Research Article

Brugmansia suaveolens (Humb. & Bonpl. ex Willd.) Sweet (Solanaceae): an alien species new to continental Europe

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Abstract

The occurrence of *Brugmansia suaveolens* (Solanaceae), a neophyte native to South America but cultivated for traditional medicine and ornament in many tropical and temperate areas of the world, is reported for the first time as casual for continental Europe. The species was discovered in two small populations in southern Italy, along the Tyrrhenian coast of the Campania region. Notes of the environments in which the species was found and its naturalization status are also presented. This new finding confirms the role of anthropic areas as starting points for the invasion processes in Italy.

Key words: exotic species, Italy, ornamental plants, naturalization status, vascular flora, xenophytes

Introduction

Solanaceae Juss. is a large family of eudicots containing about 2,500 species (Olmstead et al. 2008), widely distributed in tropical and temperate regions of the world, but mostly native to Central and South America. Also, it includes important plants cultivated in many parts of the world for food, medical and ornamental purposes. The latter two categories concern also the genus *Brugmansia* Pers., a South American genus including 7 species distributed from Venezuela and Colombia to northern Chile and southeastern Brazil (Hay et al. 2012). It contains suckering shrubs or small trees, with petiolate and alternate leaves and very variable gamopetalous corollas that represents the first trait used in systematics within the genus.

Brugmansia was sometimes included in *Datura* L. (Safford 1921; de Wolf 1956; Bristol 1966), although Lockwood (1973), Mace et al. (1999), and Doncheva et al. (2006) have respectively presented morphological, genetic, and biochemical evidence that strongly support its separation at the generic rank. Recent phylogenetic analyses based on four plastid DNA sequences confirmed the separation into two genera (Bye and Sosa 2013). Furthermore, *Brugmansia* species have sometimes (Bristol 1966) been viewed as *culta* (i.e., cultivated plants: domesticated plants that may have arisen by intentional or accidental hybridization in cultivation, by selection from existing

cultivated stocks, or from variants within wild populations that are maintained as a recognizable entity solely by continued propagation or from genetically modified plants; Brickell et al. 2016). This view was not accepted by Hay et al. (2012), who on the contrary regard them as species long conserved through cultivation by indigenous people. The genus is not reported as established in nature in continental Europe (Valdés 2012), but some species are cultivated as outdoor ornamental plants in areas with Mediterranean climate. Recently, other Solanaceae species have also been reported as new for Europe (Cambria et al. 2015; Salerno and Stinca 2017; Musarella 2020) or for single countries (Bogdanović et al. 2006; Verloove 2008; Vladimirov et al. 2015; Lakušić et al. 2017) highlighting the important role of this family in the alien flora of Europe.

In this paper, the first record for the neophyte *Brugmansia suaveolens* (Humb. & Bonpl. ex Willd.) Sweet in continental Europe (southern Italy) is reported. Information on the environment in which the species was found and its naturalization status are also presented.

Materials and methods

Field surveys in Campania region were carried out from 2015 to 2019. Collected specimens are conserved in PORUN-Herb. Stinca (acronyms according to Thiers 2020). The identification of the species was made according to D'Arcy (1973), Shaw (2000), and Hay et al. (2012), as well as considering the herbaria specimens preserved at B, BHCB, NY, P, US, and WIS (see Supplementary material Appendix 1). Geocoding of the Italian localities was performed using a portable GPS device (GPS map 60CSx, Garmin, USA), calibrated to the UTM WGS84 reference system.

Relevant literature was examined to detect or exclude previous indications of the species in Europe (Verloove 2006; Gallego et al. 2012; Valdés 2012; Tison and de Foucault 2014; Uludağ et al. 2017; Barina et al. 2018; Galasso et al. 2018).

Vegetation in which the species was found was documented using the approach of Braun-Blanquet (1964). The nomenclature and taxa delimitation follows Bartolucci et al. (2018), Galasso et al. (2018) and recent updates. The naturalization status was evaluated according to Pyšek et al. (2004).

