EPPO Datasheet: *Cardiospermum grandiflorum*

Last updated: 2020-04-23

IDENTITY

Preferred name: *Cardiospermum grandiflorum*
Authority: Swartz
Taxonomic position: Plantae: Magnoliophyta: Angiospermae: Malvids: Sapindales: Sapindaceae: Sapindoideae
Common names: balloon vine, grand balloon vine, heart pea, heart seed, showy balloon vine
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EPPO Categorization: A2 list
view more categorizations online...
EU Categorization: IAS of Union concern
EPPO Code: CRIGR

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GEOGRAPHICAL DISTRIBUTION

History of introduction and spread

C. grandiflorum has a wide Neotropical native range from Southern Mexico to Brazil and the Caribbean (the type specimen is from Jamaica). All Central and South American countries are considered part of the species' native range distribution. Distributions in the US represent non-native naturalized populations of the species. There is also a single record from Los Angeles, California (Gildenhuys *et al*., 2013).

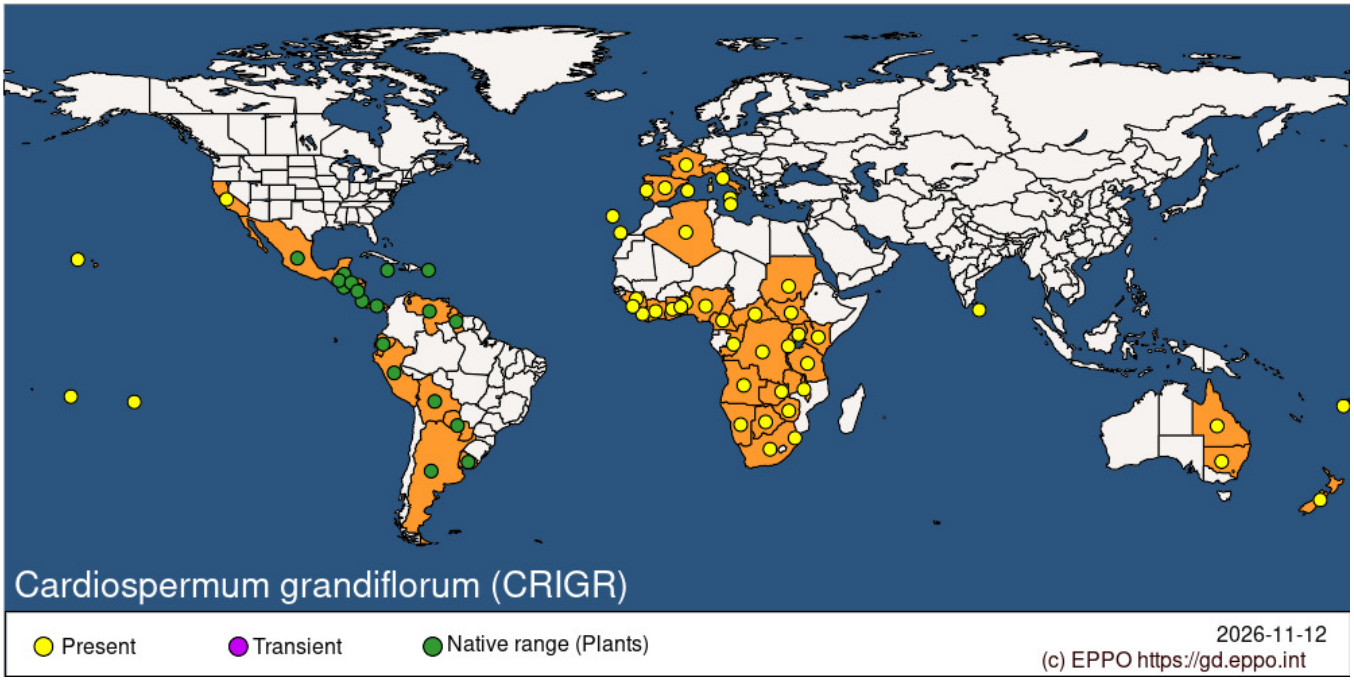
The species has been introduced intentionally to many regions of the world as a popular ornamental plant. The species is widespread and highly invasive in subtropical regions in Australia and South Africa. Some consider parts of Asia as the native range of the species but it is not listed anywhere in the region except Sri Lanka, where it is considered introduced (CABI, 2016).

