Taxon: Costus spiralis (Jacq.) Roscoe **Family:** Costaceae

Common Name(s): spiral costus
spiral ginger

Synonym(s): Alpinia spiralis Jacq.
Amomum spirale (Jacq.) Steud.
C. s. var. jacquinii Griseb.
C. s. var. pisonis Griseb.
C. s. var. roscoei Griseb.
Costus pisonis Lindl.
Gissanthe spiralis (Jacq.) Salisb.

Assessor: Chuck Chimera **Status:** Assessor Approved **End Date:** 2 Aug 2016

WRA Score: 0.0 **Designation:** L **Rating:** Low Risk

Keywords: Perennial Herb, Ornamental, Rhizomatous, Self-compatible, Hummingbird-Pollinated

Qsn #	Question	Answer Option	Answer
101	Is the species highly domesticated?	y=-3, n=0	n
102	Has the species become naturalized where grown?		
103	Does the species have weedy races?		
201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
202	Quality of climate match data	(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
203	Broad climate suitability (environmental versatility)		
204	Native or naturalized in regions with tropical or subtropical climates	y=1, n=0	y
205	Does the species have a history of repeated introductions outside its natural range?	y=-2, ?=-1, n=0	y
301	Naturalized beyond native range	y = 1*multiplier (see Appendix 2), n= question 205	n
302	Garden/amenity/disturbance weed	n=0, y = 1*multiplier (see Appendix 2)	n
303	Agricultural/forestry/horticultural weed	n=0, y = 2*multiplier (see Appendix 2)	n
304	Environmental weed	n=0, y = 2*multiplier (see Appendix 2)	n
305	Congeneric weed		
401	Produces spines, thorns or burrs	y=1, n=0	n
402	Allelopathic		
403	Parasitic	y=1, n=0	n
404	Unpalatable to grazing animals	y=1, n=-1	n
405	Toxic to animals	y=1, n=0	n

Qsn #	Question	Answer Option	Answer
406	Host for recognized pests and pathogens		
407	Causes allergies or is otherwise toxic to humans	y=1, n=0	n
408	Creates a fire hazard in natural ecosystems	y=1, n=0	n
409	Is a shade tolerant plant at some stage of its life cycle	y=1, n=0	y
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y=1, n=0	n
411	Climbing or smothering growth habit	y=1, n=0	n
412	Forms dense thickets		
501	Aquatic	y=5, n=0	n
502	Grass	y=1, n=0	n
503	Nitrogen fixing woody plant	y=1, n=0	n
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y=1, n=0	n
601	Evidence of substantial reproductive failure in native habitat	y=1, n=0	n
602	Produces viable seed	y=1, n=-1	y
603	Hybridizes naturally		
604	Self-compatible or apomictic	y=1, n=-1	y
605	Requires specialist pollinators	y=-1, n=0	y
606	Reproduction by vegetative fragmentation	y=1, n=-1	y
607	Minimum generative time (years)		
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y=1, n=-1	n
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant	y=1, n=-1	n
704	Propagules adapted to wind dispersal	y=1, n=-1	n
705	Propagules water dispersed		
706	Propagules bird dispersed	y=1, n=-1	y
707	Propagules dispersed by other animals (externally)		
708	Propagules survive passage through the gut	y=1, n=-1	y
801	Prolific seed production (>1000/m2)	y=1, n=-1	n
802	Evidence that a persistent propagule bank is formed (>1 yr)		
803	Well controlled by herbicides		
804	Tolerates, or benefits from, mutilation, cultivation, or fire		
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)		

Supporting Data:

Qsn #	Question	Answer
101	**Is the species highly domesticated?**	**n**
	Source(s)	**Notes**
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	[No evidence of domestication] "Tropical South America, except in the West"

102	**Has the species become naturalized where grown?**	
	Source(s)	**Notes**
	WRA Specialist. 2016. Personal Communication	NA

103	**Does the species have weedy races?**	
	Source(s)	**Notes**
	WRA Specialist. 2016. Personal Communication	NA

201	**Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"**	**High**
	Source(s)	**Notes**
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	"DISTRIBUTION ... Tropical South America, except in the West; in moist rain forests, savanna forests, or on granitic outcroppings, from sea-level to 350 (-i800) m."

