

Taxon: Zingiber spectabile	Family: Zingiberaceae
Common Name(s): golden beehive ginger nodding gingerwort	Synonym(s): NA

Assessor: Chuck Chimera	Status: Assessor Approved	End Date: 8 Jan 2015
WRA Score: 3.0	Designation: EVALUATE	Rating: Evaluate

Keywords: Possibly Naturalized, Aggressive, Ornamental, Shade Tolerant, Rhizomatous

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	n
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		
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	n=0, y = 1*multiplier (see Appendix 2)	y
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	y=1, n=0	n
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

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		
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/m ²)	y=1, n=-1	n
802	Evidence that a persistent propagule bank is formed (>1 yr)	y=1, n=-1	n
803	Well controlled by herbicides	y=-1, n=1	y
804	Tolerates, or benefits from, mutilation, cultivation, or fire	y=1, n=-1	y
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
	Wolff, X.Y., Astuti, I.P. & Brink, M., 1999. Zingiber G.R. Boehme [Internet] Record from Proseabase. de Guzman, C.C. and Siemonsma, J.S. (Editors). PROSEA (Plant Resources of South East Asia) Foundation, Bogor, Indonesia. http://www.proseanet.org . [Accessed 7 Jan 2015]	No evidence

102	Has the species become naturalized where grown?	
	Source(s)	Notes
	WRA Specialist. 2015. Personal Communication	NA

103	Does the species have weedy races?	
	Source(s)	Notes
	WRA Specialist. 2015. 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
	Wolff, X.Y., Astuti, I.P. & Brink, M., 1999. Zingiber G.R. Boehme [Internet] Record from Proseabase. de Guzman, C.C. and Siemonsma, J.S. (Editors). PROSEA (Plant Resources of South East Asia) Foundation, Bogor, Indonesia. http://www.proseanet.org . [Accessed 7 Jan 2015]	"Zingiber spectabile is found in Peninsular Malaysia and peninsular Thailand."

202	Quality of climate match data	High
	Source(s)	Notes
	Wolff, X.Y., Astuti, I.P. & Brink, M., 1999. Zingiber G.R. Boehme [Internet] Record from Proseabase. de Guzman, C.C. and Siemonsma, J.S. (Editors). PROSEA (Plant Resources of South East Asia) Foundation, Bogor, Indonesia. http://www.proseanet.org . [Accessed 7 Jan 2015]	

203	Broad climate suitability (environmental versatility)	n
	Source(s)	Notes

Qsn #	Question	Answer
	Dave's Garden. 2015. PlantFiles: Beehive Ginger, Nodding Gingerwort - <i>Zingiber spectabile</i> . http://davesgarden.com/guides/pf/go/155693/ . [Accessed 8 Jan 2015]	"Hardiness: 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)"
	Learn 2 Grow. 2015. <i>Zingiber spectabile</i> . http://www.learn2grow.com/plants/zingiber-spectabile/ . [Accessed 8 Jan 2015]	"This tender herbaceous perennial grows from a rhizome (an underground stem) and typically goes dormant when cool winter temperatures or seasonal drought develops. It is native to the streamsides and moist lowlands of Malaysia and southern Thailand." ...

204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	Notes
	Wolff, X.Y., Astuti, I.P. & Brink, M., 1999. <i>Zingiber G.R. Boehme</i> [Internet] Record from Proseabase. de Guzman, C.C. and Siemonsma, J.S. (Editors). PROSEA (Plant Resources of South East Asia) Foundation, Bogor, Indonesia. http://www.proseanet.org . [Accessed 7 Jan 2015]	" <i>Zingiber spectabile</i> is found in Peninsular Malaysia and peninsular Thailand. Throughout the tropics it is occasionally cultivated as an ornamental."

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	Notes
	Staples, G.W. & Herbst, D.R. 2005. <i>A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places</i> . Bishop Museum Press, Honolulu, HI	"Nodding gingerwort is occasionally cultivated in Hawaii for its attractive flower heads."
	Topp, J.M.W. 1988. <i>An Annotated Check List of the Flora of Diego Garcia, British Ocean Territory</i> . Atoll Research Bulletin 313: 1-21	"Occasionally cultivated."
	Areces Berazain, F., Vega López, V.J. and Ackerman, J.D. 2014. <i>Annotated List of the Vascular Plants at El Verde Field Station, El Yunque National Forest, Puerto Rico</i> . <i>Caribbean Naturalist</i> 16:1-51	" <i>Zingiber spectabile</i> Griff. - EXOTIC (planted). Areces, F. 538 & Vega, V. (UPRRP); Areces, F. 915 & Vega, V. (UPRRP)"
	Wolff, X.Y., Astuti, I.P. & Brink, M., 1999. <i>Zingiber G.R. Boehme</i> [Internet] Record from Proseabase. de Guzman, C.C. and Siemonsma, J.S. (Editors). PROSEA (Plant Resources of South East Asia) Foundation, Bogor, Indonesia. http://www.proseanet.org . [Accessed 7 Jan 2015]	" <i>Zingiber spectabile</i> is found in Peninsular Malaysia and peninsular Thailand. Throughout the tropics it is occasionally cultivated as an ornamental."

