United States Department of Agriculture

# Weed Risk Assessment for *Cardiospermum grandiflorum* Sw. (Sapindaceae) – Balloon vine

United States Department of Agriculture

Animal and Plant Health Inspection Service

October 17, 2013

Version 1


Left: *Cardiospermum grandiflorum* foliage and flowers (source: Black Diamond Images, 2009). Top right: *C. grandiflorum* fruits (source: DAFF, 2011). Bottom right: *C. grandiflorum* infestation (source: http://www.arc.agric.za).

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**Introduction** Plant Protection and Quarantine (PPQ) regulates noxious weeds under the authority of the Plant Protection Act (7 U.S.C. § 7701-7786, 2000) and the Federal Seed Act (7 U.S.C. § 1581-1610, 1939). A noxious weed is defined as "any plant or plant product that can directly or indirectly injure or cause damage to crops (including nursery stock or plant products), livestock, poultry, or other interests of agriculture, irrigation, navigation, the natural resources of the United States, the public health, or the environment" (7 U.S.C. § 7701-7786, 2000). We use weed risk assessment (WRA)—specifically, the PPQ WRA model (Koop et al., 2012)—to evaluate the risk potential of plants, including those newly detected in the United States, those proposed for import, and those emerging as weeds elsewhere in the world.

Because the PPQ WRA model is geographically and climatically neutral, it can be used to evaluate the baseline invasive/weed potential of any plant species for the entire United States or for any area within it. As part of this analysis, we use a stochastic simulation to evaluate how much the uncertainty associated with the analysis affects the model outcomes. We also use GIS overlays to evaluate those areas of the United States that may be suitable for the establishment of the plant. For more information on the PPQ WRA process, please refer to the document, *Background information on the PPQ Weed Risk Assessment*, which is available upon request.

## *Cardiospermum grandiflorum* Sw. – Balloon vine

**Species Information**

Family: Sapindaceae

Synonyms: None.

Initiation: *Cardiospermum grandiflorum* Sw. was recently found to have extensively naturalized in sensitive natural areas in Malta (Ameen, 2013). The PPQ Weeds Cross Functional Working Group requested that the PERAL Weed Team evaluate this species.

Foreign distribution: *Cardiospermum grandiflorum* is native to tropical regions of Asia, the Caribbean, and Central and South America from southern Mexico to Brazil (Acevedo-Rodriguez, 2005; Carroll et al., 2005; McKay et al., 2010). Some conflicting information exists about its nativity in Africa. While some sources describe it as being native to tropical regions of Africa (ISSG, 2007; McKay et al., 2010), others note that its status as an invader of the continent is unknown (DAFF, 2011; NGRP, 2013). All sources consider it to be exotic to South Africa, where it is present (ARC, 2011; Cowling et al., 1997; Macdonald et al., 2003). It has been introduced into Australia (Carroll et al., 2005; Coutts-Smith and Downey, 2006; Cowling et al., 1997; DAFF, 2011), the Canary Islands (DAFF, 2011; EPPO, 2012), the Cook Islands (Carroll et al., 2005; Coutts-Smith and Downey, 2006; Cowling et al., 1997; DAFF, 2011), French Polynesia (DAFF, 2011; ISSG, 2007), Italy (EPPO, 2012), Malta (Ameen, 2013), New Zealand (Carroll et al., 2005; Coutts-Smith and Downey, 2006; Cowling et al., 1997; DAFF, 2011), Portugal (EPPO, 2012), and South Africa (Henderson, 2001).

U.S. distribution and status: *Cardiospermum grandiflorum* has naturalized on Oahu, Hawaii (NGRP, 2013; UH, 2010) and Puerto Rico (Acevedo-Rodriguez, 2005). It is listed in Hortus as a U.S. ornamental species (Bailey, 1976) but we found no evidence that it is commonly available for purchase in the United States. It is not currently available from several large nursery distributors (e.g., Monrovia, Greenleaf Nursery Company, or Bailey Nurseries), nor did we find evidence for sales or trade of this

plant or its seeds.

WRA area[1]: Entire United States, including territories.

1. *Cardiospermum grandiflorum* analysis

**Establishment/Spread Potential**

*Cardiospermum grandiflorum* is a semi-woody vine (Acevedo-Rodriguez, 2005) that has been introduced to other regions as an ornamental and has become a serious weed in several countries (Ameen, 2013; Carroll et al., 2005; DAFF, 2011; Henderson, 2001). It grows quickly, overtopping the tree canopy and densely shading vegetation below it. The plant is common in riparian habitats and its seeds are readily spread by wind and water (Carroll et al., 2005; Cowling et al., 1997; McKay et al., 2010). It coppices aggressively after removal of aboveground biomass (McKay et al., 2010). One source states that *C. grandiflorum* can be spread via contaminated garden waste (DAFF, 2011). Although we found little confirmation of trade of this plant as an ornamental in the United States, abundant evidence exists that it is an ornamental with desirable characteristics; it is therefore likely that it could be passed around non-commercially. We had an average amount of uncertainty for this risk element.

