

On the presence of *Opuntia aurantiaca* (Opuntioideae, Cactaceae) in Catalonia (northeastern Iberian Peninsula)

Laia Guàrdia Valle¹



Reception date: 2 January 2016
 Acceptance date: 8 February 2016
 Publication date: 9 March 2016

Abstract

Detailed data regarding the occurrence of the invasive species *Opuntia aurantiaca* (Cactaceae) in Catalonia is provided. The plant is native from South America and is considered a noxious weed in South Africa and Australia. We provide the first concrete locality for the species in Europe, and provide data about the characteristics of the population in Caldes de Montbui and its invasive potentiality in the area.

Keywords: Alien plant; invasiveness; jointed cactus; Mediterranean.

Resum. *Sobre la presència d'Opuntia aurantiaca (Opuntioideae, Cactaceae) a Catalunya (nord-est de la península Ibèrica)*

S'aporten dades sobre la presència de l'espècie invasora *Opuntia aurantiaca* (Cactaceae) a Catalunya. Aquesta planta és nativa de l'Amèrica del Sud i és considerada una planta problemàtica tant a Sud-àfrica com a Austràlia. En el present treball s'indica la primera localitat concreta d'aquesta espècie a Europa. També s'aporten dades sobre les característiques de la població documentada a Caldes de Montbui i del seu potencial invasor a la zona.

Paraules clau: plantes al·lòctones; *jointed cactus*, regió mediterrània; espècies invasores.

Introduction

Many alloctonous cacti have been recorded in Europe. Among them, the genus *Opuntia* L., having more than 25 alien invasive species, is the most relevant (Essl & Kobler, 2008). *Opuntia* species colonize semi-arid and warm temperate areas habitually on siliceous substrate, being mostly restricted to the Mediterranean

1. Universitat Autònoma de Barcelona. Unitat de Botànica, Facultat de Biociències. 08193 Bellaterra. laia.guardia@uab.cat

region in the European context (Essl & Kobler, 2008; Lloret et al., 2005; Sanz-Elorza et al., 2004; Sobrino et al., 2002; Vilà et al., 2003).

Opuntia aurantiaca (jointed cactus) is a species of cactus native from South America Argentina, Paraguay and Uruguay (Moran et al., 1976; USDA-ARS, 2009). This species is considered invasive in southern Africa (Moran & Annecke, 1979), Madagascar (Allorge-Boiteau, 2002) and Australia: New South Wales (Hosking & Deighton, 1979; Hosking et al., 1988), Queensland (Mann, 1970; Hosking et al., 1988), Victoria (Parsons & Cuthbertson, 1992). The trade of exotic plants was frequent among collectors and botanists during the nineteenth century, thus promoting the introduction and circulation of alien plants via international shipping in various continents (Moran & Annecke, 1979). The jointed cactus was transported to England in 1824 from the West Indies (Moran et al., 1976). Then, it was introduced in South Africa, Cape Town, probably in 1843, as part of a consignment of exotic plants from England (Moran & Annecke, 1979). There are not references explaining how, during the 19th century, the jointed cactus reached Australia, where it is actually considered among the most noxious weeds (CABI, 2015). In both countries jointed cactus has been used as a garden ornamental and as a barrier plant (Moran & Annecke, 1979). However, *O. aurantiaca* early became an aggressive invasive, occupying those areas with an adequate climate and substrate (CABI, 2015). In South Africa and Australia, the jointed cactus extended along the desert shrub, savanna and grassland biome, especially in overgrazed and disturbed habitats (CABI, 2015; Mann, 1970; Parsons & Cuthbertson, 1992). In both countries, the cactus continues to invade new habitats and regions (CABI, 2015) and was declared in 2012 as a “weed of National Significance” by the Australian Weed Strategy Committee (Anonymous, 2015b).

Opuntia aurantiaca is a sterile hybrid of platyopuntia cacti originated in temperate South America, particularly Eastern Argentina and Southern Uruguay (Moran et al., 1976; Moran & Annecke, 1979; Moran & Zimmermann, 1984; Van de Venter et al., 1984; Moran & Zimmermann, 1991). It has the ability to cover large areas reproducing by means of stem fragments (cladodes) and sterile fruits which easily disarticulate, disperse and survive under extreme conditions until rooting become favorable (Moran & Annecke, 1979). Animals, footwear, vehicles and flood waters may participate in long-distance propagule dispersion (CABI, 2015).