202	**Quality of climate match data**	**High**
	Source(s)	**Notes**
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	

203	**Broad climate suitability (environmental versatility)**	
	Source(s)	**Notes**
	Dave's Garden. 2016. Spiral Ginger - Costus spiralis. http://davesgarden.com/guides/pf/go/92285/. [Accessed 2 Aug 2016]	"Hardiness: USDA Zone 9a: to -6.6 °C (20 °F) USDA Zone 9b: to -3.8 °C (25 °F) USDA Zone 10a: to -1.1 °C (30 °F) USDA Zone 10b: to 1.7 °C (35 °F) USDA Zone 11: above 4.5 °C (40 °F)"
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	[Elevation range exceeds 1000 m] "DISTRIBUTION ... Tropical South America, except in the West; in moist rain forests, savanna forests, or on granitic outcroppings, from sea-level to 350 (-i800) m."

Qsn #	Question	Answer
204	**Native or naturalized in regions with tropical or subtropical climates**	**y**
	Source(s)	**Notes**
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	"DISTRIBUTION ... Tropical South America, except in the West; in moist rain forests, savanna forests, or on granitic outcroppings, from sea-level to 350 (-i800) m."

205	**Does the species have a history of repeated introductions outside its natural range?**	**y**
	Source(s)	**Notes**
	McCormack, G. 2007. Cook Islands Biodiversity Database, Version 2007.2. Cook Islands Natural Heritage Trust, Rarotonga. http://cookislands.bishopmuseum.org. [Accessed 2 Aug 2016]	"COOK ISLANDS STATUS: Introduced - Recent, Not naturalised; Land, lowlands"
	Dave's Garden. 2016. Spiral Ginger - Costus spiralis. http://davesgarden.com/guides/pf/go/92285/. [Accessed 2 Aug 2016]	"This plant has been said to grow in the following regions: Big Pine Key, Florida Lutz, Florida Miami, Florida Stuart, Florida Winter Haven, Florida Yulee, Florida Vieques, Puerto Rico Santa Fe, Texas"

301	**Naturalized beyond native range**	**n**
	Source(s)	**Notes**
	McCormack, G. 2007. Cook Islands Biodiversity Database, Version 2007.2. Cook Islands Natural Heritage Trust, Rarotonga. http://cookislands.bishopmuseum.org. [Accessed 2 Aug 2016]	"COOK ISLANDS STATUS: Introduced - Recent, Not naturalised; Land, lowlands"
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	No evidence
	Wagner, W.L., Herbst, D.R.& Lorence, D.H. 2016. Flora of the Hawaiian Islands. Smithsonian Institution, Washington, D.C. http://botany.si.edu/. [Accessed 2 Aug 2016]	No evidence to date

302	**Garden/amenity/disturbance weed**	**n**
	Source(s)	**Notes**
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	No evidence

303	**Agricultural/forestry/horticultural weed**	**n**

Qsn #	Question	Answer
	Source(s)	**Notes**
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	No evidence