301	Naturalized beyond native range	
	Source(s)	Notes

Qsn #	Question	Answer
	iVillage Home & Garden Network. 2013. Ginger Forum - Caribbean Dominica. http://forums.gardenweb.com/forums/load/ginger/msg0710394713956.html?1 . [Accessed 8 Jan 2015]	"Posted by gingersrus Tallahassee z8B (My Page) on Mon, Jul 17, 06 at 16:12. Most of them are exotics from Asia, some being very invasive when planted outside there original habitat. In Costa Rica you find <i>Alpinia purpurata</i> (red ginger), <i>Zingiber spectabile</i> (beehive ginger) and others growing in the forest far from where they were first planted, and displacing some beautiful natives. The only native gingers in the New World are Costaceae (<i>Costus</i> and <i>Dimerocostus</i>) and a Zingiberaceae that looks somewhat like an <i>Alpinia</i> - called <i>Renealmia</i> ."
	Olivero Lora, S. & Dunnink, J.A.C.M. 2014. The gingers are invading: an investigation of the role of humans on the dispersal of the invasive shampoo ginger (<i>Zingiber spectabile</i>). Student Project. Organization for Tropical Studies. https://aiteots.wordpress.com/ . [Accessed 8 Jan 2015]	[Possibly Naturalized or naturalizing in Costa Rica] "An invasive species of particular concern is the <i>Zingiber spectabile</i> . Originating in Asia, this ginger plant was introduced to Costa Rica at the Wilson Botanical garden. It spread rapidly through the country due to its high ornamental value. It also spread into many natural ecosystems, particularly the Las Cruces forests immediately surrounding the botanical garden."
	Wagner, W.L., Herbst, D.R.& Lorence, D.H. 2015. Flora of the Hawaiian Islands. Smithsonian Institution, Washington, D.C. http://botany.si.edu/pacificislandbiodiversity/hawaiianflora/index.htm . [Accessed]	No evidence
	Imada, C. 2012. Hawaiian Native and Naturalized Vascular Plants Checklist (December 2012 update). Bishop Museum Technical Report 60. Bishop Museum, Honolulu, HI	No evidence in Hawaiian Islands

302	Garden/amenity/disturbance weed	
	Source(s)	Notes
	Olivero Lora, S. & Dunnink, J.A.C.M. 2014. The gingers are invading: an investigation of the role of humans on the dispersal of the invasive shampoo ginger (<i>Zingiber spectabile</i>). Student Project. Organization for Tropical Studies. https://aiteots.wordpress.com/ . [Accessed 7 Jan 2015]	[A minor weed with potential environmental impacts] "An invasive species of particular concern is the <i>Zingiber spectabile</i> . Originating in Asia, this ginger plant was introduced to Costa Rica at the Wilson Botanical garden. It spread rapidly through the country due to its high ornamental value. It also spread into many natural ecosystems, particularly the Las Cruces forests immediately surrounding the botanical garden." ... "Additionally, it seems that the invasive ginger, <i>Zingiber spectabile</i> , is outcompeting the local native ginger species, <i>Renealmia cernua</i> ."
	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 weedy] "Nodding gingerwort is an aggressive plant that can rapidly expand out of the area where it is planted, and vigorous control may be necessary to keep it confined."

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
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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

305	Congeneric weed	y
	Source(s)	Notes
	CABI. 2015. <i>Zingiber montanum</i> in: Invasive Species Compendium. www.cabi.org/isc	" <i>Z. montanum</i> is listed as 'moderately invasive' in northeastern Bangladesh, based on a 2010 forest undergrowth vegetation survey undertaken in a protected national park (Rahman et al., 2010), with the potential to compete for space and resources and thus negatively impact local and native biodiversity. In Puerto Rico and the Greater Antilles, <i>Z. montanum</i> is considered a naturalized weed and cultivation escape (Acevedo-Rodríguez and Strong, 2005, Randall, 2012)."