Opuntia aurantiaca was observed in Collserola massif (Barcelona, Catalunya, Spain) in 2011 (<opuntiaaurantiacacatalunya.blogspot.com.es>), but the record was not published, and no data about the specific site and population size was provided. Accordingly to the information source, this population was eradicated. Probably based on this obscure record, in 2012 it was listed among non-invasive alien species of the EXOCAT Project (Andreu et al., 2012). Then *O. aurantiaca* was included within the alien species recorded from Collserola (<www.parcnaturalcollserola.cat/pages/especies-exotiques>), thought not detailed localities were either provided in this case.

Material and methods

Measurements were made on fresh specimens. The names of the localities are based on the Catalan topographic maps (<www.icc.cat/vissir3>). The area of occupancy was calculated using the tools in <www.icc.cat/vissir3>. The xenotype is indicated following Kornás (1990). Spines and glochids from fresh cladodes and fruits were studied and photographed under Zeiss Axioscope compound microscope equipped with a Jenoptik ProGresC3 digital camera. The species was identified according to various on-line resources (Anonymous, 2015a, b).

Results and discussion

Opuntia aurantiaca Lindl., Edwards's Bot. Reg. 19: t. 1606 (1833)

Spain, Catalonia, Barcelona province: Vallès Oriental, Caldes de Montbui, camí de Foment, from carretera de Farell, 31TDG2910, 230-245 m, open scrub, 24 Dec 2015, L. Guàrdia Valle (Figs. 1, 2).

Plants from the locality of Caldes de Montbui are spreading shrubs up to 40 cm high, but they reach up to 1.5 m long when grow supported in vegetation. Cladodes 45-180 × 10-30 mm. Young segments are more or less flattened whereas older are cylindrical to subcylindrical. Spines (Fig. 2A, B) arise in groups from areoles, which also contain minute thorns or glochids (Fig. 2C) and trichomes. Long spines (up to 3.5 mm long) have minute, backward-directed barbs at their extremities (Fig. 2A, B), similar but larger than those observed in glochids (Fig. 2C). Flowers 2.5-5 cm wide, bright yellow. Fruit 2.5-3.3 × 1.25-2.25 cm, egg-shaped with more or less flattened top, red-purple when ripe (Fig. 1B).

Opuntia aurantiaca grows in open scrub on siliceous (granodiorite) sandy soil. In the locality here provided it is accompanied by the following native species: *Brachypodium retusum* (Pers.) P. Beauv., *Cistus albidus* L., *Cistus salvifolius* L., *Dactylis glomerata* L. subsp. *hispanica* (Roth) Nyman, *Hyparrhenia* sp., *Lavandula stoechas* L., *Thymus vulgaris* L. subsp. *vulgaris*, *Vicia parviflora* Cav. and the acrocarpous moss *Pleurochaete squarrosa* (Brid.) Lindb. *Opuntia ficus-indica* (L.) Mill. also grows and reproduces profusely in the same locality.

The recorded population of *O. aurantiaca* consists of c. 50 vigorous individuals with the potential of further expansion in nearby open areas, as demonstrated by the numerous detached cladodes and fruits observed nearby the adult plants, many of which already rooted and were growing vigorously (Fig. 2). The area of occupancy of the population is c. 350 m². The species in this locality can be considered an ergasiophygyte, and the colonization event is probably recent, taking into consideration the invasive potential of the species (abundance of viable propagules, adequacy of the site and availability of uncolonized terrain) and the reduced area occupied at present.

It was not possible to find *O. aurantiaca* in the neighboring urbanized area, although a detailed prospection was carried out. However, it is probable than the jointed cactus were used as garden ornamental in the proximities. The site where the naturalized population was observed, at Caldes de Montbui, is at the entrance



Figure 1. *Opuntia aurantiaca*, from Caldes de Montbui. A: reproductive specimen growing together with *Cistus salvifolius*; B: detail of cladodes and fruits; C: fruit hitched to footwear; D: young specimen arising from fruit. Scale bars indicated in the figures.