304	Environmental weed	n
	Source(s)	**Notes**
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	No evidence

305	Congeneric weed	
	Source(s)	**Notes**
	Andrew, G. A. & John, L. 2010. National Invasive Species Strategy for Saint Lucia. http://www.ciasnet.org/. [Accessed 2 Aug 2016]	"Costus spicatus ... Present; potential threat in lower montane rainforest"
	CABI. 2014. Cheilocostus speciosus in: Invasive Species Compendium. www.cabi.org/isc	[Costus speciosus is a synonym of Cheilocostus speciosus] "Other Scientific Names: Costus speciosus (J.König) Sm." ... "C. speciosus is a perennial herb native to Malaysia. It is widely naturalized in the Pacific region, although it can be very invasive there. It is often found in disturbed areas, on roadsides and in the forest understory. In Pohnpei it is common in watersheds where the land has been disturbed by sakau growing (Englberger, 2009). Its seeds can be spread by birds and rodents, in soil and on machinery. C. speciosus can also spread via its stems and rhizomes (Englberger, 2009)."
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	Costus cylindricus, Costus dubius, Costus guanaiensis, Costus pulverulentus, Costus sarmentosus, Costus scaber, Costus sericeus, Costus speciosus, Costus spicatus, & Costus woodsonii included in the GCW as naturalized and/or weeds. Impacts are unspecified

401	Produces spines, thorns or burrs	n
	Source(s)	**Notes**
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	[No evidence] "Leafy stems I-3.5 m tall. Rhizomes densely brownish strigose. Sheaths 5-20 mm in diam, glabrescent. Ligule truncate, 2-10 mm long, glabrous or villose towards the margins. Petiole 2-I7 mm long, glabrous to villose. Leaves narrowly elliptic, shortly acuminate at the apex, cuneate to rounded at the base, 8-43 cm long, 5-i4 cm wide, glabrous to densely villose on both sides."

402	Allelopathic	
	Source(s)	**Notes**
	WRA Specialist. 2016. Personal Communication	Unknown

403	Parasitic	n

Qsn #	Question	Answer
	Source(s)	**Notes**
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	"Leafy stems I-3.5 m tall. Rhizomes densely brownish strigose." [Costaceae. No evidence]

404	Unpalatable to grazing animals	n
	Source(s)	**Notes**
	Malta, A. D. J. R., & Pontes, A. R. M. (2013). The Simplified Novel Diet of the Highly Threatened Blond Capuchin in the Vanishing Pernambuco Endemism Center. In Primates in Fragments (pp. 245-257). Springer, New York	"Table 17.1 Food items and their parts monthly exploited by the studied group of Cebus queirozi , the blond capuchin, their location and status, at Usina Salgado Mill, Pernambuco Endemism Center" [Costus spiralis - Part eaten = Fl flower]
	Bachand, M., Trudel, O. C., Ansseau, C., & Cortez, J. A. (2009). Dieta de Tapirus terrestris Linnaeus em um fragmento de Mata Atlântica do Nordeste do Brasil. Revista Brasileira de Biociências, 7(2): 188-194	[Leaves palatable to tapirs] "Tabela 1. Espécies vegetais consumidas pela anta brasileira" [Plant species consumed by Brazilian tapir] ... "Costus spiralis - Folhas consumidas]

405	Toxic to animals	n
	Source(s)	**Notes**
	Bachand, M., Trudel, O. C., Ansseau, C., & Cortez, J. A. (2009). Dieta de Tapirus terrestris Linnaeus em um fragmento de Mata Atlântica do Nordeste do Brasil. Revista Brasileira de Biociências, 7(2): 188-194	[No evidence. Leaves palatable to tapirs] "Tabela 1. Espécies vegetais consumidas pela anta brasileira" [Plant species consumed by Brazilian tapir] ... "Costus spiralis - Folhas consumidas]
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	[No evidence. Used medicinally by people] "For tumor, boils, swellings"
	Wagstaff, D.J. 2008. International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	No evidence

406	Host for recognized pests and pathogens	
	Source(s)	**Notes**
	Tavares, W. D. S., Salgado-Neto, G., Legaspi, J. C., Ramalho, F. D. S., Serrão, J. E., & Zanuncio, J. C. (2012). Biological and ecological consequences of Diolcogaster sp. (Hymenoptera: Braconidae) parasitizing Agaraea minuta (Lepidoptera: Arctiidae) and the effects on two Costus (Costaceae) plant species in Brazil. Florida Entomologist, 95(4), 966-970	"Agaraea minuta has potential to defoliate C. spicatus and C. spiralis plants, although it damages the former more severely than the latter. The parasitoid, Diolcogaster sp., could suppress populations of A. minuta, which could result in increased plant biomass."
	Costa, F. R., Espinelli, F. P., & Figueiredo, F. O. (2011). Guia de zingiberales dos sítios PPBio na Amazônia Ocidental brasileira. Áttema Design Editorial, Manaus, Brazil	No evidence