Risk score = 17 Uncertainty index = 0.17

**Impact Potential**

*Cardiospermum grandiflorum* forms dense infestations that smother large swaths of underlying vegetation in its introduced habitats (Ameen, 2013; McKay et al., 2010). In Australia, it is "particularly abundant in riparian corridors, where it may cover other vegetation in uninterrupted stands kilometres in length," and herbarium records from Australia note "vines rampant, smothering trees and climbing over the canopy 16 to 20 m" (Carroll et al., 2005). It negatively affects ecosystem processes and plant communities (Ameen, 2013; Coutts-Smith and Downey, 2006), is a "transformer" in South Africa (Henderson, 2001), and is a dominant plant invader on Rarotonga (Sherley, 2000). *Cardiospermum grandiflorum* is on the EPPO Alert List (EPPO, 2012), is a National Accord Pest Plant in New Zealand (BOPEC, 2004), is listed as a Class 3 noxious pest in Queensland and a Class 4 pest in New South Wales (DAFF, 2011), and is a Category 1 prohibited plant in South Africa (ARC, 2011). Mechanical and chemical control require repeated treatments, which are labor intensive and costly (McKay et al., 2010). We had slightly above average uncertainty for this risk element, as we lacked detailed information about the impacts of this species in its invaded range.

Risk score = 2.5 Uncertainty index = 0.20

**Geographic Potential**

Based on three climatic variables, we estimate that about 11 percent of the United States is suitable for the establishment of *Cardiospermum grandiflorum* (Fig. 1). This predicted distribution is based on the species' known distribution elsewhere in the world and includes point-referenced localities and areas of occurrence. The map for *Cardiospermum grandiflorum* represents the joint distribution of Plant Hardiness Zones 9-13, areas with 10-100+ inches of annual precipitation, and the following Köppen-Geiger climate classes: tropical rainforest, tropical savanna, steppe, Mediterranean, humid subtropical, and marine west coast.

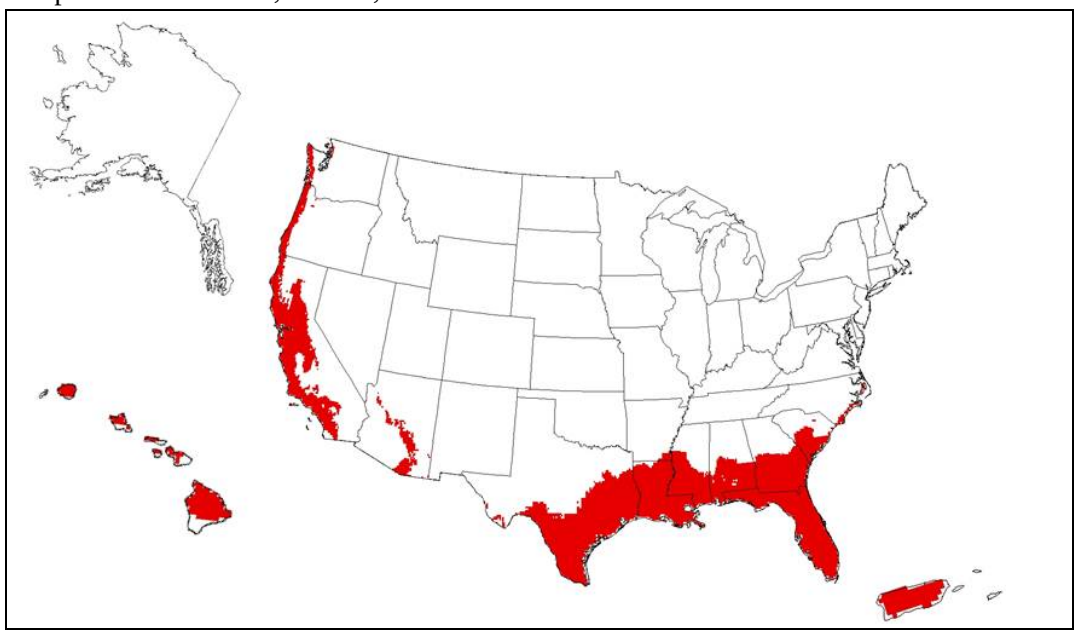
The area estimated likely represents a conservative estimate as it only uses three climatic

[1] "WRA area" is the area in relation to which the weed risk assessment is conducted [definition modified from that for "PRA area" (IPPC, 2012).