401	Produces spines, thorns or burrs	n
	Source(s)	Notes
	Wolff, X.Y., Astuti, I.P. & Brink, M., 1999. <i>Zingiber G.R. Boehme</i> [Internet] Record from Proseabase. de Guzman, C.C. and Siemonsma, J.S. (Editors). PROSEA (Plant Resources of South East Asia) Foundation, Bogor, Indonesia. http://www.proseanet.org . [Accessed 7 Jan 2015]	[No evidence] " <i>Zingiber spectabile</i> . Leafy stems 2.0-3.5 m tall, basal leafless stem part up to 1 m tall, swollen at base. Leaf sheath sparsely pilose, margin scarious; ligule deeply 2-lobed, lobes up to 1.5 cm long, broad, pale green; blade lanceolate, 30-50 cm x 6-10 cm, glabrous or slightly hairy at the base below. Inflorescence a cylindrical spike, 10-30 cm x 6-7 cm, with rounded apex; scape radical, erect, 20-40 cm long; bracts obovate, 4.5 cm long, turning red from yellow through orange, fleshy, curved outwards with the edge incurved forming pouches; bracteole linear, up to 4 cm long; calyx up to 3.5 cm long, cream to pinkish; corolla 7 cm long, yellow, dorsal lobe up to 3 cm x 1.7 cm, lateral lobes 1.8 cm x 0.6 cm, labellum 4-6 cm long, dark purple with yellow spots, midlobe ovate, 1.6 cm x 1.4 cm, shorter than or as long as the lateral corolla lobes, apex cleft, side-lobes 1 cm x 1 cm, broadly rounded; anther yellow, anther appendage purple. Fruit an ovoid capsule, 3 cm x 1 cm, sparsely pilose."

402	Allelopathic	
	Source(s)	Notes

Qsn #	Question	Answer
	Han, C. M., Pan, K. W., Wu, N., Wang, J. C., & Li, W. 2008. Allelopathic effect of ginger on seed germination and seedling growth of soybean and chive. <i>Scientia Horticulturae</i> , 116(3): 330-336	[Unknown. Allelopathic chemicals present in other Zingiber species] "The rhizome, stem and leaf aqueous extracts of ginger were assayed at 10, 20, 40, and 80 g l ⁻¹ for their effects on seed germination and early seedling growth of soybean and chive. All aqueous extracts at all concentrations inhibited seed germination, seedling growth, water uptake and lipase activity of soybean and chive compared with the control, and the degree of inhibition increased with the incremental extracts concentration. The degree of toxicity of different ginger plant parts can be classified in order of decreasing inhibition as stem > leaf > rhizome. The results of this study suggest that rhizome, stem and leaf of ginger contain water-soluble allelochemicals which could inhibit seed germination and seedling growth of soybean and chive. The rhizome is the main harvested part of ginger. The residue (mainly stems and leaves) of the ginger plant should be removed from the field so as to diminish its inhibitory effect. Further work is needed to specify and verify the allelochemicals produced by this plant. The results of this study suggest that ginger allelochemicals are heterotoxic, and thus intercropping should not be practiced using ginger."

403	Parasitic	n
	Source(s)	Notes
	Wolff, X.Y., Astuti, I.P. & Brink, M., 1999. <i>Zingiber G.R. Boehme</i> [Internet] Record from Proseabase. de Guzman, C.C. and Siemonsma, J.S. (Editors). PROSEA (Plant Resources of South East Asia) Foundation, Bogor, Indonesia. http://www.proseanet.org . [Accessed 7 Jan 2015]	[No evidence] "Erect, robust perennial herbs, with several leafy stems, 0.5-3.5 m tall. Rhizome horizontal, fleshy, aromatic, at or near soil surface." [Zingiberaceae]

404	Unpalatable to grazing animals	n
	Source(s)	Notes
	WRA Specialist. 2015. Personal Communication	Unknown

405	Toxic to animals	n
	Source(s)	Notes
	Sivasothy, Y., Sulaiman, S. F., Ooi, K. L., Ibrahim, H., & Awang, K. 2013. Antioxidant and antibacterial activities of flavonoids and curcuminoids from <i>Zingiber spectabile</i> Griff. <i>Food Control</i> , 30(2): 714-720	[No evidence of toxicity] " <i>Zingiber spectabile</i> Griff., locally known as tepus tanah, is native in the moist lowland forests of Peninsular Malaysia. The leaves and rhizomes are used to flavour food. Its young rhizomes are sliced, soaked in vinegar and used as an appetizer (Jones, 1993)."
	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	n
	Source(s)	Notes

Qsn #	Question	Answer
	Blanchett, S. 2010. Growing your Zingiber spectabile seed. The Spectabilis Ginger or Beehive Ginger. http://www.members.westnet.com.au/wackos/PDFs/Growing 20your%20zingiber%20specable%20seed.pdf . [Accessed]	"The only major pests of this plant are chewing insects such as Grasshoppers and Caterpillars, these can simply be crushed or sprayed with the insecticide Carbaryl if the infestation is heavy. "
	Wolff, X.Y., Astuti, I.P. & Brink, M., 1999. Zingiber G.R. Boehme [Internet] Record from Proseabase. de Guzman, C.C. and Siemonsma, J.S. (Editors). PROSEA (Plant Resources of South East Asia) Foundation, Bogor, Indonesia. http://www.proseanet.org . [Accessed 8 Jan 2015]	"Udaspes sp. and Kerranadiocles sp. are reported as diseases on Zingiber and can be controlled with fungicides. Zingiber is attacked by several insect pests, including Tribolium sp., which bores into the stem, and Agrotis ipsilon grubs attacking the underground organs."