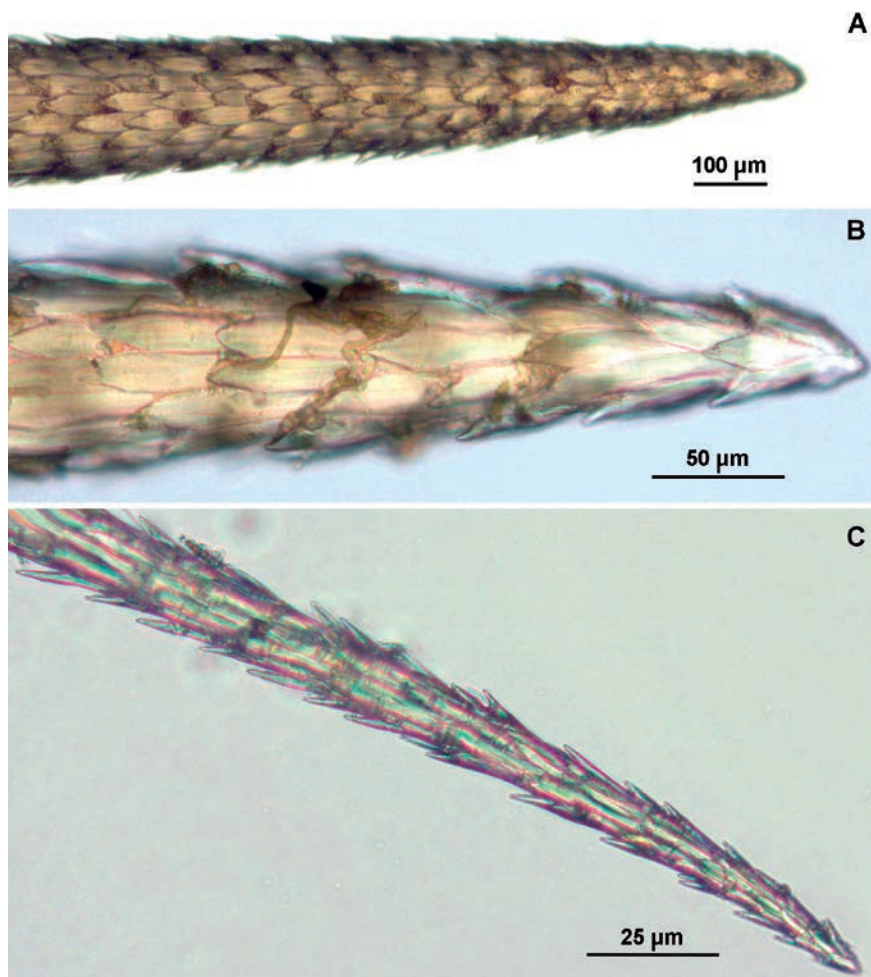


Figure 2. *Opuntia aurantiaca*: Photographs of spines (A and B) and glochids (C) with back-ward oriented barbs. All from specimens collected in Caldes de Montbui. Scale bars indicated in the figures.

of a popular hiking and biking trail (“camí de Foment o de les llobardes”) for locals and visitors, and many take the dog there for a walk. Because propagules of *O. aurantiaca* are very efficient attaching to practically any surface which contacts them (Fig 1C), the high occurrence of potential dispersers should be taken into consideration to explain its presence in the site and also in the assessment of invasiveness potential. Another factor to consider is the proximity of a water course: “Riera de Caldes”, which potentially could improve dispersion events by floodwaters, a common spread mechanism of the jointed cactus.

Microscope observation of the spines and glochids (hair-like spines) showed the back-wards oriented barbs at the apex region of the spines, and all along the smaller glochids. The barbs had an acute conical apex somewhat bent towards the spine axis (Fig. 2). These hook-like structures are responsible for the successful adhesion and dispersion of cladodes and fruits, via animals, humans and vehicle tires. In fact, animal injury has been reported in numerous occasions in Australia and South Africa, both in grazing animals and dogs (CABI, 2015). At the base of the spines, not only glochids (minute spines) were observed, but also multicellular trichomes. The spines, glochids, barbs and trichomes are also related to fog collection abilities in other *Opuntia* species with similar spine morphology what might help the success of such cacti in arid regions (Ju et al., 2012).