Results and discussion

Nomenclature

Brugmansia suaveolens (Humb. & Bonpl. ex Willd.) Sweet, Hort. Suburb. Lond.: 41. 1818.

≡ *Datura suaveolens* Humb. & Bonpl. ex Willd., Enum. Pl.: 227. 1809.

Lectotype (designated by Hay et al. 2012): Germany. Cult. Hort. Reg. Bot. Berolinensis, leg. *C.L. Willdenow* 4257, det. *C.L. Willdenow* (B -W 04257 -02 0!, image of the lectotype available at http://herbarium.bgbm.org/object/BW04257020).

= *Datura gardneri* Hook., Bot. Mag. 72: t. 4252. 1846.

= *Datura sualveolens* Humb. & Bonpl. ex Willd. var. *macrocalyx* Sendtn, in Mart. Fl. Bras. 10: 161. 1846.

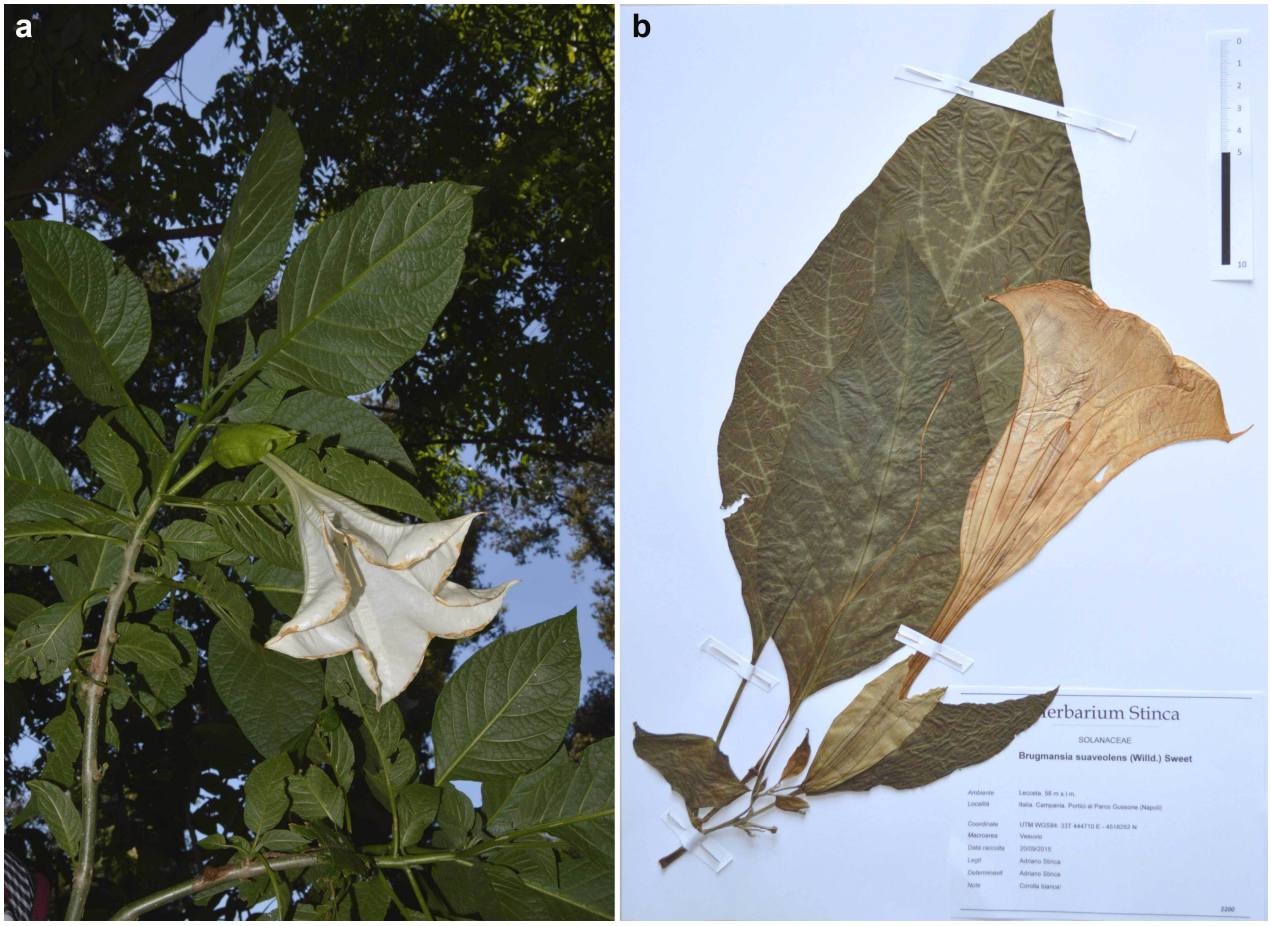

Figure 1. *Brugmansia suaveolens* (Humb. & Bonpl. ex Willd.) Sweet at the Royal Park of Portici (Italy), with details of the flower and leaves in a living plant (A) and in one herbarium sample PORUN-Herb. Stinca 2200 (B). Photos A. Stinca.

Morphological description

The plants found in southern Italy (Figure 1) show the following morphological traits. Deciduous erect shrubs, up to 4 m tall, with young stems densely covered by multicellular appressed trichomes. The leaves are green, deciduous, alternate, petiolate (up to 12.2 cm long) and simple, ovate-lanceolate (5.0–38.5 × 2.0–16.8 cm), with entire or slightly undulate margin, acute-acuminate apex, asymmetric and cuneate base. The lower surface is more covered by multicellular trichomes mostly on main veins, and pale green than the upper one. The flowers are axillary, solitary, on a peduncle 3.3–4.7 cm long covered by multicellular appressed trichomes. The calyx is gamosepalous, 5-lobed, with tube 6.0–6.8 cm long, and acute-acuminate lobes 2.2–2.9 × 1.3–1.5 cm, green and hairless. It is green and covered by multicellular trichomes on the main veins and margin of lobes. The corolla is infundibuliform, 5-lobed, with