The introduction of *C. grandiflorum* into South Africa as an ornamental plant occurred around 100 years ago (Simelane *et al*., 2011). The species rapidly spread and is now considered invasive in five of the country's nine provinces, of which the Kwazulu-Natal and the Eastern Cape provinces are the most severely affected (Henderson, 2001; Simelane *et al*., 2011). Little information is available about the species' introduction history into other non-native ranges in Southern Africa (e.g. Angola, Botswana, Namibia, Mozambique, Swaziland, Zimbabwe). Some uncertainty exists about the species' status (native or introduced) in tropical Africa. For some countries (e.g. Uganda) both morphological and phylogenetic data suggest a native range distribution.

In Australia, the first herbarium records of *C. grandiflorum* date back to 1923 from around Sydney, New South Wales (Carroll *et al.*, 2005a). The species is now abundant throughout the east coast of Australia between Sydney and Cairns. Inland spread to forested areas such as Toowoomba (Queensland) and the Blue Mountains (New South Wales) has been recently observed (Carroll *et al.*, 2005a; E Gildenhuys, pers. obs.). The species is present in isolated populations in the North Island of New Zealand around Auckland. *C. grandiflorum* is widespread and invasive on Rarotonga, Cook Islands, and Tahiti, but the exact dates of introduction are not known.

In the EPPO region, *C. grandiflorum* has non-native records from France (Landes and Alpes-Maritimes departments, considered a casual species in the process of becoming established), Italy (Liguria, in the mainland and the Catania (Canalicchio) in the island of Sicily), Malta (considered as an invasive species), Portugal (Madeira) and Spain (Canary Islands: Gran Canaria, Tenerife, La Gomera, La Palma). In the Alpes-Maritimes department in France, the species was first recorded in Menton in the city of Beausoleil in an urban area. See EPPO (2017) for more detail.

Distribution



EPPO Region: Algeria, France (mainland), Italy (mainland, Sicilia), Malta, Portugal (mainland, Madeira), Spain (mainland, Islas Baleares, Islas Canárias)
Africa: Algeria, Angola, Benin, Botswana, Cameroon, Central African Republic, Congo, Congo, The Democratic Republic of the, Cote d'Ivoire, Eswatini, Ghana, Guinea, Kenya, Liberia, Malawi, Namibia, Nigeria, Rwanda, Sierra Leone, South Africa, South Sudan, Sudan, Tanzania, United Republic of, Togo, Uganda, Zambia, Zimbabwe
Asia: Sri Lanka
North America: Mexico, United States of America (California, Hawaii)
Central America and Caribbean: Belize, Costa Rica, El Salvador, Guatemala, Honduras, Jamaica, Nicaragua, Panama, Puerto Rico
South America: Argentina, Bolivia, Ecuador, Guyana, Paraguay, Peru, Uruguay, Venezuela
Oceania: Australia (New South Wales, Queensland), Cook Islands, Fiji, French Polynesia, New Zealand

MORPHOLOGY

Plant type

Annual or perennial vine-like climber.

Description

C. grandiflorum is a large, semi-woody annual or perennial often draping over other vegetation. While the fruit of *C. grandiflorum* can be variable in size, its distinct shape and coverage by hairs make the species easily recognizable and distinguishable from closely related taxa such as *C. halicacabum and C. corindum. C. grandiflorum* has hairy ribbed stems that are reddish-green in colour and covered in bristly hairs. Leaves are compound and up to 16 cm long and are dark green and heavily serrated. The species' flowers have four petals that are white with a yellow lip. Flowers are fragrant and grow in clusters with a pair of tendrils at the flower base. Fruits are balloon-shaped, up to 65 mm long, inflated, representing a 3-angled and pointed tipped capsule, covered in fine bristly hair. Young fruit capsules are green, turning brown as the fruit matures. Each fruit is septifragal and contains three black seeds each with a characteristic white heart-shaped hilum (Weckerle & Rutishauser, 2005).