407	Causes allergies or is otherwise toxic to humans	n
	Source(s)	Notes
	Chee, B.J. & Lau, K.H. 2010. The spectacular ginger : Zingiber spectabile Griffith. Malaysian Naturalist. September 2010: 12-13	[No evidence] "Even though it is not as celebrated as the common ginger there are also many reported uses of Z. spectabile as traditional medicine and as food. The young and tender shoots are always consumed as "ulam" or eaten fresh as salad. It is sometimes used as extra flavoring in cooking. In traditional Malay medicine, the leaves of Z. spectabile are pounded into a thick paste and applied to injured parts of the body; it is used to reduce inflammation and to treat backaches and headaches."
	Sivasothy, Y., Sulaiman, S. F., Ooi, K. L., Ibrahim, H., & Awang, K. 2013. Antioxidant and antibacterial activities of flavonoids and curcuminoids from Zingiber spectabile Griff. Food Control, 30(2): 714-720	[No evidence] "Zingiber spectabile Griff., locally known as tepus tanah, is native in the moist lowland forests of Peninsular Malaysia. The leaves and rhizomes are used to flavour food. Its young rhizomes are sliced, soaked in vinegar and used as an appetizer (Jones, 1993)."
	Wolff, X.Y., Astuti, I.P. & Brink, M., 1999. Zingiber G.R. Boehme [Internet] Record from Proseabase. de Guzman, C.C. and Siemonsma, J.S. (Editors). PROSEA (Plant Resources of South East Asia) Foundation, Bogor, Indonesia. http://www.proseanet.org . [Accessed 7 Jan 2015]	[No evidence] "Zingiber spectabile. Used for flavouring in Malaysia. In traditional medicine, pounded leaves are applied to poultice swellings, whereas cold water infusions are used to bathe inflamed eyelids. It is in use by forest tribes (Orang Asli) to treat headache and back-aches. The large inflorescences are sometimes cut for ornamental purposes."
	Wagstaff, D.J. 2008. International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	Z. officinal reported to cause dermatitis, but no evidence for Z. spectabile

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	Notes
	Wolff, X.Y., Astuti, I.P. & Brink, M., 1999. Zingiber G.R. Boehme [Internet] Record from Proseabase. de Guzman, C.C. and Siemonsma, J.S. (Editors). PROSEA (Plant Resources of South East Asia) Foundation, Bogor, Indonesia. http://www.proseanet.org . [Accessed 7 Jan 2015]	[No evidence. Growth habit and habitat would likely prevent fire] "Erect, robust perennial herbs, with several leafy stems, 0.5-3.5 m tall." ... "Ecology Zingiber is commonly found in moist, partially shaded evergreen and monsoon forests on soils rich in organic matter, but also in secondary forests, open habitats at forest edges, disturbed sites and bamboo thickets on rocky soils, at altitudes up to 3000 m. Zingiber spectabile grows in evergreen forests, but also along trails, roadsides, streams and forest edges, on hillsides and disturbed sites, at altitudes up to 1000 m."

409	Is a shade tolerant plant at some stage of its life cycle	y
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Qsn #	Question	Answer
	Source(s)	Notes
	Chee, B.J. & Lau, K.H. 2010. The spectacular ginger : <i>Zingiber spectabile</i> Griffith. Malaysian Naturalist. September 2010: 12-13	"It can be found growing under the shade in evergreen forests, along trails, roadsides, streams and edges of the forest up to 1000m altitudes."
	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	[Presumably shade tolerant] " <i>Zingiber spectabile</i> is native to Malaysia, where it is a common and conspicuous element in the forest understory."

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
	Source(s)	Notes
	Learn 2 Grow. 2015. <i>Zingiber spectabile</i> . http://www.learn2grow.com/plants/zingiber-spectabile/ . [Accessed 8 Jan 2015]	"Soil pH - Acidic, Neutral Soil Drainage - Average Soil type - Loam, Sand"

411	Climbing or smothering growth habit	n
	Source(s)	Notes
	Wolff, X.Y., Astuti, I.P. & Brink, M., 1999. <i>Zingiber G.R. Boehme</i> [Internet] Record from Proseabase. de Guzman, C.C. and Siemonsma, J.S. (Editors). PROSEA (Plant Resources of South East Asia) Foundation, Bogor, Indonesia. http://www.proseanet.org . [Accessed 7 Jan 2015]	"Erect, robust perennial herbs, with several leafy stems, 0.5-3.5 m tall. Rhizome horizontal, fleshy, aromatic, at or near soil surface."