tube 25.0–30.5 cm long, and maximum diameter at the apex, to 17.5 cm. It ends with slightly recurved acute-apiculate tips 0.8–1.3 cm long, has a white color, pale-green and hairy veins especially at the base (yellow-orange in the herbarium samples). The stamens are included in the corolla, have the filaments adnate to the corolla tube, the anthers basifixed and adherent between them, forming a

short sheath around the style. The ovary is 2-locular, ca. 5.0 × 1.5 mm, with a style 21.0–25.5 cm long and stigma elongate. The fruit is a capsule (not produced in the plants observed in Italy).

Taxonomic remarks

Within *Brugmansia* sect. *Brugmansia*, *B. suaveolens* is very similar to the Amazonian species *B. insignis* (Barb. Rodr.) Lockwood ex R.E. Schult., from which it differs by the petal tips 1.5–2.0 cm long, and spreading to slightly reflexed (petal tips 4.0–6.5 cm long, almost thread-like, and spreading at night to thrown forward or limp during the day in *B. insignis*) (Shaw 2000; Hay et al. 2012).

Native range and habitat

Brugmansia suaveolens is a species native to eastern Brazil, near the Atlantic coast (Hay et al. 2012). However, in the protologue Willdenow (1809) indicated it for Mexico. According to Hay et al. (2012), Willdenow confused it with *Brugmansia* ×*candida* Pers., a hybrid between *B. aurea* Lagerh. and *B. versicolor* Lagerh.

In Brazil, *Brugmansia suaveolens* should grows along margins of forest and streams, colonizing old fields, and in swamps or marshy areas generally below 1000 m of altitude. However, the International Union for Conservation of Nature considers it extinct in the wild (Hay 2014).

In many tropical and temperate areas of the world it is used as an ornamental plant (e.g. Europe) and in traditional medicine (e.g. South America and India) (CABI 2020).