BIOLOGY AND ECOLOGY

General

The breeding system of *C. grandiflorum* is not well understood. The species' flowers are functionally unisexual (Acevedo-Rodríguez, 2005). In addition, experimental data from closely related species supports potential self-compatibility. *C. halicacabum* is self-compatible, producing a high percentage of viable seeds when self-fertilized (Acevedo-Rodríguez, 2005). Another congener, *C. canescens*, exhibits geitonogamy, that is, successful pollination between flowers of the same plant (Solomon Raju *et al*., 2011). Temperature seems to have an impact on the phenology of *C. grandiflorum*, with warmer climates supporting longer flowering periods. The species is thought to form large seed banks, as individual plants can produce hundreds of seeds (J Le Roux, pers. obs. 2016) especially in dense populations (FloraBase, 2012). Seeds can remain viable for up to 2 years (Vivian-Smith & Panetta, 2002). The fruits of *C. grandiflorum* are well adapted for wind and water dispersal (Gildenhuys *et al*., 2013). The success of seed germination and optimal growth requirements are not well studied in *C. grandiflorum*, but again, research on the closely related *C. halicacabum* may provide insights into key requirements in the reproductive biology of the species. For *C. halicacabum* optimum germination takes place at 35°C, with well-drained soil conditions increasing germination success (Johnston *et al*., 1979; Jolley *et al.*, 1983; Dempsey, 2011). *C. grandiflorum* is also capable of vegetative reproduction through resprouting.

Habitats

Cardiospermum grandiflorum prefers open habitats, though it may grow well in forest edges (CABI, 2017). It thrives in well-drained soil types. Research on invasive populations from Australia found soil types to vary substantially among regions of high-density populations indicating that the species has a wide edaphic tolerance.

Environmental requirements

Optimal growth takes place in well-lit (sunny) locations, although it is capable of germinating under dark conditions (ARC, 2011). Seeds and young plants are able to survive flooded, saturated and dry conditions, while performing best in intermediate conditions (Dempsey, 2011). In both the native and introduced ranges, *C. grandiflorum* performs best in subtropical climates, in habitats such as forest margins, along watercourses and in disturbed urban open areas (Carroll *et al*., 2005a, Gildenhuys *et al*., 2013). The species also responds rapidly to environmental disturbances (Carroll *et al*., 2005a,b) and is commonly observed in highly disturbed habitats such as abandoned agricultural fields, urban environments and areas outside domestic gardens (J J Le Roux, pers. obs., 2016).

Natural enemies

C. grandiflorum produces numerous secondary compounds (e.g. flavone aglycones and cyanogenic compounds) that probably protect it against herbivores such as soapberry bugs (Subramanyam *et al*., 2007). Soapberry bugs from the genera *Leptocoris, Jadera* and *Boisea* (family Rhopalidae) feed exclusively on seeds of Sapindaceae and are natural seed predators of *Cardiospermum* globally, including in their non-native ranges (Carroll *et al*., 2005b). Soapberry bugs co-occur with the widespread distribution of *Cardiospermum* (excluding Europe) and thus may affect reproduction globally. For example, American soapberry bugs can destroy approximately 95% of invasive balloon vine seeds (Carroll *et al*., 2003).

Uses and benefits

C. grandiflorum is available in the ornamental trade within the EPPO region and is listed as cultivated in various botanical gardens and available through index seminum catalogues. Numerous extracts from the species have been reported for their medicinal uses. For example, root derivatives of the plant have been shown to offer laxative, emetic and diuretic effects. The leaves of the plant have been used to alleviate swelling, oedema and pulmonary complications (GISD, 2015) and may have antibacterial activity (Nnamani *et al.*, 2012). To date, no commercial enterprises make use of this species in the production of medicinal products.

PATHWAYS FOR MOVEMENT

Plants or seeds for planting are considered the main pathway for entry into the EPPO region. From this pathway, individual plants can be transferred to suitable habitats through either intentional introduction into the environment or unintentionally through the disposal of plant material. While online trade currently lists *C. grandiflorum* infrequently, a congeneric species, *C. halicacabum* is readily available. It is possible that some traders may confuse these two species as the latter is frequently mislabelled as *C. grandiflorum.*

IMPACTS

Effects on plants

In its invasive range *C. grandiflorum* typically forms dense draping carpets/mats, smothering large areas of underlying vegetation (McKay *et al*., 2010; Ameen, 2013). For example, in Australia these carpets can cover native vegetation in riparian ecosystems in uninterrupted stands sometimes several kilometres in area, including trees up to 20 m high (Carroll *et al*., 2005a). The resultant exclusion of sunlight has negative impacts on photosynthesis, leading to the competitive exclusion of other species, including natives. *C. grandiflorum* therefore has the potential to negatively affect overall ecosystem processes and plant communities (Coutts-Smith & Downey, 2006; Ameen, 2013). While empirical data on the impacts of the species is currently lacking, its potential impacts can be deduced from similar invasive growth forms elsewhere in the world. For example, the woody vine *Clematis vitalba* is a vigorous climber that, similar to *C. grandiflorum*, smothers vegetation. In New Zealand *C. vitalba* has had serious impacts on biodiversity (Ogle *et al*., 2000). In South Africa *C. grandiflorum* is considered a transformer species (Henderson, 2001; Carroll et al., 2005a) and it is a major weed in riparian zones (banks of watercourses).