407	Causes allergies or is otherwise toxic to humans	n
	Source(s)	**Notes**

Qsn #	Question	Answer
	Dave's Garden. 2016. Spiral Ginger - Costus spiralis. http://davesgarden.com/guides/pf/go/92285/. [Accessed 2 Aug 2016]	"Danger: N/A"
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	[No evidence. Used medicinally by people] "For tumor, boils, swellings"
	Wagstaff, D.J. 2008. International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	No evidence

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	**Notes**
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	[No evidence. [An herbaceous plant that does not occur in fire prone habitats] "in moist rain forests, savanna forests, or on granitic outcroppings," ... "Leafy stems I-3.5 m tall. Rhizomes densely brownish strigose."

409	Is a shade tolerant plant at some stage of its life cycle	y
	Source(s)	**Notes**
	Dave's Garden. 2016. Spiral Ginger - Costus spiralis. http://davesgarden.com/guides/pf/go/92285/. [Accessed 2 Aug 2016]	"Sun Exposure: Sun to Partial Shade"
	Bachand, M., Trudel, O. C., Ansseau, C., & Cortez, J. A. (2009). Dieta de Tapirus terrestris Linnaeus em um fragmento de Mata Atlântica do Nordeste do Brasil. Revista Brasileira de Biociências, 7(2): 188-194	[Classified as tolerant of shade] "Tabela 1. ... Costus spiralis - Tolerância à sombra = Tolerante"

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	n
	Source(s)	**Notes**
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	"All New World Costoideae are terrestrial (some African species of Costus, in contrast, are epiphytic); they occur mainly on clayey or sandy soils, most of them preferring dark sands, only few white sands (eg, Costus spiralis var spiralis)."
	Costa, F. R., Espinelli, F. P., & Figueiredo, F. O. (2011). Guia de zingiberales dos sítios PPBio na Amazônia Ocidental brasileira. Áttema Design Editorial, Manaus, Brazil	"Forests on granitic soils of intermediate to high fertility, and also savannas."
	Dave's Garden. 2016. Spiral Ginger - Costus spiralis. http://davesgarden.com/guides/pf/go/92285/. [Accessed 2 Aug 2016]	"Soil pH requirements: 6.1 to 6.5 (mildly acidic) 6.6 to 7.5 (neutral) 7.6 to 7.8 (mildly alkaline)"

411	Climbing or smothering growth habit	n
	Source(s)	**Notes**

Qsn #	Question	Answer
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	"Leafy stems I-3.5 m tall. Rhizomes densely brownish strigose. Sheaths 5-20 mm in diam, glabrescent. Ligule truncate, 2-10 mm long, glabrous or villose towards the margins. Petiole 2-I7 mm long, glabrous to villose. Leaves narrowly elliptic, shortly acuminate at the apex, cuneate to rounded at the base, 8-43 cm long, 5-i4 cm wide, glabrous to densely villose on both sides."

412	Forms dense thickets	
	Source(s)	**Notes**
	Anonymous. 1945. Flora of Panama. Part III. Fascicle I. Annals of the Missouri Botanical Garden, 32(1): 1-105	"in lowland thickets." [Unknown. Other Costus species form thickets]

501	Aquatic	n
	Source(s)	**Notes**
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	"All New World Costoideae are terrestrial (some African species of Costus, in contrast, are epiphytic); they occur mainly on clayey or sandy soils, most of them preferring dark sands, only few white sands (eg, Costus spiralis var spiralis)."