variables. Other environmental variables, such as soil and habitat type, may further limit the areas in which this species is likely to establish. This species is greatly noted as problematic near waterways, but also occurs on roadsides, waste sites, open forests, disturbed forests, and suburban zones. It occurs in rainforests in New South Wales, in Caribbean lowlands of South America, low to mid-elevation areas of the Andes, and in Costa Rica on forest edges and roadsides of more than 1000 meters in elevation. Of nearly 200 herbarium specimens, the elevation range was between 10 and 1800 meters (Carroll et al., 2005). In South Africa, *C. grandiflorum* occurs in coastal KwaZulu-Natal and the eastern Transvaal Lowveld (Cowling et al., 1997). Although this species has been recorded from a mixed zone 8-9 region of Australia, it is unlikely that *C. grandiflorum* would thrive in the colder temperatures. *Cardiospermum grandiflorum* has infrequently been observed in steppe climates and areas with 0 to 20 inches of precipitation per year; however, due to its association with riparian zones, it seems likely that it would occur only in wet microhabitats of these dry regions.

**Entry Potential** We did not assess the entry potential of *Cardiospermum grandiflorum* because this species is already present in the United States in Hawaii (Acevedo-Rodriguez, 2005; NGRP, 2013; UH, 2010).

**Figure 1**. Predicted distribution of *Cardiospermum grandiflorum* in the United States. Map insets for Alaska, Hawaii, and Puerto Rico are not to scale.



2. Results and Conclusion

Model Probabilities: P(Major Invader) = 79.8%
P(Minor Invader) = 19.4%
P(Non-Invader) = 0.8%

Risk Result = High Risk
Secondary Screening = Not Applicable

**Figure 2**. *Cardiospermum grandiflorum* risk score (black box) relative to the risk scores of species used to develop and validate the PPQ WRA model (other symbols). See Appendix A for the complete assessment.

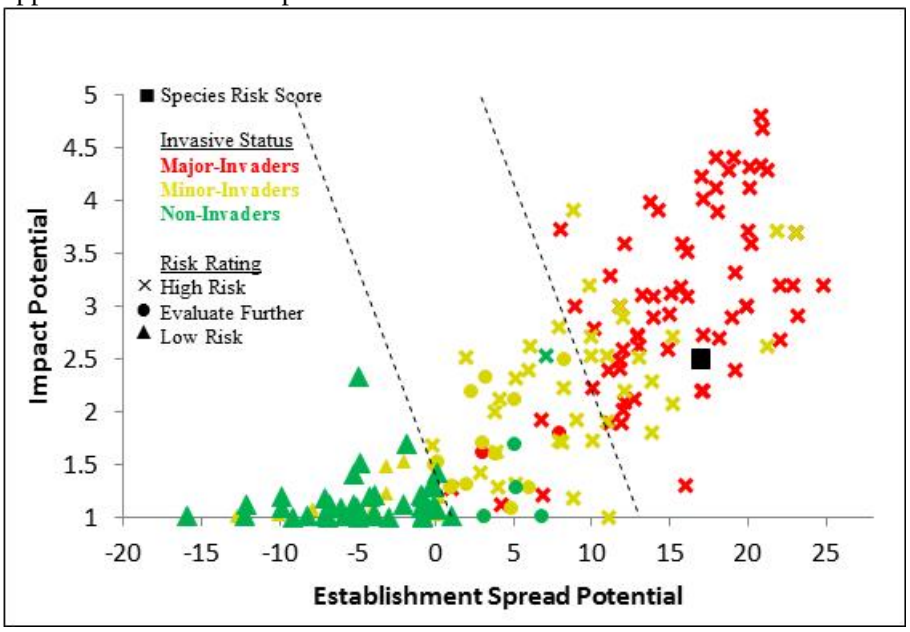
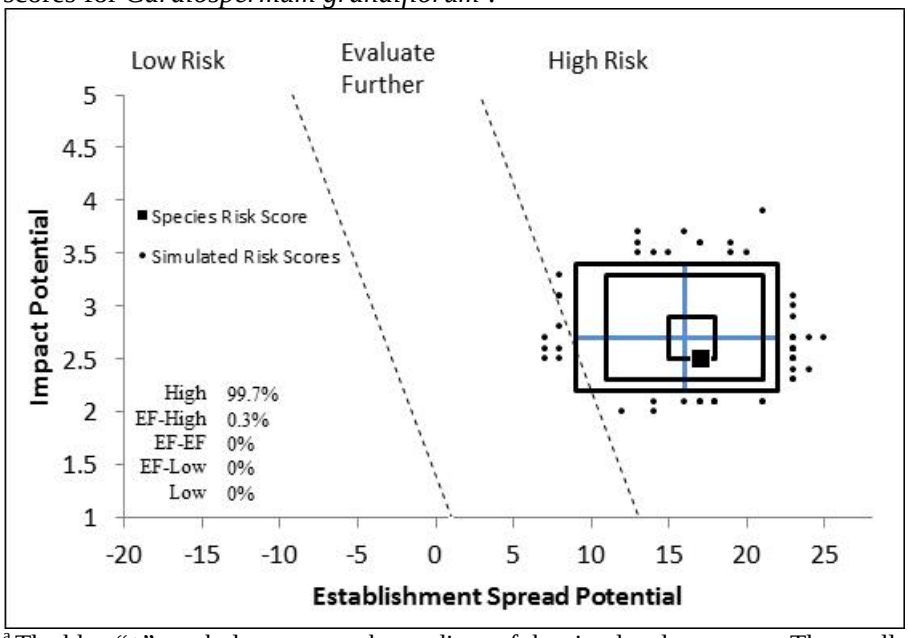