412	Forms dense thickets	
	Source(s)	Notes
	Olivero Lora, S. & Dunnink, J.A.C.M. 2014. The gingers are invading: an investigation of the role of humans on the dispersal of the invasive shampoo ginger (<i>Zingiber spectabile</i>). Student Project. Organization for Tropical Studies. https://aiteots.wordpress.com/ . [Accessed 8 Jan 2015]	[Unknown] "Additionally, it seems that the invasive ginger, <i>Zingiber spectabile</i> , is outcompeting the local native ginger species, <i>Renealmia cernua</i> ."

501	Aquatic	n
	Source(s)	Notes
	Wolff, X.Y., Astuti, I.P. & Brink, M., 1999. <i>Zingiber G.R. Boehme</i> [Internet] Record from Proseabase. de Guzman, C.C. and Siemonsma, J.S. (Editors). PROSEA (Plant Resources of South East Asia) Foundation, Bogor, Indonesia. http://www.proseanet.org . [Accessed 7 Jan 2015]	[Terrestrial] " <i>Zingiber spectabile</i> grows in evergreen forests, but also along trails, roadsides, streams and forest edges, on hillsides and disturbed sites, at altitudes up to 1000 m."

502	Grass	n
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Qsn #	Question	Answer
	Source(s)	Notes
	Wolff, X.Y., Astuti, I.P. & Brink, M., 1999. <i>Zingiber G.R. Boehme</i> [Internet] Record from Proseabase. de Guzman, C.C. and Siemonsma, J.S. (Editors). PROSEA (Plant Resources of South East Asia) Foundation, Bogor, Indonesia. http://www.proseanet.org . [Accessed 7 Jan 2015]	Zingiberaceae

503	Nitrogen fixing woody plant	n
	Source(s)	Notes
	Wolff, X.Y., Astuti, I.P. & Brink, M., 1999. <i>Zingiber G.R. Boehme</i> [Internet] Record from Proseabase. de Guzman, C.C. and Siemonsma, J.S. (Editors). PROSEA (Plant Resources of South East Asia) Foundation, Bogor, Indonesia. http://www.proseanet.org . [Accessed 7 Jan 2015]	Zingiberaceae

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	Notes
	Wolff, X.Y., Astuti, I.P. & Brink, M., 1999. <i>Zingiber G.R. Boehme</i> [Internet] Record from Proseabase. de Guzman, C.C. and Siemonsma, J.S. (Editors). PROSEA (Plant Resources of South East Asia) Foundation, Bogor, Indonesia. http://www.proseanet.org . [Accessed 7 Jan 2015]	"Erect, robust perennial herbs, with several leafy stems, 0.5-3.5 m tall. Rhizome horizontal, fleshy, aromatic, at or near soil surface."
	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. <i>Plant Protection Quarterly</i> , 25(2): 56-74	"This question addresses taxa that have specialized organs and should not include plants with just rhizomes/ stolons"

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	Notes
	Wolff, X.Y., Astuti, I.P. & Brink, M., 1999. <i>Zingiber G.R. Boehme</i> [Internet] Record from Proseabase. de Guzman, C.C. and Siemonsma, J.S. (Editors). PROSEA (Plant Resources of South East Asia) Foundation, Bogor, Indonesia. http://www.proseanet.org . [Accessed]	No evidence

602	Produces viable seed	y
	Source(s)	Notes
	Montoso Gardens. 2007. <i>Zingiber spectabile</i> (Zingiberaceae). http://www.montosogardens.com/zingiber_spectabile.htm . [Accessed 8 Jan 2015]	"Propagated by division, stem cuttings and seeds."

Qsn #	Question	Answer
	Dave's Garden. 2015. PlantFiles: Beehive Ginger, Nodding Gingerwort - <i>Zingiber spectabile</i> . http://davesgarden.com/guides/pf/go/155693/ . [Accessed 8 Jan 2015]	"Seed Collecting: Allow seedheads to dry on plants; remove and collect seeds. Seed does not store well; sow as soon as possible"
	Blanchett, S. 2010. Growing your <i>Zingiber spectabile</i> seed. The Spectabilis Ginger or Beehive Ginger. http://www.members.westnet.com.au/wackos/PDFs/Growing 20your%20zingiber%20specable%20seed.pdf . [Accessed 8 Jan 2015]	"Sow your seeds on a well drained medium such as 75% sand and 25% Peat moss, or a potting mix with 50% coarse sand added to it. Just cover the seed with a sieved layer of sand or potting mix. Keep them in a very bright, filtered light location and maintain consistent moisture levels, not sopping wet, just nice and moist. It may take up to a month for all the seed to germinate, don't throw them out!"

