to the numerous data collected in the field, it was possible to introduce here an assessment of the invasive status of these species. Moreover, I provided more information about *S. torvum* and a more complete key for the identification of species of *Solanum* section *Torva* in Europe. Mature plants blended with the younger ones, spread in the investigated area, let us thinking that this species could expand its presence along the stream and in the neighboring areas. For this reason, further field investigations are necessary to update the invasive status to this new alien species, and to monitor its diffusion.

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Compliance with Ethical Standards
Conflict of Interest: The authors declare that they have no conflict of interest.
This Research involved Human Participants who gave a verbal informed consent prior to the interview.

Specimena visa

Solanum torvum Sw.

ITALY: Villa San Giovanni (Reggio Calabria), Vallone Santa Trada, under the A2 Mediterranean motorway overpass, along a stream, 49 m a.s.l., 33S 559294.36 E - 4232588.43 N, 08/01/2019, Carmelo Maria Musarella (REGGIO). **ANGOLA:** Ambriz, 1853, F. Welwitsch., LISU220817 (LISU). **BELIZE:** Near Cowpen, Swasey Branch, Monkey River, 1942/03/16, Percy H. Gentle, MO-159618 (MO); Plants of Corozal District, British Honduras, San Antonio, 1931, Gentle P.H., K001160868 (K). **BRAZIL:** Paraíba João Pessoa Conj. João Agripino, 29/11/1990, Agra M.F. & Góis G., K001058849. **CÔTE D'IVOIRE:** Abidjan, Campus universitaire d'Abidjan, 1967/04/21, M. Bonzi, HNB02280 (HNB). **COUNTRY UNKNOWN:** Ind. occ., no date, Swartz O.P., S-R-5814 (Lectotypus) (S); Ind. occ., no date, Anon., LINN-HS365-2-1 (LINN); West Indies, 01/1819, Herb. Gay J., K001161194 (K). **DOMINICA:** On P. Bupaits Head, St. Domingo, 1793, no collector, K001161201 (K); St Domingo, 1837, no collector, K001161193 (K). **INDIA:** [Harkan Charace] Madras, 08/1845, no collector, K001152876 (K). **INDONESIA:** Jawa, 1859, Horsfield T., K001080492 (K); Jawa, 1802, Horsfield T., K001080493 (K); Java, no date, Siebold P.F. von, M0166041 (M). Mexico: Chiquilistlan, 1892/05/30, Marcus E. Jones, RSA0017366 (RSA). **PAPUA NEW GUINEA:** Pacific Ocean, Melanesia, Papua New Guinea, New Britain, East New Britain Province, Sali Vallage, 1968/10/16, Millar A.N., BISH1014310 (BISH). **SAINT KITTS AND NEVIS:** Saint Kitts: ex Ins. Sti Christoph. Ind. Occid., no date, no collector, S09-42981 (S). **SENEGAL:** Culta, 1828-1-1, Richard, MPU011202 (MPU). **THAILAND:** Doi Sutep, Nordostseite im Schilflande, 1905/03/17, Hosseus, C.C., M0166039 (M).

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Figure 2



Figure 3



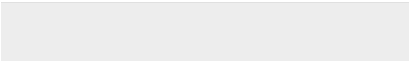
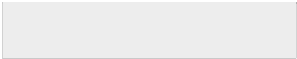
Figure 5

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