Occurrence in Europe

In the European territories, *Brugmansia suaveolens* has so far been reported only for Macaronesian islands: Canary (Hansen and Sunding 1993; Acebes et al. 2010), Madeira (Hansen and Sunding 1993; Jardim and Menezes de Sequeira 2008), and Azores (Silva et al. 2010) (Figure 2).

Distribution and ecology in Italy

The field surveys allowed me to find the species in two localities in southern Italy: at Portici and Positano (Figure 2), in September 2015 and August 2017, respectively. Both areas are located in the Campania region in the metropolitan city of Naples and in the province of Salerno, respectively.

In Portici, I found the species in the Royal Park which is located in the Bay of Naples on the southwestern foothills of Mt Vesuvius, at 58 m a.s.l. (coordinates: 40.813420°; 14.344428°). The population of *Brugmansia suaveolens* found in Positano is located between the localities Grotte and Laurito, near the state road "SS 143 Amalfitana" and Vallone Nocella. This second site is situated on the Amalfi coast in the Sorrento Peninsula, on the

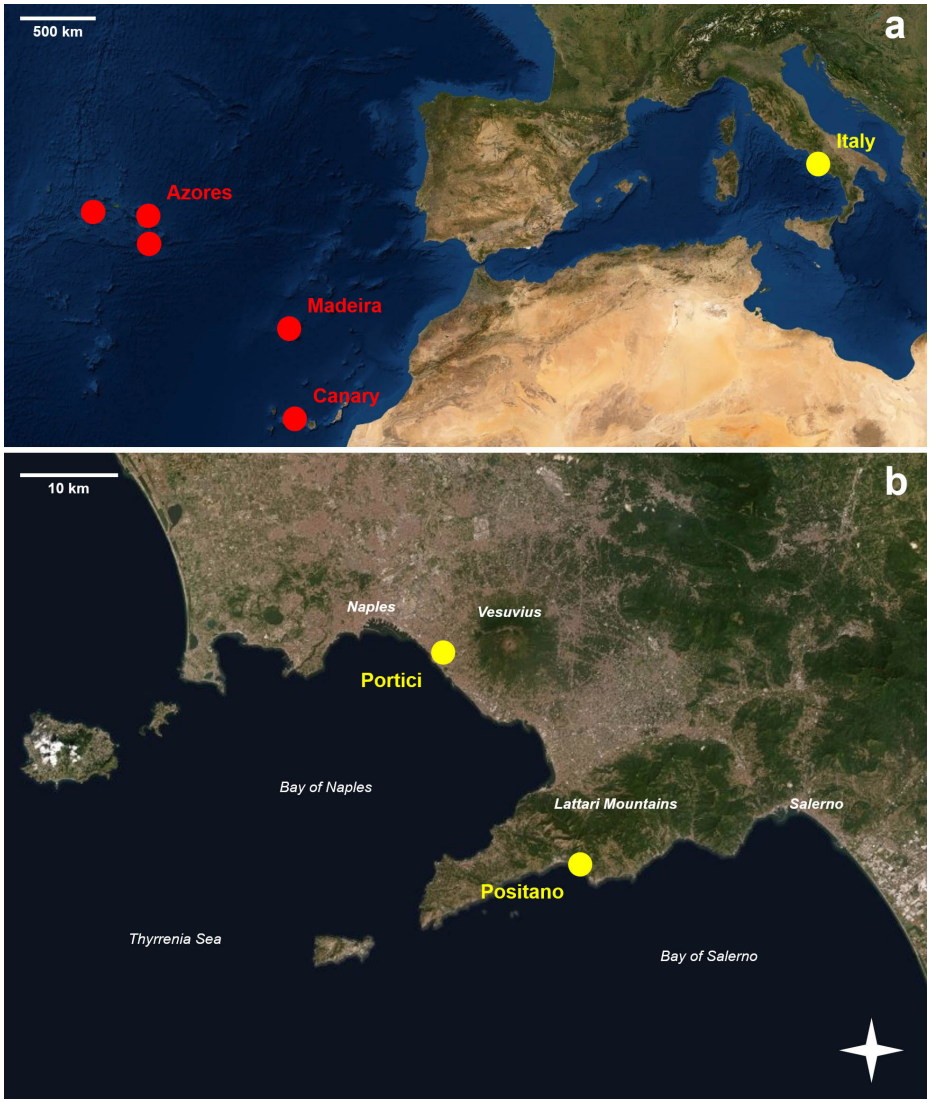

Figure 2. Distribution map of *Brugmansia suaveolens* (Humb. & Bonpl. ex Willd.) Sweet in Europe (A) and Italy (B) (red circles: previous reports for Macaronesian islands; yellow circles: new records for Italy).

southwestern slopes of the Lattari Mts, at 122 m a.s.l. (coordinates: 40.625447°; 14.509648°). According to the bioclimatic map of Europe (Rivas-Martínez et al. 2004), the costal sectors of the Campania region has a Pluvioseasonal Oceanic Mediterranean bioclimate. Soils at Portici and Positano have volcanic (i.e. derived from lava and soil flows, fallout and flow slags, ash and lapilli) and sedimentary (i.e. derived from Jurassic limestones and dolomites) origin, respectively. Both site are inside natural woods of holm oak (Table 1). Interestingly, although some of the holm oaks trees currently present in the Portici forest were planted around 1746 (explosives were sometimes used to break the lava and create planting holes and favorable microsite conditions for plant and root development) (Mazzoleni 1990), some native tree species which colonized the area after the 1631 eruption were already present and left in this place during the plantation (Carafa 1755). Also, its forest dynamics and functional processes, such as natural regeneration and nutrient cycling, are similar to