603	Hybridizes naturally	
	Source(s)	Notes
	Ravindran, P. N. & Nirmal Babu, K. (eds.). 2005. <i>Ginger: The Genus Zingiber</i> . CRC Press, Boca Raton, FL	[Unknown] "Ramachandran (1969) studied the cytology of five species of <i>Zingiber</i> (<i>Z. macrostachyum</i> , <i>Z. roseum</i> , <i>Z. wightianum</i> , <i>Z. zerumbet</i> , and <i>Z. officinale</i>) and found a diploid number of $2n \approx 22$ in all species. He found evidence of structural hybridity involving interchanges and inversions in ginger. Mahanty (1970) studied the cytology of Zingiberales. He reported $2n \approx 22$ for <i>Z. spectabile</i> and <i>Z. cylindricum</i> and concluded that the genus <i>Zingiber</i> appears to be much more correctly placed in Hydychieae than in the Zingibereae."

604	Self-compatible or apomictic	
	Source(s)	Notes
	Ravindran, P. N. & Nirmal Babu, K. (eds.). 2005. <i>Ginger: The Genus Zingiber</i> . CRC Press, Boca Raton, FL	[Possibly] "Dhamayanthi et al. (2003) investigated the self-incompatibility system in ginger. They reported that heterostyly with a gametophytically controlled self-incompatibility system exists in ginger. Flowers are distylous, there are long ("pin") and short ("thrum") styles. The "pin" type has a slender style that protrudes out of the floral parts, which are short, covering not even half the length of the style."
	Holttum, R.E. 1950. <i>The Zingiberaceae of the Malay Peninsula</i> . The Garden's Bulletin Singapore. Vol. XIII. Part 1. Government Printing Office, Singapore	[Related species may be self-compatible] "But self-sterility cannot be universal, as I have found seeds produced by an isolated inflorescence of <i>Zingiber zerumbet</i> ."

605	Requires specialist pollinators	
	Source(s)	Notes
	Ravindran, P. N. & Nirmal Babu, K. (eds.). 2005. <i>Ginger: The Genus Zingiber</i> . CRC Press, Boca Raton, FL	"The flowers are usually cross-pollinated. The pollination in the species of <i>Zingiber</i> is rather simple because of the specially modified anther structure and nature of staminodes. An insect visiting a flower first lands on the labellum and moves to the throat of the corolla tube. When the insect's front portion pushes the base of the anther, the anther bends forward and dusts the pollen grains on the backside of the insect. As it bends forward, the stigma protrudes and arches through the long anther crest and presses against the proboscis of the insect. Thus, pollen grains from other flowers deposited on the back of the insect stick to the stigma, and pollination is effected."

Qsn #	Question	Answer
	Momose, K., Yumoto, T., Nagamitsu, T., Kato, M., Nagamasu, H., Sakai, S., Rhett, Harrison, D., Itioka, T., Hamid, A. A. & Inoue, T. 1998. Pollination biology in a lowland dipterocarp forest in Sarawak, Malaysia. I. Characteristics of the plant-pollinator community in a lowland dipterocarp forest. <i>American Journal of Botany</i> , 85(10): 1477-1501	[Possibly] "TABLE 1. Numbers of genera and species, and main pollination systems of the 73 plant families observed in a lowland dipterocarp forest in Sarawak, Malaysia." [Zingiberaceae - Pollination systems = Amegilla, Nomia, bird] "Amegilla pollination—Seventeen species in six families (Costaceae, Gesneriaceae, Marantaceae, Pentaphragmataceae, Polygalaceae, and Zingiberaceae) were pollinated only by the trap-lining long-tongued bees," ... "Twenty-one species in nine families (Zingiberaceae, Verbenaceae, Acanthaceae, etc.) were pollinated by smaller trap-lining bees, Nomia spp." ... "Bird pollination—Nineteen species in seven families were pollinated by birds"

606	Reproduction by vegetative fragmentation	y
	Source(s)	Notes
	Simpson, D. 2014. Some Magnetic Island Plants. http://www.somemagneticislandplants.com.au/ . [Accessed 8 Jan 2015]	"Beehive Ginger grows to about 3 m high or more, arising from a fleshy, creeping rhizome." ... "Propagation is by division, including offsets."
	Staples, G.W. & Herbst, D.R. 2005. <i>A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places</i> . Bishop Museum Press, Honolulu, HI	[Spreads by rhizomes] "Nodding gingerwort is an aggressive plant that can rapidly expand out of the area where it is planted, and vigorous control may be necessary to keep it confined."

607	Minimum generative time (years)	2
	Source(s)	Notes
	Ravindran, P. N. & Nirmal Babu, K. (eds.). 2005. <i>Ginger: The Genus Zingiber</i> . CRC Press, Boca Raton, FL	[Likely 2+ years] "The plants are perennial, medium-sized herbs with stout rhizomes. Most of the species produce the inflorescence on a separate shoot directly from the rhizome, at the tips of a short or long peduncle."