In Malta, there is evidence of impacts on biodiversity as the species has formed extensive invasive populations. The invaded area in Malta may present unique micro-climatic conditions for the species due to it being a steep-sided dry valley.

Environmental and social impact

In East Africa, dense populations of invasive *C. grandiflorum* have been reported to hinder the free movement of wildlife and livestock (BioNET-International, 2016). Invasion by *C. grandiflorum* may have negative impacts on supporting ecosystem services by changing relative primary production by competitive displacement of native vegetation.

CONTROL

To date, managing *C. grandiflorum* invasions has mostly involved manual removal or burning. Manual removal involves cutting plants at the base. Roots are dug up after the above-ground biomass has died off to avoid resprouting.

The use of chemicals to control populations of *C. grandiflorum* may potentially be problematic for two reasons: firstly because of non-target impact on underlying vegetation, and secondly the high risk of environmental contamination because of the species' typical proximity to waterways (Simelane *et al*., 2011). A potential problem with both manual and chemical management is the species' ability to form relatively large seed banks, so that once the weedy canopy is cleared or has died off, seeds start to sprout as they respond strongly to the availability of light (FloraBase, 2012).

Classical biological control has only been explored against the species in South Africa. Since the inception of a biological control programme in 2003, ten insects and two fungal agents have either been recorded on the target weed in the native South American range or have been undergoing host-specificity testing in South Africa (McKay *et al*., 2010; Simelane & Mawela, 2013). Eight of these insects displayed wider host ranges, capable of feeding and developing on other cosmopolitan *Cardiospermum* species in South Africa, in particular *C. halicacabum* and *C. corindum.* This is problematic for the region because, while both *C. grandiflorum* and *C. halicacabum* are non-native in South Africa, *C. corindum* is considered native (Gildenhuys *et al.*, 2015a,b). Of those potential biological control agents tested to date, most were largely restricted to its taxonomic family (Sapindaceae) or genus, but not necessarily to the species *C. grandiflorum*. One promising seed-feeding curculionid weevil, *Cissoanthonomus tuberculipennis,*

was released in South Africa's KwaZulu Natal Province in late 2013 (Simelane *et al*., 2014). The effectiveness of this biological control agent and its host specificity under field conditions remains to be assessed.

'Neoclassical' biological control, that is, the use of natural enemies that are native to the introduced range, represents a possible management approach for *C. grandiflorum.* Soapberry bugs (genera *Leptocoris, Jadera* and *Boisea* from the family Rhopalidae) feed exclusively on seeds of Sapindaceae and are natural seed predators of *Cardiospermum* species in both their native and non-native regions (Carroll *et al.*, 2005b). Native American soapberry bugs have been shown to destroy approximately 95% of introduced balloon vine seed crops (Carroll *et al.*, 2003). In the European context, such neoclassical biological control might occur if insects utilizing native Sapindaceae shift onto balloon vine. However, the genera *Leptocoris, Jadera* and *Boisea* are absent from the continent.

REGULATORY STATUS

Europe (overall): *C. grandiflorum* was included on the EPPO Alert List in 2012. It was upgraded to the List of Invasive Alien Plants in 2013. In 2017, *C. grandiflorum* was added to the EPPO A2 List of pests recommended for regulation. In 2017, *C. grandiflorum* was identified as a priority for risk assessment within the requirements of Regulation 1143/2014 (Branquart *et al*., 2016; Tanner *et al.*, 2017). A subsequent pest risk analysis concluded that *C. grandiflorum* had a moderate phytosanitary risk to the endangered area (EPPO, 2017) and was added to the EPPO A2 List of pests recommended for regulation. In 2019, *C. grandiflorum* was included on the (EU) list of species of Union concern (EU Regulation 1143/2014).