**Figure 3**. Monte Carlo simulation results (N=5,000) for uncertainty around the risk scores for *Cardiospermum grandiflorum*[a].




[a] The blue "+" symbol represents the medians of the simulated outcomes. The smallest box contains 50 percent of the outcomes, the second 95 percent, and the largest 99 percent.

## 3. Discussion

The result of the weed risk assessment for *Cardiospermum grandiflorum* is High Risk (Fig. 2).We had average uncertainty for establishment and above average uncertainty for impact potential; however, we feel confident in our conclusion based on this species' behavior in its introduced range and the results of our uncertainty simulation (Fig. 3). This species is an aggressive invader and a regulated weed in several countries (ARC, 2011; BOPEC, 2004; DAFF, 2011; Carroll et al., 2005; Henderson, 2001; McKay et al., 2010). A 2008 analysis of this species with the Hawaiian version of the Australian weed risk assessment also generated a result of high risk (UH, 2010). Although *C. grandiflorum* is a popular ornamental as well as a well-documented invasive plant elsewhere in the world, we found surprisingly little biological information about it. Its preference for sensitive riparian areas and need for multiple control treatments may enable it to become invasive and make treatment expensive and ecologically damaging.

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**Appendix A**. Weed risk assessment for *Cardiospermum grandiflorum* Sw. (Sapindaceae). The following information came from the original risk assessment, which is available upon request (full responses and all guidance). We modified the information to fit on the page.

| Question ID | Answer - Uncertainty | Score | Notes (and references) |
|---|---|---|---|
| **ESTABLISHMENT/SPREAD POTENTIAL** | | | |
| ES-1 (Status/invasiveness outside its native range) | F - negl | 5 | *Cardiospermum grandiflorum* is native to Mexico, Central and South America, and Jamaica (Carroll et al., 2005; NGRP, 2013), and tropical Asia (McKay et al., 2010). There is some debate as to whether it is or is not native to Africa (ISSG, 2007; McKay et al., 2010; NGRP, 2013), although it is agreed that it is exotic to South Africa, where it is found in forest margins, water courses, and urban open spaces in subtropical regions (Henderson, 2001). It is considered naturalized or invasive in many other parts of Africa (Macdonald et al., 2003). It invades forest gaps and edges in Malawi, Mozambique, Swaziland, and Zimbabwe (Macdonald et al., 2003). It was introduced into Australia in the 1920s from unknown sources (Carroll et al., 2005), but likely as a garden escape (Coutts-Smith and Downey, 2006), and is widely naturalized there (Carroll et al., 2005). It is found in subtropical rainforests of Queensland and New South Wales (Grice and Setter, 2003). Naturalized in Canary Islands (DAFF, 2011). Widespread on Rarotonga (Space and Flynn, 2002). Recently naturalized and spreading in Malta (Ameen, 2013). Naturalized in Micronesia (DAFF, 2011). Cultivated and locally naturalized, though not common, in Puerto Rico (Acevedo-Rodriguez, 2005). Naturalized in Hawaii (Wagner et al., 1990). Naturalized on Tahiti Island (NGRP, 2013). Casually naturalized in Belgium, introduced in 1959 as a contaminant of wool (Verloove, 2006). Casual in Landes and Alpes-Maritimes departments in France (EPPO, 2012). Alternate answers for the Monte Carlo simulation were both "e." |
| ES-2 (Is the species highly domesticated) | n - low | 0 | We found no evidence of selection for reduced weed potential. *Cardiospermum grandiflorum* is an ornamental grown chiefly for its interesting seed pods (DAFF, 2012). |
| ES-3 (Weedy congeners) | y - negl | 1 | *Cardiospermum halicacabum* is a principal weed in Australia (Holm et al., 1979), where it is a noxious weed and invasive species (rank of 4 and 5) (Randall, 2007). It is also a pest in the United States (Rankins et al., 2005). *Cardiospermum halicacabum* is a pest of soybean seed crops, as the seed is similar size and shape (Johnston et al., 1979; Koepke-Hill et al., 2008). |
| ES-4 (Shade tolerant at some stage of its life cycle) | n - low | 0 | We found no evidence of continual deep shade tolerance; species prefers disturbed habitats , such as riparian corridors, forest edges, and urban areas (ARC, 2011; Cowling et al., 1997; EPPO, 2012; Sherley, 2000), which tend to be high light environments. |
| ES-5 (Climbing or smothering growth form) | y - negl | 1 | *Cardiospermum grandiflorum* is a canopy-dwelling vine (Acevedo-Rodriguez, 2005; ARC, 2011). Australian herbarium records note "smothering trees and climbing over canopy of 16-20m" (Carroll et al., 2005). |
| ES-6 (Forms dense thickets) | n - low | 0 | *Cardiospermum grandiflorum* is a canopy-dwelling vine (Acevedo-Rodriguez, 2005; ARC, 2011). |
| ES-7 (Aquatic) | n - negl | 0 | *Cardiospermum grandiflorum* is a terrestrial vine (Acevedo-Rodriguez, 2005). |