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	n
	Source(s)	Notes
	Holttum, R.E. 1950. <i>The Zingiberaceae of the Malay Peninsula</i> . The Garden's Bulletin Singapore. Vol. XIII. Part 1. Government Printing Office, Singapore	[No evidence, and seeds, if produced, are small but lack means of external attachment] "Fruit about 2-5 cm. long, ellipsoid, covered with the bracteole ; seeds up to 6 in each loculus, black when ripe, ellipsoid, 6 mm. long, covered 2/3 from base by a white aril with fimbriate or lobed edge."

Qsn #	Question	Answer
702	Propagules dispersed intentionally by people	y
	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	"Nodding gingerwort is occasionally cultivated in Hawaii for its attractive flower heads."
	Wolff, X.Y., Astuti, I.P. & Brink, M., 1999. Zingiber G.R. Boehme [Internet] Record from Proseabase. de Guzman, C.C. and Siemonsma, J.S. (Editors). PROSEA (Plant Resources of South East Asia) Foundation, Bogor, Indonesia. http://www.proseanet.org . [Accessed 7 Jan 2015]	"Zingiber spectabile is found in Peninsular Malaysia and peninsular Thailand. Throughout the tropics it is occasionally cultivated as an ornamental."
703	Propagules likely to disperse as a produce contaminant	n
	Source(s)	Notes
	Holttum, R.E. 1950. The Zingiberaceae of the Malay Peninsula. The Garden's Bulletin Singapore. Vol. XIII. Part 1. Government Printing Office, Singapore	[No evidence. Propagation is typically by rhizome division] "Fruit about 2-5 cm. long, ellipsoid, covered with the bracteole ; seeds up to 6 in each loculus, black when ripe, ellipsoid, 6 mm. long, covered 2/3 from base by a white aril with fimbriate or lobed edge."
704	Propagules adapted to wind dispersal	n
	Source(s)	Notes
	Holttum, R.E. 1950. The Zingiberaceae of the Malay Peninsula. The Garden's Bulletin Singapore. Vol. XIII. Part 1. Government Printing Office, Singapore	"Fruit about 2-5 cm. long, ellipsoid, covered with the bracteole ; seeds up to 6 in each loculus, black when ripe, ellipsoid, 6 mm. long, covered 2/3 from base by a white aril with fimbriate or lobed edge."
705	Propagules water dispersed	
	Source(s)	Notes
	Wolff, X.Y., Astuti, I.P. & Brink, M., 1999. Zingiber G.R. Boehme [Internet] Record from Proseabase. de Guzman, C.C. and Siemonsma, J.S. (Editors). PROSEA (Plant Resources of South East Asia) Foundation, Bogor, Indonesia. http://www.proseanet.org . [Accessed 8 Jan 2015]	[Unknown. Streamside distribution suggests water may aid in dispersal of rhizome fragments, or seeds, if produced] "Zingiber spectabile grows in evergreen forests, but also along trails, roadsides, streams and forest edges, on hillsides and disturbed sites"
706	Propagules bird dispersed	
	Source(s)	Notes
	Holttum, R.E. 1950. The Zingiberaceae of the Malay Peninsula. The Garden's Bulletin Singapore. Vol. XIII. Part 1. Government Printing Office, Singapore	[Arillate seed, if produced, may promote dispersal by birds] "Fruit about 2-5 cm. long, ellipsoid, covered with the bracteole ; seeds up to 6 in each loculus, black when ripe, ellipsoid, 6 mm. long, covered 2/3 from base by a white aril with fimbriate or lobed edge."

Qsn #	Question	Answer
	Olivero Lora, S. & Dunnink, J.A.C.M. 2014. The gingers are invading: an investigation of the role of humans on the dispersal of the invasive shampoo ginger (<i>Zingiber spectabile</i>). Student Project. Organization for Tropical Studies. https://aiteots.wordpress.com/ . [Accessed 8 Jan 2015]	[Possibly. Students speculate that seeds are bird dispersed] "We found that seeds were randomly dispersed within 50 meters of the trails. It seems that humans are not playing a massive role in dispersing these seeds. It is possible that humans originally dispersed these seeds along the various trails in Las Cruces. These plants were left to grow and spread throughout the forest allowing them to be dispersed deep into the forest by small mammals, birds and ants."

707	Propagules dispersed by other animals (externally)	
	Source(s)	Notes
	Holttum, R.E. 1950. The Zingiberaceae of the Malay Peninsula. The Garden's Bulletin Singapore. Vol. XIII. Part 1. Government Printing Office, Singapore	[Arillate seed, if produced, may promote external dispersal by ants] "Fruit about 2-5 cm. long, ellipsoid, covered with the bracteole ; seeds up to 6 in each loculus, black when ripe, ellipsoid, 6 mm. long, covered 2/3 from base by a white aril with fimbriate or lobed edge."

