Taxon: Costus pictus D.Don **Family:** Costaceae

Common Name(s): painted spiral ginger, spotted spiral ginger

Synonym(s): Costus congestus Rowlee, Costus mexicanus Liebm.

Assessor: Chuck Chimera **Status:** Assessor Approved **End Date:** 8 Aug 2016

WRA Score: 2.0 **Designation:** L **Rating:** Low Risk

Keywords: Perennial Herb, Possibly Naturalized, Ornamental, Rhizomatous, Bird-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)	y=1, n=0	y
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		
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		
405	Toxic to animals		
406	Host for recognized pests and pathogens		
407	Causes allergies or is otherwise toxic to humans		
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		

Qsn #	Question	Answer Option	Answer
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y=1, n=0	y
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		
605	Requires specialist pollinators	y=-1, n=0	y
606	Reproduction by vegetative fragmentation	y=1, n=-1	y
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	2
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		
707	Propagules dispersed by other animals (externally)		
708	Propagules survive passage through the gut		
801	Prolific seed production (>1000/m2)		
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] "Common from Mexico to Costa Rica; in rain forests, clearings, and hill forests, along watercourses and roads, down to sea-level, but mainly from 300- 1800 m."

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	"Common from Mexico to Costa Rica; in rain forests, clearings, and hill forests, along watercourses and roads, down to sea-level, but mainly from 300- 1800 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)	y
	Source(s)	Notes
	Hubbuch, C. 2016. Gardening in the Coastal Southeast - The Genus Costus. http://southeastgarden.com/costus.html. [Accessed 3 Aug 2016]	"It is reported to be cold hardy from zone 8 and south. It flowers reliably in middle zone 9a and south."
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	[Elevation range exceeds 1000 m, demonstrating environmental versatility] "Common from Mexico to Costa Rica; in rain forests, clearings, and hill forests, along watercourses and roads, down to sea-level, but mainly from 300- 1800 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	"Common from Mexico to Costa Rica; in rain forests, clearings, and hill forests, along watercourses and roads, down to sea-level, but mainly from 300- 1800 m."

205	**Does the species have a history of repeated introductions outside its natural range?**	**y**
	Source(s)	**Notes**
	Imada, C.T., Staples, G.W. & Herbst, D.R. 2005. Annotated Checklist of Cultivated Plants of Hawai'i. http://www2.bishopmuseum.org/HBS/botany/cultivatedplants/. [Accessed 3 Aug 2016]	"Costus pictus D. Don Locations: Harold L. Lyon Arboretum Wahiawa Botanical Garden Waimea Arboretum & Botanical Garden"
	Subramoniam, A. 2016. Plants with Anti-Diabetes Mellitus Properties. CRC Press, Boca Raton, FL	"II is widely grown in gardens as an ornamental plant in South India and also runs wild in many places."

301	**Naturalized beyond native range**	
	Source(s)	**Notes**
	GingersRus. 2016. Costus pictus. www.gingersrus.com/cart/index.php?productID=28	"This plant is widespread on the island of Puerto Rico and I have tried to determine whether or not it is native there. The concensus is that it is an exotic plant, introduced to Puerto Rico many years ago. There apparently are no Costus species that are native to the island. From communication with Dr. Jannette Gavillan of the University of Puerto Rico at Cayey the plant is known as the "insulin plant" also in the Dominican Republic and the Yucatan of Mexico which may be its native origins."
	Subramoniam, A. 2016. Plants with Anti-Diabetes Mellitus Properties. CRC Press, Boca Raton, FL	[Suggests plants may be naturalized or naturalizing] "The plant occurs in Mexico and elsewhere. II is native to Central and South America and has been introduced from Mexico or America to India. II is widely grown in gardens as an ornamental plant in South India and also runs wild in many places."
	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 3 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

Qsn #	Question	Answer
303	**Agricultural/forestry/horticultural 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

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] "Plants I-4 m tall. Sheaths purplish or green, glabrous or rarely strigose, to 5 mm in diam. Ligule truncate, 2-4(-8) mm long, often red-brown when dry, glabrous or rarely strigose."