502	Grass	n
	Source(s)	**Notes**
	USDA, ARS, Germplasm Resources Information Network, 2016. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 2 Aug 2016]	Costaceae

503	Nitrogen fixing woody plant	n
	Source(s)	**Notes**
	USDA, ARS, Germplasm Resources Information Network, 2016. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 2 Aug 2016]	Costaceae

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	**Notes**
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	"Leafy stems I-3.5 m tall. Rhizomes densely brownish strigose."
	Gordon, D. R., Mitterdorfer, B., Pheloung, P. C., Ansari, S., Buddenhagen, C., Chimera, C., ... & Williams, P. A. 2010). Guidance for addressing the Australian Weed Risk Assessment questions. Plant Protection Quarterly, 25(2): 56-74	"This question relates to perennial plants with tubers, corms or bulbs. This question is specifically to deal with plants that have specialized organs and should not include plants merely with rhizomes/ stolons"

Qsn #	Question	Answer
601	**Evidence of substantial reproductive failure in native habitat**	**n**
	Source(s)	**Notes**
	Araújo, F. P., & Oliveira, P. E. (2007). Biologia floral de Costus spiralis (Jacq.) Roscoe (Costaceae) e mecanismos para evitar a autopolinização. Revista Brasileira de Botânica, 30(1), 61-70	[No evidence] "There was no difference between germination rates of seeds from self-pollination and cross-pollination, but the seeds produced from natural fruit-set presented significantly higher germination rates than those from hand pollination treatments. The results confirm the efficiency and importance of the hummingbirds as pollen vectors for C. spiralis."
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	[No evidence] "Tropical South America, except in the West; in moist rain forests, savanna forests, or on granitic outcroppings, from sea-level to 350 (-i800oo) m."

602	Produces viable seed	y
	Source(s)	**Notes**
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	"Capsule ellipsoid, 10-13 mm long, glabrous, seeds black."
	Dave's Garden. 2016. Spiral Ginger - Costus spiralis. http://davesgarden.com/guides/pf/go/92285/. [Accessed 2 Aug 2016]	"Propagation Methods: By dividing rhizomes, tubers, corms or bulbs (including offsets)"
	Araújo, F. P., & Oliveira, P. E. (2007). Biologia floral de Costus spiralis (Jacq.) Roscoe (Costaceae) e mecanismos para evitar a autopolinização. Revista Brasileira de Botânica, 30(1), 61-70	[May be limited outside native range] "There was no difference between germination rates of seeds from self-pollination and cross-pollination, but the seeds produced from natural fruit-set presented significantly higher germination rates than those from hand pollination treatments. The results confirm the efficiency and importance of the hummingbirds as pollen vectors for C. spiralis."

603	Hybridizes naturally	
	Source(s)	**Notes**
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	[Unknown. Hybridization documented in genus] "Some specimens from Chiriqui, Panama', are intermediate between C. lasius and C. scaber. Woodson (I 945) already remarked that some of the specimens cited below were putative hybrids. Their description is as follows:" ... "C. scaber Ruiz & Pavon x C. lasius Loesener" ... "At the present nothing certain can be said with certainty about differences in the floral structure of the four species, since well-preserved flowers were only available of C. scaber. Future collectors are urged to pay more attention to the flowers of these species and will collect spirit material in addition to dried specimens"

604	Self-compatible or apomictic	y
	Source(s)	**Notes**
	Araújo, F. P., & Oliveira, P. E. (2007). Biologia floral de Costus spiralis (Jacq.) Roscoe (Costaceae) e mecanismos para evitar a autopolinização. Revista Brasileira de Botânica, 30(1), 61-70	[Self-compatible, but floral morphology prevents self-pollination] "C. spiralis is a self-compatible, non apomictic species, which does not present spontaneous self-pollination. It presents movement herkogamy to avoid self-pollination."