| Question ID | Answer - Uncertainty | Score | Notes (and references) |
|---|---|---|---|
| ES-8 (Grass) | n - negl | 0 | *Cardiospermum grandiflorum* is a semi-woody vine in the Sapindaceae (Acevedo-Rodriguez, 2005). |
| ES-9 (Nitrogen-fixing woody plant) | n - negl | 0 | The plant is a member of Sapindaceae, a family in which no species are known to fix nitrogen (Martin and Dowd, 1990). |
| ES-10 (Does it produce viable seeds or spores) | y – negl | 1 | Substantial evidence exists of propagation by seeding in invaded habitats, particularly in riparian zones (Carroll et al., 2005; DAFF, 2012; Sherley, 2000). |
| ES-11 (Self-compatible or apomictic) | ? - max | 0 | Unknown. Flowers are functionally unisexual (Acevedo-Rodriguez, 2005). The congener *C. halicacabum* is experimentally self-compatible, producing a high percentage of viable seeds (UH, 2010). Another congener, *C. canescens*, exhibits geitonogamy (pollination between flowers of the same plant) and xenogamy (pollination between flowers of different plants) (Solomon Raju et al., 2011). |
| ES-12 (Requires special pollinators) | n - mod | | We found no evidence for this species. Congeners *C. halicacabum* and *C. canescens* attract generalist pollinators (UH, 2010; Solomon Raju et al., 2011). |
| ES-13 (Minimum generation time) | ? - max | 0 | Unknown. |
| ES-14 (Prolific reproduction) | n - mod | -1 | Each 3 to 5.5 cm-long fruit produces three 4 to 5.5mm seeds (Acevedo-Rodriguez, 2005; DAFF, 2012). We found no information about how many flowers or fruit are produced per plant or per unit area. From online images, even large masses of the vine do not appear to bear great numbers of flowers. |
| ES-15 (Propagules likely to be dispersed unintentionally by people) | y - low | 1 | Contaminant of yard waste (DAFF, 2011; ISSG, 2007). |
| ES-16 (Propagules likely to disperse in trade as contaminants or hitchhikers) | y – high | 2 | The black seeds are similar in size and shape to soybean and are weeds of soy crops, but we found no evidence that they are a trade contaminant (EPPO, 2012). However, in Belgium, *C. grandiflorum* was reported to have been introduced as a contaminant of wool (Verloove, 2006). Because the introduction to Belgium seems unusual and is based on a single report, we used high uncertainty. |
| ES-17 (Number of natural dispersal vectors) | 3 | 2 | Fruit and seed traits for ES-17a through ES-17e: Seed pod is lightweight, splits into three segments, each of which contains one seed attached to a papery scale to assist wind dispersal (Acevedo-Rodriguez, 2005; Cowling et al., 1997; DAFF, 2012). |
| ES-17a (Wind dispersal) | y - negl | | Seeds are dispersed by wind (Cowling et al., 1997). |
| ES-17b (Water dispersal) | y - negl | | Plant is profuse along waterways and the fruits float (Cowling et al., 1997; EPPO, 2012). |
| ES-17c (Bird dispersal) | n - low | | We found no evidence for bird dispersal. Seeds are enclosed in papery "balloon" and separate with a papery scale when they mature, are not fleshy (Acevedo-Rodriguez, 2005; Cowling et al., 1997). |