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

403	**Parasitic**	**n**
	Source(s)	**Notes**

Qsn #	Question	Answer
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	"Plants I-4 m tall. Sheaths purplish or green, glabrous or rarely strigose, to 5 mm in diam. Ligule truncate, 2-4(-8) mm long, often red-brown when dry, glabrous or rarely strigose." [Costaceae. No evidence]

404	Unpalatable to grazing animals	
	Source(s)	**Notes**
	Lush Plants. 2016. Spiral Ginger - Costus pictus. https://lushplants.com.au/plant-shop/edible-plants-fruit-trees/spiral-ginger-plants-costus-pictus-detail. [Accessed 3 Aug 2016]	[Flowers palatable to humans. Palatability of foliage to animals unknown] "It flowers throughout spring and summer, and flowers are edible; they are often added to salads."

405	Toxic to animals	
	Source(s)	**Notes**
	Subramoniam, A. 2016. Plants with Anti-Diabetes Mellitus Properties. CRC Press, Boca Raton, FL	[Possible chronic toxicity] "Toxicity: Folklore information available in the district of Kanyakumari. Tami l Nadu. suggests that it may have renal toxicity. C. pictus leaf-fed normal rat s showed an increase in the levels of serum urea and creatinine (Subramoniam et a I., unpublished observation). Therefore, a detailed toxicity evaluation is required." ... "Further, in another investigation, palmitic acid was found to be the major component in the stem, leaf, and rhizome oils of C. pictus. Excess palmitic acid is found to induce degeneration of myofibrils in healthy adult rat cardiomyocytes and enhance LDL-C to HDL-C ratio. Excess palmitic acid intake may lead to the development of coronary heart diseases. Hence. the constant use of C. pictus leaves for diabetic treatment may cause serious cardiac diseases and is not recommended for the treatment (Jose and Reddy 2010)."

406	Host for recognized pests and pathogens	
	Source(s)	**Notes**
	WRA Specialist. 2016. Personal Communication	Unknown

407	Causes allergies or is otherwise toxic to humans	
	Source(s)	**Notes**
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"(Antidiabetic, diuretic.)"

Qsn #	Question	Answer
	Subramoniam, A. 2016. Plants with Anti-Diabetes Mellitus Properties. CRC Press, Boca Raton, FL	[Possible chronic toxicity] "Toxicity: Folklore information available in the district of Kanyakumari. Tami l Nadu. suggests that it may have renal toxicity. C. pictus leaf-fed normal rat s showed an increase in the levels of serum urea and creatinine (Subramoniam et a I., unpublished observation). Therefore, a detailed toxicity evaluation is required." ... "Further, in another investigation, palmitic acid was found to be the major component in the stem, leaf, and rhizome oils of C. pictus. Excess palmitic acid is found to induce degeneration of myofibrils in healthy adult rat cardiomyocytes and enhance LDL-C to HDL-C ratio. Excess palmitic acid intake may lead to the development of coronary heart diseases. Hence. the constant use of C. pictus leaves for diabetic treatment may cause serious cardiac diseases and is not recommended for the treatment (Jose and Reddy 2010)."

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	**Notes**
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	"Common from Mexico to Costa Rica; in rain forests, clearings, and hill forests, along watercourses and roads..." [No evidence. An herbaceous plant that does not occur in fire prone habitats]

409	Is a shade tolerant plant at some stage of its life cycle	
	Source(s)	**Notes**
	Hubbuch, C. 2016. Gardening in the Coastal Southeast - The Genus Costus. http://southeastgarden.com/costus.html. [Accessed 3 Aug 2016]	"It grows well in a moist, shady site."
	NParks Flora&FaunaWeb. 2016. Costus pictus. https://florafaunaweb.nparks.gov.sg/special-pages/plant-detail.aspx?id=5877. [Accessed 3 Aug 2016]	"Light Preference : Semi-Shade"

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
	Source(s)	**Notes**
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	"in rain forests, clearings, and hill forests, along watercourses and road"
	NParks Flora&FaunaWeb. 2016. Costus pictus. https://florafaunaweb.nparks.gov.sg/special-pages/plant-detail.aspx?id=5877. [Accessed 3 Aug 2016]	"Moist Soils, Well-Drained Soils"
	GingersRus. 2016. Costus pictus. www.gingersrus.com/cart/index.php?productID=28	"This is the easiest of all the spiral gingers to grow, as it seems to be able to handle a wide range of soil and sunlight."