C. grandiflorum is regulated under legislation (Environment Protection and Biodiversity Conservation Act 1999) in New South Wales (Australia) and listed as Class 4 – a locally controlled weed. The growth and spread of this species must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed. In Queensland it is listed as Class 3 – this species is primarily an environmental weed and a pest control notice may be issued for land that is, or is adjacent to, an environmentally significant area (throughout the entire state). It is also illegal to sell a declared plant or its seed in this state. In Western Australia it is listed as Unassessed – this species is declared in other states or territories and is prohibited until assessed via a weed risk assessment (throughout the entire state).

In South Africa control of the species is enabled by the Conservation of Agricultural Resources (CARA) Act 43 of 1983, as amended, in conjunction with the National Environmental Management: Biodiversity (NEMBA) Act 10 of 2004. Currently *C. grandiflorum* is listed as a Category 1b 'invader species' on the NEMBA mandated list of 2014 (Government of the Republic of South Africa, 2014). Category 1b means that the 'invasive species that may not be owned, imported into South Africa, grown, moved, sold, given as a gift or dumped in a waterway'. Category 1b species are major invaders that may need government assistance to remove. All Category 1b species must be contained, and in many cases they already fall under a government sponsored management programme (http://www.en vironment.gov.za).

In New Zealand *C. grandiflorum* is currently legally listed (under the country's Biosecurity Act 1993) as an 'Unwanted Organism'.

REFERENCES

Acevedo-Rodríguez P (2005) Vines and climbing plants of Puerto Rico and the Virgin Islands. *Contributions from the United States National Herbarium* **51**, 1–483.

Ameen J (2013) Valley flora being slowly choked by invasive plant. Times of Malta, Allied Newspapers Ltd. http://www.timesofmalta.c om/articles/view/20130309/local/Valley-flora-being-slowly-chokedby-invasive-plant.460792 [accessed on 15 August 2016]

ARC (2011) Southern Africa Plant Invaders Atlas (SAPIA) News. http://www.arc.agric.za/home.asp?pid=1&toolid=2&sec=1001 [accessed on 28 July 2016]

BioNET-International (2016) http://keys.lucidcentral.org/keys/v3/eafrine t/weeds/key/weeds/Media/Html/Cardiospermum_grandiflorum_(Ba lloon_Vine).htm [accessed on 25 August 2016]

Branquart E, Brundu G, Buholzer S, Ehret P, Fried G, Starfinger U et al. (2016) A prioritization process for invasive alien plant species compliant with Regulation (EU) No. 1143/2014. *EPPO Bulletin* **46**, 603–617.

CABI (2017) Invasive Species Compendium. www.isc.org [accessed on 25 July 2017]

Carroll SP & Loye JE (2012) Soapberry bug (Hemiptera: Rhopalidae: Serinethinae) native and introduced host plants: biogeographic background of anthropogenic evolution. *Annals of the Entomological Society of America* **105**, 671–684.

Carroll SP, Marler M, Winchell R & Dingle H (2003) Evolution of cryptic flight morph and life history differences during host race radiation in the soapberry bug, *Jadera haematoloma* Herrich-Schaeffer (Hemiptera: Rhopalidae). *Annals of the Entomological Society of America* **96**, 135–143.

Carroll SP, Mathieson M & Loye JE (2005a) Invasion history and ecology of the environmental weed balloon vine, *Cardiospermum grandiflorum* Swartz, in Australia. *Plant Protection Quarterly* **20**, 140–144.

Coutts-Smith AJ & Downey PO (2006) Impact of weeds on threatened biodiversity in New South Wales. Technical Series no. 11. CRC for Australian Weed Management, Adelaide (AU).

Dempsey MA (2011) Anatomical and morphological responses of *Cardiospermum halicacabum* l. (balloon vine), to four levels of water availability. MSc Dissertation University of North Texas.

EPPO (2017) Pest Risk Analysis *Cardiospermum grandiflorum* EPPO, Paris. https://www.eppo.int/INVASIVE_PLANTS/ias_plants.htm [accessed on 29 September 2017]

FloraBase (2012) *Cardiospermum grandiflorum* Sw. https://florabase.d paw.wa.gov.au/browse/profile/17318 [accessed on 23 August 2016]

Gildenhuys E, Ellis AG, Carrol SP & Le Roux JJ (2015a) Combining known native range distributions and phylogeny to resolve biogeographic uncertainties of balloon vines (*Cardiospermum*, Sapindaceae). *Diversity and Distributions* **21**, 163–174.