| Question ID | Answer - Uncertainty | Score | Notes (and references) |
|---|---|---|---|
| ES-17d (Animal external dispersal) | y - high | | In Belgium, *C. grandiflorum* was reported to have been introduced in 1959 as a contaminant of wool of unknown origin (Verloove, 2006) but we found no supporting evidence for this. Seeds are smooth at maturity (Cowling et al., 1997; DAFF, 2012) and are unlikely to adhere to animal fibers, fur, or feathers. The plant is a pasture weed in New Zealand and it is possible that wool may contain some seeds (EPPO, 2012). Because the introduction to Belgium appears to be unusual, we used high uncertainty. |
| ES-17e (Animal internal dispersal) | n – low | | We found no evidence for internal animal dispersal. Non-fleshy seeds are enclosed in papery "balloon" and separate with a papery scale when they mature (Acevedo-Rodriguez, 2005; Cowling et al., 1997), and do not appear likely to offer rewards to frugivorous animals. |
| ES-18 (Evidence that a persistent (>1yr) propagule bank (seed bank) is formed) | y - mod | 1 | Seed longevity is approximately two years (EPPO, 2012). |
| ES-19 (Tolerates/benefits from mutilation, cultivation or fire) | y - low | 1 | Species coppices aggressively and can regrow from root fragments (McKay et al., 2010). |
| ES-20 (Is resistant to some herbicides or has the potential to become resistant) | –? - max | 1 | We found no evidence for this species. It is not listed by Heap (2013) as herbicide resistant. However, because populations of the soybean weed congener *C. halicacabum* are resistant to imazaquin in Brazil (Souza et al., 2004), we answered unknown as we don't know if these species can hybridize. |
| ES-21 (Number of cold hardiness zones suitable for its survival) | 5 | 0 | |
| ES-22 (Number of climate types suitable for its survival) | 6 | 2 | |
| ES-23 (Number of precipitation bands suitable for its survival) | 10 | 1 | |
| **Impact Potential** | | | |
| **General Impacts** | | | |
| Imp-G1 (Allelopathic) | n - mod | 0 | We found no evidence. |
| Imp-G2 (Parasitic) | n - negl | 0 | We found no evidence. The Sapindaceae is not a plant family known to contain parasitic plants (Heide-Jorgensen, 2008; Nickrent, 2009). |
| **Impacts to Natural Systems** | | | |
| Imp-N1 (Change ecosystem processes and parameters that affect other species) | ? - max | | We found no evidence that *C. grandiflorum* affects ecosystem processes. It is considered a "transformer" in South Africa (Henderson, 2001) and in Australia (Carroll et al., 2005), but that may be due to its canopy-smothering habit. |

| Question ID | Answer - Uncertainty | Score | Notes (and references) |
|---|---|---|---|
| Imp-N2 (Change community structure) | y - negl | 0.2 | *Cardiospermum grandiflorum* is a vine with the well-known ability to smother the existing canopy layer (Carroll et al., 2005; McKay et al., 2010). Herbarium collections note the vines climb over a canopy of 16-20 meters (Carroll et al., 2005). |
| Imp-N3 (Change community composition) | y - low | 0.2 | In Malta, it has reduced the biodiversity of a Natura 2000 site (Ameen, 2013). It displaces indigenous plants in South Africa (Macdonald et al., 2003). |
| Imp-N4 (Is it likely to affect federal Threatened and Endangered species) | y - mod | 0.1 | In Australia, *Cardiospermum grandiflorum* was listed as likely to harm the endangered fig parrot (*Cyclopsitta diophghalma coxeni*) (Coutts-Smith and Downey, 2006). *Cardiospermum grandiflorum* is native to the Neotropics and thrives in riparian zones (Carroll et al., 2005), and is predicted by our geographic potential analysis to be successful in Florida. Given its observed habit of covering large areas of canopy (McKay et al., 2010), some protected understory species are likely to be impacted by its introduction. |
| Imp-N5 (Is it likely to affect any globally outstanding ecoregions) | y - mod | 0.1 | *Cardiospermum grandiflorum* already occurs in Hawaii (Wagner et al., 1990) and this species could become problematic in Florida (see above). Both are considered globally outstanding ecoregions (Ricketts et al., 1999). Additionally, it is common in riparian zones and is found in littoral rainforest ecosystems, and coastal river flat eucalypt forests in New South Wales, Australia (Coutts-Smith and Downey, 2006). |
| Imp-N6 (Weed status in natural systems) | c - negl | 0.6 | This plant is a regulated weed of Australia and South Africa (Carroll et al., 2005; DAFF, 2012), and we found evidence of control programs for *C. grandiflorum* in natural systems (ISSG, 2007; McKay et al., 2010). The alternate answers for the Monte Carlo simulation were both "b." |
| **Impact to Anthropogenic Systems (cities, suburbs, roadways)** | | | |
| Imp-A1 (Impacts human property, processes, civilization, or safety) | n - mod | 0 | Although *C. grandiflorum* occurs in waste areas and along roadways (DAFF, 2011; EPPO, 2012), we found no evidence that it significantly impacts those areas. |
| Imp-A2 (Changes or limits recreational use of an area) | ? - max | | We found no direct evidence. Because aggressive vines can impede access and because this species invades riparian zones, we answered unknown. |
| Imp-A3 (Outcompetes, replaces, or otherwise affects desirable plants and vegetation) | n - mod | 0 | We found no evidence. |
| Imp-A4 (Weed status in anthropogenic systems) | b - mod | 0.1 | *Cardiospermum grandiflorum* is found along road and rail networks (DAFF, 2012; EPPO, 2012), but we found no direct evidence of control. The alternate answers for the Monte Carlo simulation were "c" and "a." |
| **Impact to Production Systems (agriculture, nurseries, forest plantations, orchards, etc.)** | | | |
| Imp-P1 (Reduces crop/product yield) | n - low | 0 | We found no evidence that *C. grandiflorum* reduces crop yields or quality. Because this species is primarily a weed of natural areas and is relatively well known, we used low uncertainty for most answers in this section. |
| Imp-P2 (Lowers commodity value) | n - low | 0 | We found no evidence. |