Qsn #	Question	Answer
411	**Climbing or smothering growth habit**	**n**
	Source(s)	**Notes**
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	"Plants I-4 m tall. Sheaths purplish or green, glabrous or rarely strigose, to 5 mm in diam. Ligule truncate, 2-4(-8) mm long, often red-brown when dry, glabrous or rarely strigose."

412	**Forms dense thickets**	
	Source(s)	**Notes**
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	[Unknown] "Common from Mexico to Costa Rica; in rain forests, clearings, and hill forests, along watercourses and roads, down to sea-level, but mainly from 300-1800 m."

501	**Aquatic**	**n**
	Source(s)	**Notes**
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	[Terrestrial] ". Common from Mexico to Costa Rica; in rain forests, clearings, and hill forests, along watercourses and roads, down to sea-level, but mainly from 300- 1800 m."

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	"Plants 1-4 m tall. Sheaths purplish or green, glabrous or rarely strigose, to 5 mm in diam. Ligule truncate, 2-4(-8) mm long, often red-brown when dry, glabrous or rarely strigose. Petiole to 8 mm long, glabrous. Leaves narrowly elliptic, cuneate, rounded, or slightly cordate at the base, acuminate at the apex, acumen to 15 mm long with a 2-3 mm long filiform point, 10-25(-31) cm long, 2.5-6(-10) cm wide, upper side glabrous or sparsely strigose, lower side glabrous to rather densely puberulous, or rarely strigose."

Qsn #	Question	Answer
	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"

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	**Notes**
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	[No evidence] "Common from Mexico to Costa Rica; in rain forests, clearings, and hill forests, along watercourses and roads, down to sea-level, but mainly from 300- 1800 m."

602	Produces viable seed	y
	Source(s)	**Notes**
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	"Capsule subglobose, trisulcate, to I5 mm in diam, glabrous to densely rusty-puberulous, seeds black"
	NParks Flora&FaunaWeb. 2016. Costus pictus. https://florafaunaweb.nparks.gov.sg/special-pages/plant-detail.aspx?id=5877. [Accessed 3 Aug 2016]	"Propagation Method : Seed, Stem Cutting, Division"

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"

Qsn #	Question	Answer
604	**Self-compatible or apomictic**	
	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	[Related taxon 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."
	Schemske, D. W. 1980. The evolutionary significance of extrafloral nectar production by Costus woodsonii (Zingiberaceae): an experimental analysis of ant protection. The Journal of Ecology, 6 (3): 959-967	[Unknown for C. pictus. Selfing documented in genus] "This research utilized experimental field and greenhouse approaches to assess the fitness consequences of selfing and out- crossing in three neotropical herbs of the genus Costus (Zingiberaceae). All species are self-compatible, and require a treefall gap for germination and establishment. Self-pollination resulted in lower seed out- put in all species, and this difference was significant for Costus allenii and C. laevis."

605	**Requires specialist pollinators**	**y**
	Source(s)	**Notes**
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	"Labellum tubular, rather small and only slightly exceeding the corolla (or shorter than the corolla), yellow, orange, or red. The bracts are of the same colour or rarely green. This type occurs in Costus subgen Costus, species 19-35. Until now there is only one observation about pollination in this group, ie, an annotation by Steyer- mark on a herbarium label describing Costus scaber from Guatemala as being visited by a hummingbird. According to Dodson & van der Pijl (1966) in their observations about pollination of orchids, the conditions of a "hummingbird flower" are: "flowers tubular... nectar very abundant... medium-length, rather broad tubes... hard flower wall . . . vivid colors . . . often scarlet." All these characters are found in this group of species of Costus and further observations about pollination by humming- birds may be expected" ... "Costus pictus can be recognized by its reddish yellow flowers, its green inflorescence in which the callus of the bracts is inconspicuous or even absent, and by the short ligule which is usually reddish-brown when dry."