Qsn #	Question	Answer
605	**Requires specialist pollinators**	**y**
	Source(s)	**Notes**
	Araújo, F. P., & Oliveira, P. E. (2007). Biologia floral de Costus spiralis (Jacq.) Roscoe (Costaceae) e mecanismos para evitar a autopolinização. Revista Brasileira de Botânica, 30(1), 61-70	"The pollinators of C. spiralis were the hummingbirds Phaethornis pretrei (Lesson & DeLattre) (Phaethornithinae), Eupetomena macroura (Gmelin) and Heliomaster squamosus (Temminck) (Trochilinae). Amazilia fimbriata (Gmelin) acted as nectar robber. Costus spiralis has a floral morphology adapted to pollination by Phaethornithinae, with a long and curved floral tube which conforms with the beak morphology of these birds. The strategy of trapline foraging by Phaethornithinae hummingbirds, favors the reproduction of the plant, increasing pollen flow between groups of C. spiralis."

606	**Reproduction by vegetative fragmentation**	**y**
	Source(s)	**Notes**
	Dave's Garden. 2016. Spiral Ginger - Costus spiralis. http://davesgarden.com/guides/pf/go/92285/. [Accessed 2 Aug 2016]	"Propagation Methods: By dividing rhizomes, tubers, corms or bulbs (including offsets)"
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	[Rhizomatous. Presumably Yes] "Leafy stems I-3.5 m tall. Rhizomes densely brownish strigose."

607	**Minimum generative time (years)**	
	Source(s)	**Notes**
	Costa, F. R., Espinelli, F. P., & Figueiredo, F. O. (2011). Guia de zingiberales dos sítios PPBio na Amazônia Ocidental brasileira. Áttema Design Editorial, Manaus, Brazil	"Flowers during the rainy season and fruits at the start of the dry season. Pollinated by hummingbirds." [Unknown. a rhizomatous plant that may be able to reproduce vegetatively prior to first flowering]

701	**Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)**	**n**
	Source(s)	**Notes**
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	[No evidence] "Nothing is known about the seed-dispersal of the Costoideae; they might be myrmecochores." ... "Capsule ellipsoid, 10 -13 mm long, glabrous, seeds black."

702	**Propagules dispersed intentionally by people**	**y**
	Source(s)	**Notes**
	Dave's Garden. 2016. Spiral Ginger - Costus spiralis. http://davesgarden.com/guides/pf/go/92285/. [Accessed 2 Aug 2016]	Cultivated as an ornamental
	GingersRus. 2016. Plant Datasheet for Costus spiralis. http://www.gingersrus.com/DataSheet.php?PID=2372. [Accessed 2 Aug 2016]	Cultivated as an ornamental

703	**Propagules likely to disperse as a produce contaminant**	**n**

Qsn #	Question	Answer
	Source(s)	**Notes**
	Araújo, F. P., & Oliveira, P. E. (2007). Biologia floral de Costus spiralis (Jacq.) Roscoe (Costaceae) e mecanismos para evitar a autopolinização. Revista Brasileira de Botânica, 30(1), 61-70	[No evidence. Unlikely in cultivation. Seed set may be absent due to pollinator limitation outside native range] "C. spiralis is a self-compatible, non apomictic species, which does not present spontaneous self-pollination. It presents movement herkogamy to avoid selfpollination. The pollinators of C. spiralis were the hummingbirds Phaethornis pretrei (Lesson & DeLattre) (Phaethornithinae), Eupetomena macroura (Gmelin) and Heliomaster squamosus (Temminck) (Trochilinae). Amazilia fimbriata (Gmelin) acted as nectar robber. Costus spiralis has a floral morphology adapted to pollination by Phaethornithinae, with a long and curved floral tube which conforms with the beak morphology of these birds. The strategy of trapline foraging by Phaethornithinae hummingbirds, favors the reproduction of the plant, increasing pollen flow between groups of C. spiralis. There was no difference between germination rates of seeds from self-pollination and cross-pollination, but the seeds produced from natural fruit-set presented significantly higher germination rates than those from hand pollination treatments. The results confirm the efficiency and importance of the hummingbirds as pollen vectors for C. spiralis."