| Question ID | Answer - Uncertainty | Score | Notes (and references) |
|---|---|---|---|
| Imp-P3 (Is it likely to impact trade) | y - high | | *Cardiospermum grandiflorum* is regulated in Australia (DAFF, 2011), New Zealand (BOPEC, 2004), and South Africa (ARC, 2011). It has been reported as a contaminant of wool (Verloove, 2006), but we found no other reports of *C. grandiflorum* impacting the trade of any goods. Because wool contamination may be an unusual event (see ES-16), we used high uncertainty. |
| Imp-P4 (Reduces the quality or availability of irrigation, or strongly competes with plants for water) | n - low | 0 | We found no evidence. |
| Imp-P5 (Toxic to animals, including livestock/range animals and poultry) | n - low | 0 | We found no evidence. |
| Imp-P6 (Weed status in production systems) | a - mod | 0 | *Cardiospermum grandiflorum* is a weed of natural areas, and evidence suggests that it occurs mostly in riparian zones and is not likely to significantly affect timber forestry (Carroll et al., 2005; Henderson, 2001). It spread from creek banks into forests, particularly when aided by some disturbance (Carroll et al., 2005), but we found no evidence that it affects silvicultural systems. One source states it is a weed of soybeans (EPPO, 2012) but we found no supporting information for this. Consequently, we answered "a," with moderate uncertainty. The alternate answers for the Monte Carlo simulation were "b" and "c." |
| **Geographic Potential** | | | Unless otherwise indicated, the following evidence represents geographically referenced points obtained from the Global Biodiversity Information Facility (GBIF, 2013). |
| **Plant cold hardiness zones** | | | |
| Geo-Z1 (Zone 1) | n - negl | N/A | We found no evidence it occurs in this zone. |
| Geo-Z2 (Zone 2) | n - negl | N/A | We found no evidence it occurs in this zone. |
| Geo-Z3 (Zone 3) | n - negl | N/A | We found no evidence it occurs in this zone. |
| Geo-Z4 (Zone 4) | n - negl | N/A | We found no evidence it occurs in this zone. |
| Geo-Z5 (Zone 5) | n - negl | N/A | We found no evidence it occurs in this zone. |
| Geo-Z6 (Zone 6) | n - negl | N/A | We found no evidence it occurs in this zone. |
| Geo-Z7 (Zone 7) | n - negl | N/A | We found no evidence it occurs in this zone. |
| Geo-Z8 (Zone 8) | n - high | N/A | Some points in this zone in Australia, but in a region where Zone 8 and 9 are very intermixed. Because this is a tropical species, we think it is unlikely to survive in these colder climates. |
| Geo-Z9 (Zone 9) | y - negl | N/A | Southern Mexico; Australia: southeast Queensland including Lamington National Park and Springbrook National Park, Sydney, Adelaide, rainforest in northeastern New South Wales (Carroll et al., 2005); and Bay of Plenty, New Zealand (BOPEC, 2004; EPPO, 2012). |
| Geo-Z10 (Zone 10) | y - negl | N/A | Sicily; Italy (EPPO, 2012); southern Mexico; Australia: Queensland, Perth (Carroll et al., 2005); Malta (Ameen 2013; EPPO, 2012); Port St. Johns, South Africa (ARC, 2011); and southwestern Brazil (Carroll et al., 2005). |
| Geo-Z11 (Zone 11) | y - negl | N/A | Guatemala, Belize, and Mexico. |