606	**Reproduction by vegetative fragmentation**	**y**
	Source(s)	**Notes**
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"Rhizomatous perennial herb" [Rhizomatous. Presumably Yes]

Qsn #	Question	Answer
607	**Minimum generative time (years)**	**2**
	Source(s)	**Notes**
	Hubbuch, C. 2016. Gardening in the Coastal Southeast - The Genus Costus. http://southeastgarden.com/costus.html. [Accessed 3 Aug 2016]	"Red and yellow flowers are produced on second year stalks where it does not die back over winter."

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	"Capsule subglobose, trisulcate, to I5 mm in diam, glabrous to densely rusty-puberulous, seeds black." ... "Common from Mexico to Costa Rica; in rain forests, clearings, and hill forests, along watercourses and roads, down to sea-level, but mainly from 300-1800 m." [Unlikely. Fruits & seeds, if produced, lack means of external attachment]

702	**Propagules dispersed intentionally by people**	**y**
	Source(s)	**Notes**
	Botanical Growers Network. 2016. Ginger Costus Pictus. http://botanicalgrowers-store.com/gingercostuspictus.aspx. [Accessed 8 Aug 2016]	[Sold commercially] "In Stock Costus Pictus Unusual tiger striped flowers emerge from lime green bracts atop a modeled reed like stem. This is a very unusual costus. In ground or in a container costus grow vigorously when provided with moist well drained soil. These gingers are heavy feeders and grow at their optimum potential when fertilized regularly. Very tropical and easy to grow. Your new plant comes very well established in the growers 6" Round Pot with the growers soil mix (NOT BARE ROOT), neatly packaged, and only mildly trimmed before shipping."

703	**Propagules likely to disperse as a produce contaminant**	**n**
	Source(s)	**Notes**
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	"Capsule subglobose, trisulcate, to I5 mm in diam, glabrous to densely rusty-puberulous, seeds black." [No evidence & unlikely. Seeds may be rare in cultivation due to pollinator limitations]

704	**Propagules adapted to wind dispersal**	**n**
	Source(s)	**Notes**
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	"Capsule subglobose, trisulcate, to I5 mm in diam, glabrous to densely rusty-puberulous, seeds black"

Qsn #	Question	Answer
705	**Propagules water dispersed**	
	Source(s)	**Notes**
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	"Common from Mexico to Costa Rica; in rain forests, clearings, and hill forests, along watercourses and roads" [Unknown. Possible that rhizome fragments or seeds could be moved by water if growing in riparian areas]

706	**Propagules bird dispersed**	
	Source(s)	**Notes**
	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"
	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]

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**	
	Source(s)	**Notes**
	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. Presumably yes if seeds are produced] "Appendix 2A. Fruiting plants of the lower montane rainforest of Tobago, West Indies (2003 and 2004 dry seasons)" ... "Costus scaber - Dispersal mode = bird"

801	**Prolific seed production (>1000/m2)**	
	Source(s)	**Notes**
	Maas, P.J.M. 1972. Costoideae (Zingiberaceae). Flora Neotropica 8: 1-139	"Capsule subglobose, trisulcate, to I5 mm in diam, glabrous to densely rustypuberulous, seeds black." [Densities unknown]

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 9 Aug 2016]	"Storage Behaviour: No data available for species. Of 1 known taxa of genus Costus, 100.00% Orthodox"

803	**Well controlled by herbicides**	

Qsn #	Question	Answer
	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
• Possibly naturalized in India & Puerto Rico
• Other Costus species have naturalized and may be invasive
• Tolerates many soil conditions
• Reproduces by seeds & vegetatively by rhizomes
• Flowers at 2 years, but may be able to reproduce vegetatively at an earlier age
• Lack of ecological information minimizes accuracy of risk prediction

Low Risk Traits
• No evidence of invasiveness outside native range
• Unarmed (no spines, thorns or burrs)
• 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