704	Propagules adapted to wind dispersal	n
	Source(s)	**Notes**
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	"Capsule ellipsoid, 10-13 mm long, glabrous, seeds black."
	Link, A. & Stevenson, P.R. (2004). Fruit dispersal syndromes in animal disseminated plants at Tinigua National Park, Colombia. Revista Chilena de Historia Natural 77: 319-334	[Costus spiralis identified as animal dispersed, but types of animals unspecified] "Animal dispersed plant species in Tinigua National Park, that were included in the analyses of dispersal syndromes. The columns show the morphological traits for each plant species. Fruit size refers to the largest dimension of the fruit (width or length)"

705	Propagules water dispersed	
	Source(s)	**Notes**
	Costa, F. R., Espinelli, F. P., & Figueiredo, F. O. (2011). Guia de zingiberales dos sítios PPBio na Amazônia Ocidental brasileira. Áttema Design Editorial, Manaus, Brazil	"Often found close to streams, clearings, and roadsides." [Unknown. Possible that rhizome fragments or seeds could be moved by water if growing in riparian areas]

706	Propagules bird dispersed	y
	Source(s)	**Notes**
	Link, A. & Stevenson, P.R. (2004). Fruit dispersal syndromes in animal disseminated plants at Tinigua National Park, Colombia. Revista Chilena de Historia Natural 77: 319-334	[Costus spiralis identified as animal dispersed, but types of animals unspecified] "Animal dispersed plant species in Tinigua National Park, that were included in the analyses of dispersal syndromes. The columns show the morphological traits for each plant species. Fruit size refers to the largest dimension of the fruit (width or length)"

Qsn #	Question	Answer
	Parra, J. L., Agudelo, M., Molina, Y., & Londoño, G. (2001). Use of space by a pair of salvin's curassows (Mitu salvini) in northwestern Colombian Amazon. Ornitologia Neotropical, 12(3), 189-204	[Fruits eaten by curassows] "Although the group of curassows showed a marked preference for flooded forest, this does not mean that other habitats were less important. Our study has demonstrated that all habitats play an important role on the curassows movements, at least during some periods of the year. The flooded forest is a key habitat for this group, not only because it provides suitable nesting sites, but also because some of the most important food items, including fruits (i.e., Guarea guidonia, Trichilia pleeana, Costus spiralis, Psychotria psychotriaefolia),"
	Rother, D. C., Rodrigues, R. R., & Pizo, M. A. (2009). Effects of bamboo stands on seed rain and seed limitation in a rainforest. Forest Ecology and Management, 257(3), 885-892	[Unknown. Related taxon is bird dispersed] "Appendix A. Family, species, seed abundance, dispersal syndrome and plant habit for seeds collected at bamboo (B) and non-bamboo (NB) stands." [Costus spiralis - Dispersal syndrome - Z = zoochorous]
	Lefevre, K.L. 2008. The influence of human disturbance on avian frugivory and seed dispersal in a neotropical rainforest. PhD Dissertation. University of Toronto, Toronto	[Unknown. Related taxon is bird dispersed] "Appendix 2A. Fruiting plants of the lower montane rainforest of Tobago, West Indies (2003 and 2004 dry seasons)" ... "Costus scaber - Dispersal mode = bird"

707	Propagules dispersed by other animals (externally)	
	Source(s)	**Notes**
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	[Possibly, if seeds are produced in cultivation] "Nothing is known about the seed-dispersal of the Costoideae; they might be myrmecochores."