| Question ID | Answer - Uncertainty | Score | Notes (and references) |
|---|---|---|---|
| Geo-Z12 (Zone 12) | y - negl | N/A | Costa Rica, Nicaragua, and Mexico. Puerto Rico, St. Croix, and St. Thomas in the Virgin Islands (Acevedo-Rodriguez, 2005), Jamaica (Carroll et al., 2005), Zaire, Nigeria, Ivory Coast, and Liberia (NGRP, 2013). |
| Geo-Z13 (Zone 13) | y - negl | N/A | Costa Rica, Panama, and Colombia. |
| **Köppen-Geiger climate classes** | | | |
| Geo-C1 (Tropical rainforest) | y - negl | N/A | Guatemala, Costa Rica, Panama, and Peru. |
| Geo-C2 (Tropical savanna) | y - negl | N/A | Mexico, Costa Rica, and Honduras. |
| Geo-C3 (Steppe) | y - mod | N/A | We found a few points in Namibia and South Africa, and a point in Nigeria. This seems a bit too dry for this tropical species, but it may occur in wetter microhabitats such as along rivers and streams. |
| Geo-C4 (Desert) | n - low | N/A | We found no evidence it occurs in this climate, but there are a few points near this climate in Africa. |
| Geo-C5 (Mediterranean) | y - mod | N/A | A few points in Australia, Colombia, and South Africa. Malta (Ameen, 2013). We used moderate uncertainty because there were only a few points. |
| Geo-C6 (Humid subtropical) | y - negl | N/A | Australia, Argentina, Brazil, and one point in Mexico. |
| Geo-C7 (Marine west coast) | y - negl | N/A | Colombia, Ecuador, and a few points in Australia. |
| Geo-C8 (Humid cont. warm sum.) | n - negl | N/A | We found no evidence it occurs in this climate. |
| Geo-C9 (Humid cont. cool sum.) | n - negl | N/A | We found no evidence it occurs in this climate. |
| Geo-C10 (Subarctic) | n - negl | N/A | We found no evidence it occurs in this climate. |
| Geo-C11 (Tundra) | n - negl | N/A | We found no evidence it occurs in this climate. |
| Geo-C12 (Icecap) | n - negl | N/A | We found no evidence it occurs in this climate. |
| **10-inch precipitation bands** | | | |
| Geo-R1 (0-10 inches; 0-25 cm) | n - high | N/A | A few points in Colombia, South Africa, and Namibia. It seems unlikely for this species to occur in such a dry climate, given that it is well represented in very wet environments worldwide. The points contained in GBIF may be misidentifications or plants growing in highly protected environments. We answered no but with high uncertainty. |
| Geo-R2 (10-20 inches; 25-51 cm) | y - mod | N/A | One point in Australia and Bolivia. A few points in South Africa and Namibia. This seems too dry for this tropical species, but it may occur in wetter microhabitats, such as along rivers and streams. |
| Geo-R3 (20-30 inches; 51-76 cm) | y - negl | N/A | Australia and Bolivia. |
| Geo-R4 (30-40 inches; 76-102 cm) | y - negl | N/A | Australia, Bolivia, and South Africa. |
| Geo-R5 (40-50 inches; 102-127 cm) | y - negl | N/A | Australia, Paraguay, and South Africa. |
| Geo-R6 (50-60 inches; 127-152 cm) | y - negl | N/A | Guinea, Ivory Coast, Liberia, and Paraguay. A few points in Australia. |

| Question ID | Answer - Uncertainty | Score | Notes (and references) |
|---|---|---|---|
| Geo-R7 (60-70 inches; 152-178 cm) | y - negl | N/A | Argentina, Guinea, Ivory Coast, and Liberia. |
| Geo-R8 (70-80 inches; 178-203 cm) | y - negl | N/A | Guinea, Ivory Coast, and Liberia. |
| Geo-R9 (80-90 inches; 203-229 cm) | y - negl | N/A | Brazil. |
| Geo-R10 (90-100 inches; 229-254 cm) | y - negl | N/A | Brazil and Costa Rica. |
| Geo-R11 (100+ inches; 254+ cm) | y - negl | N/A | Costa Rica and Panama. |
| **Entry Potential** | | | |
| Ent-1 (Plant already here) | y - negl | 1 | *Cardiospermum grandiflorum* has naturalized on Oahu, Hawaii (ISSG, 2007). |
| Ent-2 (Plant proposed for entry, or entry is imminent ) | - | N/A | |
| Ent-3 (Human value & cultivation/trade status) | - | N/A | |
| Ent-4 (Entry as a contaminant) | | | |
| Ent-4a (Plant present in Canada, Mexico, Central America, the Caribbean or China ) | - | N/A | |
| Ent-4b (Contaminant of plant propagative material (except seeds) | - | N/A | |
| Ent-4c (Contaminant of seeds for planting) | - | N/A | |
| Ent-4d (Contaminant of ballast water) | - | N/A | |
| Ent-4e (Contaminant of aquarium plants or other aquarium products) | - | N/A | |
| Ent-4f (Contaminant of landscape products) | - | N/A | |
| Ent-4g (Contaminant of containers, packing materials, trade goods, equipment or conveyances) | - | N/A | |
| Ent-4h (Contaminants of fruit, vegetables, or other products for consumption or processing) | - | N/A | |

| Question ID | Answer - Uncertainty | Score | Notes (and references) |
|---|---|---|---|
| Ent-4i (Contaminant of some other pathway) | - | N/A | |
| Ent-5 (Likely to enter through natural dispersal) | - | N/A | |