Bibliographical references

- Allorge-Boiteau L. 2002. Les cactées introduites à Madagascar. *Succulentas (France)* 25: 9-16.
- Andreu, J.; Pino, J.; Basnou, C.; Guardiola, M.; Ordóñez, L. 2012. Les espècies exòtiques de Catalunya. Resum del projecte EXOCAT 2012. CREA. Generalitat de Catalunya. Departament d'Agricultura, Ramaderia, Pesca, Alimentació i Medi Natural.
- Anonymous. 2015a. Cacti Guide. <www.cactiguide.com>. Accessed Dec 2015.
- Anonymous. 2015b. Weeds Australia. <www.weeds.org.au>. National Weeds Strategy Executive Committee, Launceston, Tasmania. Accessed Dec 2015.
- CABI, 2015. *Opuntia aurantiaca*. In: *Invasive Species Compendium*. Wallingford, UK: CAB International. <www.cabi.org/isc>. Accessed Dec 2015.
- Essl, F.; Kobbler, J. 2008. Spiny invaders – Patterns and determinants of cacti invasion in Europe. *Flora - Morphology, Distribution, Functional Ecology of Plants* 204: 485–494.
- Hosking, J.R.; Deighton, P.J. 1979. The distribution and control of *Opuntia aurantiaca* in New South Wales. In: Medd, R.W., Auld, B.A., (eds.). *Proceedings of the seventh Asian-Pacific Weed Science Society conference*, Sydney, Australia. Asian-Pacific Weed Science Society. Australia: 195-200
- Hosking, J.R.; McFadyen, R.E.; Murray, N.D. 1988. Distribution and biological control of cactus species in eastern Australia. *Plant Protection Quarterly* 3:115-123.
- Ju, J.; Bai, H.; Zheng Y.; Zhao, T.; Fang, R.; Jiang, L. 2012. A multi-structural and multi-functional integrated fog collection system in cactus. *Nature Communications* 3:1247 doi: 10.1038/ncomms2253.
- Kornás, J. 1990. Plant invasions in Central Europe: Historical and ecological aspects. In: Di Castri, F., Hansen, A.J.; Debussche, M. (eds.). *Biological Invasions in Europe and the Mediterranean Basin*. Pp. 19-36. Kluwer Acad. Publ., Dordrecht.
- Lloret, F.; Medail, F.; Brundu, G.; Camarda, I.; Moragues, E.; Rita, J.; Lambdon, P.; Hulme, P.E. 2005. Species attributes and invasion success by alien plants on Mediterranean islands. *J. Ecol.* 93: 512-521.
- Mann, J. 1970. *Cacti naturalized in Australia and their control*. Brisbane, Australia: Department of Lands.
- Moran, V.C.; Annecke, D.P. 1979. Critical reviews of biological pest control in South Africa. 3. The jointed cactus, *Opuntia aurantiaca* Lindley. *Journal of the Entomological Society of Southern Africa* 42: 299-329.
- Moran V.C.; Zimmermann, H.G. 1984. The biological control of cactus weeds: achievements and prospects. *Biocontrol News Inf. Commonw. Agric. Bur.* 5: 279-320.

- Moran V.C.; Zimmermann, H.G. 1991. Biological control of jointed cactus, *Opuntia aurantiaca* (Cactaceae), in South Africa. *Agriculture, Ecosystems & Environment* 37(1-3): 5-27.
- Moran V.C.; Zimmermann, H.G.; Annecke, D.P. 1976. The identity and distribution of *Opuntia aurantiaca* Lindley. *Taxon* 25: 281-287.
- Parsons, W.T.; Cuthbertson, E.G. 1992. *Noxious Weeds of Australia*. Melbourne, Australia: Inkata Press, 692 pp.
- Sanz-Elorza, M.; Dana Sánchez, E.D.; Vesperinas, E.S. 2004. Sobre la presencia de cactáceas naturalizadas en la costa meridional de Cataluña. *An. Jard. Bot. Madrid* 61: 27-33.
- Sobrino, E.; Sanz-Elorza, M.; Dana, E.D.; Gonzalez-Moreno, A. 2002. Invasibility of a coastal strip in NE Spain by alien plants. *J. Veg. Sci.* 13: 585-594.
- USDA-ARS, 2009. Germplasm Resources Information Network (GRIN), Online Database. Beltsville, USA: National Germplasm Resources Laboratory. <<http://www.ars-grin.gov/>>
- Van de Venter, H.A.; Hosten, L.; Lubke, R.A.; Palmer, A.R. 1984. Morphology of *Opuntia aurantiaca* (jointed cactus) biotypes and its close relatives *O. discolor* and *O. salmiana* (Cactaceae). *South African Journal of Botany* 3: 331-339.
- Vilà, M.; Gimeno, I. 2003. Seed predation of two alien *Opuntia* species invading Mediterranean communities. *Plant Ecology* 167: 1-8.