Table 1. Phytosociological relevés of vegetation with *Brugmansia suaveolens* (Humb. & Bonpl. ex Willd.) Sweet performed at Portici and Positano (A: alien species; R: ruderal species).

	Locality	Portici	Positano
	Date	30 April 2016	27 Aug. 2017
	Area of relevé (m^2)	150	150
	Total cover (%)	90	95
	Number of taxon (specie and subspecies)	30	24
A	*Brugmansia suaveolens* (Humb. & Bonpl. ex Willd.) Sweet	1	1
	Quercus ilex L. subsp. *ilex*	4	3
	Fraxinus ornus L. subsp. *ornus*	2	2
	Sambucus nigra L.	2	
	Celtis australis L. subsp. *australis*	1	
A	*Ailanthus altissima* (Mill.) Swingle	1	
	Ficus carica L.		3
	Acer opalus Mill. subsp. *obtusatum* (Waldst. & Kit. ex Willd.) Gams		+
	Rubus ulmifolius Schott		1
	Myrtus communis L.		+
	Ruscus aculeatus L.	1	+
	Emerus major Mill. subsp. *emeroides* (Boiss. & Spruner) Soldano & F.Conti		+
	Viburnum tinus L. subsp. *tinus*		+
	Dioscorea communis (L.) Caddick & Wilkin	2	
	Smilax aspera L.		2
	Hedera helix L. subsp. *helix*	2	1
	Brachypodium sylvaticum (Huds.) P.Beauv. subsp. *sylvaticum*		1
R	*Parietaria judaica* L.	1	1
A	*Phytolacca americana* L.	+	1
	Rubia peregrina L.	1	+
R	*Acanthus mollis* L. subsp. *mollis*	1	
	Asparagus acutifolius L.		+
	Asplenium onopteris L.	+	+
A	*Erigeron sumatrensis* Retz.	+	+
	Arum italicum Mill. subsp. *italicum*	+	+
	Silene latifolia Poir.	+	
	Convolvulus silvaticus Kit.	+	
R	*Urtica membranacea* Poir.	+	
R	*Scrophularia peregrina* L.	+	
R	*Daucus carota* L. subsp. *carota*	+	
R	*Stellaria media* (L.) Vill. subsp. *media*	+	
R	*Euphorbia peplus* L.	+	
A	*Salpichroa origanifolia* (Lam.) Baill.	+	
A	*Tradescantia fluminensis* Vell.	+	
A	*Asparagus setaceus* (Kunth) Jessop	+	
A	*Araujia sericifera* Brot.	+	
A	*Oxalis debilis* Kunth	+	
A	*Veronica persica* Poir.	+	
A	*Galinsoga quadriradiata* Ruiz & Pav.	+	
	Mycelis muralis (L.) Dumort. subsp. *muralis*		+
	Selaginella denticulata (L.) Spring		+
	Asplenium ceterach L. subsp. *ceterach*		+
	Pentanema squarrosum (L.) D.Gut.Larr., Santos- Vicente, Anderb., E.Rico & M.M.Mart.Ort.		+