708	Propagules survive passage through the gut	y
	Source(s)	**Notes**
	Parra, J. L., Agudelo, M., Molina, Y., & Londoño, G. (2001). Use of space by a pair of salvin's curassows (Mitu salvini) in northwestern Colombian Amazon. Ornitologia Neotropical, 12(3), 189-204	[Presumably yes. Fruits eaten by curassows, but seed set may be limited outside native range] "Although the group of curassows showed a marked preference for flooded forest, this does not mean that other habitats were less important. Our study has demonstrated that all habitats play an important role on the curassows movements, at least during some periods of the year. The flooded forest is a key habitat for this group, not only because it provides suitable nesting sites, but also because some of the most important food items, including fruits (i.e., Guarea guidonia, Trichilia pleeana, Costus spiralis, Psychotria psychotriaefolia),"

801	Prolific seed production (>1000/m2)	n
	Source(s)	**Notes**
	Moura, F. D. B. P., Duarte, J. M. M., & de Lyra Lemos, R. P. (2011). Floristic composition and dispersal syndromes at an urban remnant from the Atlantic forest in Brazilian Northeast. Acta Scientiarum. Biological Sciences, 33(4), 471-478	"Table 1. Floristic list, reproductive phenology and dispersal syndromes of species from the Municipal Park of Maceió, Alagoas State." [Costus spiralis - *= species not recorded at fruiting]

Qsn #	Question	Answer
	Araújo, F. P., & Oliveira, P. E. (2007). Biologia floral de Costus spiralis (Jacq.) Roscoe (Costaceae) e mecanismos para evitar a autopolinização. Revista Brasileira de Botânica, 30(1), 61-70	[Hummingbird pollinated. Seed set in cultivation likely limited] "C. spiralis is a self-compatible, non apomictic species, which does not present spontaneous self-pollination. It presents movement herkogamy to avoid selfpollination. The pollinators of C. spiralis were the hummingbirds Phaethornis pretrei (Lesson & DeLattre) (Phaethornithinae), Eupetomena macroura (Gmelin) and Heliomaster squamosus (Temminck) (Trochilinae). Amazilia fimbriata (Gmelin) acted as nectar robber. Costus spiralis has a floral morphology adapted to pollination by Phaethornithinae, with a long and curved floral tube which conforms with the beak morphology of these birds. The strategy of trapline foraging by Phaethornithinae hummingbirds, favors the reproduction of the plant, increasing pollen flow between groups of C. spiralis. There was no difference between germination rates of seeds from self-pollination and cross-pollination, but the seeds produced from natural fruit-set presented significantly higher germination rates than those from hand pollination treatments. The results confirm the efficiency and importance of the hummingbirds as pollen vectors for C. spiralis."

802	**Evidence that a persistent propagule bank is formed (>1 yr)**	
	Source(s)	**Notes**
	Royal Botanic Gardens Kew. (2016) Seed Information Database (SID). Version 7.1. http://data.kew.org/sid/. [Accessed 2 Aug 2016]	"Storage Behaviour: No data available for species. Of 1 known taxa of genus Costus, 100.00% Orthodox"

803	**Well controlled by herbicides**	
	Source(s)	**Notes**
	WRA Specialist. 2016. Personal Communication	Unknown. No information on herbicide efficacy or chemical control of this species

804	**Tolerates, or benefits from, mutilation, cultivation, or fire**	
	Source(s)	**Notes**
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	[Possibly Yes. Other Costus species can tolerate damage to and spread from rhizomes & rhizome fragments] "Costus woodsonii" ... "Its rhizomes are robust and invasive, and once established they are difficult to remove easily propagated by shoots that develop on the inflorescences."

805	**Effective natural enemies present locally (e.g. introduced biocontrol agents)**	
	Source(s)	**Notes**
	WRA Specialist. 2016. Personal Communication	Unknown

Summary of Risk Traits:

High Risk / Undesirable Traits
• Thrives in tropical climates
• Other Costus species have naturalized and may be invasive
• Shade tolerant
• Reproduces by seeds & vegetatively by rhizomes
• Self-compatible (but floral morphology prevents self-pollination)
• Bird-dispersed
• Lack of ecological information minimizes accuracy of risk prediction

Low Risk Traits
• No evidence of naturalization or invasiveness outside native range
• Unarmed (no spines, thorns or burrs)
• Non-toxic
• Ornamental value
• Hummingbird-pollinated in native range (may limit seed set where hummingbirds are absent)
• Limited or lacking seed production may minimize longer distance dispersal