Gildenhuys E, Ellis AG, Carrol SP & Le Roux JJ (2015b) From the Neotropics to the Namib: evidence for rapid ecological divergence following extreme long-distance dispersal. *Botanical Journal of the Linnean Society* **179**, 477–486.

Gildenhuys E, Ellis AG, Carroll S & Le Roux JJ (2013) The ecology, biogeography, history and future if two globally important weeds: *Cardiospermum halicacabum* Linn. and *C. grandiflorum* SW. *Neobiota* **19**, 45–65.

GISD (2015) Global invasive species database, species profile *Cardiospermum grandiflorum.* http://www.iucngisd.org/gisd/species. php?sc=1346 [accessed on 23 August 2016]

Henderson L (2001) Alien weeds and invasive plants, pp. 60–61. Agricultural Research Council, Cape Town (ZA).

Johnston KS, Murray DS & Williams JC (1979) Germination and emergence of balloonvine (*Cardiospermum halicacabum*). *Weed Science* **27**, 73–76.

Jolley ER, Walker RH, McGuire JA, Johnston SK, Murray DS & Williams JC (1983) Balloonvine biology and control in soybeans. Alabama agricultural experiment station, Auburn University 547, 1–36.

McKay F, Oleiro M, Fourie A & Simelane D (2010) Natural enemies of balloon vine *Cardiospermum grandiflorum* (Sapindaceae) in Argentina and their potential use as a biological control agent in South Africa. *International Journal of Tropical Insect Science* **30**, 67–76.

Nnamani PO, Kenechukwu FC & Oguamanam WN (2012) *Cardiospermum grandiflorum* leaf extract potentiates amoxocillin activity of *Staphylococcus aureus. Journal of Medicinal Plants Research* **6**, 901–905.

Ogle CC, Cock GDL, Arnold G & Mickleson N (2000) Impact of an exotic vine *Clematis vitalba* (F. Ranunculaceae) and of control measures on plant biodiversity in indigenous forest, Taihape. *New Zealand. Austral Ecology* **25**, 539–551.

Simelane DO, Fourie A & Mawela KV (2011) Prospective agents for the biological control of *Cardiospermum grandiflorum* Sw (sapindaceae) in South Africa. *African Entomology* **19**, 269– 277.

Simelane DO & Mawela KV (2013) Biological control of balloon vine *Cardiospermum grandiflorum* in South Africa: targeting the seed output with the weevil *Cissoanthonomus tuberculipennis*. In *Plant Protection News* (eds. Truter M & Dippenaar-Schoeman A), pp. 9–10. Agricultural Research Council, Pretoria (SA).

Simelane DO, Mawela KV, Mc Kay F & Oleiro M (2014) Field and laboratory studies to determine the suitability of *Cissoanthonomus tuberculipennis* (Coleoptera: Curculionidae) for release against *Cardiospermum grandiflorum* (Sapindaceae) in South Africa. *Biocontrol Science and Technology* **24**, 734–750.

Solomon Raju AJ, Venkata Ramana K, Govinda Rao N & Varalakshmi P (2011) Monoecy and entomophily in *Cardiospermum canescens* Wall. (Sapindaceae), a medicinally valuable herbaceous vine. *Current Science* **101**, 617–619.

Subramanyam R, Newmaster SG, Paliyath G & Newmaster CB (2007) Exploring ethnobiological classifications for novel alternative medicine: A case study of *Cardiospermum halicacabum* L. (Modakathon, Balloon Vine) as a traditional herb for treating rheumatoid arthritis. *Ethnobotany* **19**, 1–18.

Tanner R, Branquart E, Brundu G, Buholzer S, Chapman D, Ehret P et al. (2017) The prioritisation of a short list of alien plants for risk analysis within the framework of the Regulation (EU) No. 1143/2014. *NeoBiota* **35**, 87–118. https://doi.org/10.3897/neobiota.35.12366

Vivian-Smith G & Panetta FD (2002) Going with the flow: dispersal of invasive vines in coastal catchments. *Coast to Coast* **2002**, 491–494.

Weckerle CS & Rutishauser R (2005) Gynoecium, fruit and seed structure of Paullinieae (Sapindaceae). *Botanical Journal of the Linnean Society* **147**, 159–189.

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Datasheet history

This datasheet was first published in the EPPO Bulletin in 2017 and is now maintained in an electronic format in the EPPO Global Database. The sections on 'Identity' and 'Geographical distribution' are automatically updated from the database. For other sections, the date of last revision is indicated on the right.

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