those of a natural forest ecosystem (Ricciardi et al. 1993). For all these reasons, the Portici forest can be defined an "old-growth urban forests" (Teobaldelli et al. 2020). However, the vegetation with *Brugmansia suaveolens* of Portici showed a higher presence of alien and ruderal species (11 and 7), compared to Positano (3 and 1) (Table 1), probably due to

human impact on this area. Furthermore, the Royal Park of Portici is placed within the urban continuum of the towns of Portici and Ercolano (metropolitan city of Naples), and its flora has a high percentage of non-native species (Stinca and Motti 2009).

During the first survey in Portici, I observed 5 individuals, ranging from 1 (4 individuals) to 3 m (1 individual). However, during the last monitoring of this population performed in November 2019, I noticed only 2 individuals by 1.5 and 3.5 m tall. In this area the signs of some anthropogenic interventions (e.g. elimination of undergrowth vegetation) were visible. Instead, 7 individuals ranging from 0.5 (2 individuals) to 4 m (1 individual) are still present in Positano.

Probably, in the reported localities this neophyte was accidentally introduced through discharge of garden waste (pruning) of plants nearby cultivated and therefore subsequently vegetatively established. Indeed, *Brugmansia suaveolens* is easily vegetatively propagated by nurserymen (Navie 2012) and sometimes cultivated as ornamental in the gardens of Campania region for its showy and fragrant flowers (*pers. obs.*).

Naturalization status in Italy

In Italy, *Brugmansia suaveolens* was detected by me and monitored for four consecutive years (from 2015 to 2019). In both localities (Portici and Positano), the plants were in bloom, but the fructification was not observed. Therefore, *B. suaveolens* is considered as a casual alien plant in Italy, according to the definition proposed by Pyšek et al. (2004). My discovery confirms that human-disturbed areas (e.g. gardens and cultivated fields) may act as a starting points for the invasion processes in Italy (Stinca et al. 2017). However, particular attention should be paid to the possibility that *Brugmansia* species in Europe may play a role in the epidemiology of aphid-transmitted viruses such as *Potato spindle tuber viroid* (PSTVd; Verhoeven et al. 2008; Mertelik et al. 2010; Luigi et al. 2011), *Colombian datura virus* (CDV; Salamon and Palkovics 2005; Vovlas et al. 2009) and *Tomato spotted wilt virus* (TSWV; Nikolić et al. 2013), representing a threat to susceptible important crops growing nearby, especially other Solanaceae such as potatoes and tomatoes.

Conclusions

The management of alien species in a territory must be based on the knowledge on their presence and distribution, also supported through an early warning system, as remarked in the Regulation (EU) No. 1143/2014. To this aim, in this paper, the casual presence in continental Europe of *Brugmansia suaveolens* is reported for the first time. Importantly, this discovery confirms that anthropic areas (e.g. gardens and cultivated fields) may act as starting points for the invasion processes in Italy (Stinca et al.

2017). However, further field investigations will be useful to eventually discover new populations, monitoring its sexual reproduction capability and update its status of naturalization in Italy and Europe.

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Supplementary material

The following supplementary material is available for this article:

Appendix 1. Specimina visa selecta.

This material is available as part of online article from:
http://www.reabic.net/journals/bir/2020/Supplements/BIR_2020_Stinca_etal_SupplementaryMaterial.pdf