708	Propagules survive passage through the gut	
	Source(s)	Notes
	Holttum, R.E. 1950. The Zingiberaceae of the Malay Peninsula. The Garden's Bulletin Singapore. Vol. XIII. Part 1. Government Printing Office, Singapore	[Arillate seed, if produced, may promote internal dispersal by birds] "Fruit about 2-5 cm. long, ellipsoid, covered with the bracteole ; seeds up to 6 in each loculus, black when ripe, ellipsoid, 6 mm. long, covered 2/3 from base by a white aril with fimbriate or lobed edge."
	Olivero Lora, S. & Dunnink, J.A.C.M. 2014. The gingers are invading: an investigation of the role of humans on the dispersal of the invasive shampoo ginger (<i>Zingiber spectabile</i>). Student Project. Organization for Tropical Studies. https://aiteots.wordpress.com/ . [Accessed 8 Jan 2015]	[Possibly. Student authors speculate that seeds are dispersed by birds] "These plants were left to grow and spread throughout the forest allowing them to be dispersed deep into the forest by small mammals, birds and ants."

801	Prolific seed production (>1000/m2)	n
	Source(s)	Notes
	Holttum, R.E. 1950. The Zingiberaceae of the Malay Peninsula. The Garden's Bulletin Singapore. Vol. XIII. Part 1. Government Printing Office, Singapore	"Fruit about 2-5 cm. long, ellipsoid, covered with the bracteole ; seeds up to 6 in each loculus, black when ripe, ellipsoid, 6 mm. long, covered 2/3 from base by a white aril with fimbriate or lobed edge."
	Wolff, X.Y., Astuti, I.P. & Brink, M., 1999. <i>Zingiber G.R. Boehme</i> [Internet] Record from Proseabase. de Guzman, C.C. and Siemonsma, J.S. (Editors). PROSEA (Plant Resources of South East Asia) Foundation, Bogor, Indonesia. http://www.proseanet.org . [Accessed 8 Jan 2015]	"Zingiber is generally propagated by division of rhizomes."
	WRA Specialist. 2015. Personal Communication	Unlikely. Most propagation information recommends division of rhizomes. Seed production in cultivation appears to be limited

802	Evidence that a persistent propagule bank is formed (>1 yr)	n

Qsn #	Question	Answer
	Source(s)	Notes
	Hardy Tropical Plants. 2015. <i>Zingiber spectabile</i> . http://www.hardytrropicalplants.com/2012/07/zingiber-spectabile.html#.VK7UmnvfAbg . [Accessed 8 Jan 2015]	"The seeds quickly lose their ability to germinate, so sow as soon as possible."

803	Well controlled by herbicides	y
	Source(s)	Notes
	Motooka, P., Ching, L. & Nagai, G. 2002. Herbicidal Weed Control Methods for Pasture and Natural Areas of Hawaii. CTAHR free publication WC-8. CTAHR, UH Manoa, Honolulu, HI	[Likely Yes. Herbicides are effective at controlling more invasive <i>Hedychium</i> species] "Metsulfuron Escort®, 60% dry flowable (DuPont) Ally®, 60% dry flowable (DuPont)...Use: Selective control of dicots in pastures and noncropland. Kahili ginger, yellow ginger and white ginger very sensitive (0.5 oz. product / acre). Application: Foliar spray 0.06-0.45 oz active/acre, with an effective surfactant, in 20-100 gal/acre. Very low doses effective. Extreme precautions should be taken to prevent drift and in cleaning equipment. Weeds can develop cross resistance between sulfonylureas (e.g., metsulfuron, sulfometuron) and imidazolinones (e.g., imazapyr) if any one or combination of these types of chemicals are used repeatedly over 4-6 years."

804	Tolerates, or benefits from, mutilation, cultivation, or fire	y
	Source(s)	Notes
	Simpson, D. 2014. Some Magnetic Island Plants. http://www.somemagneticislandplants.com.au/ . [Accessed 8 Jan 2015]	[Presumably Yes] "Beehive Ginger grows to about 3 m high or more, arising from a fleshy, creeping rhizome." ... "Propagation is by division, including offsets."

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	Notes
	Paret, M. L., de Silva, A. S., Criley, R. A., & Alvarez, A. M. 2008. <i>Ralstonia solanacearum</i> race 4: Risk assessment for edible ginger and floricultural ginger industries in Hawaii. HortTechnology, 18(1): 90-96	[Possibly Yes] "Fourteen species of ginger belonging to Zingiberaceae and Costaceae were evaluated for susceptibility to the bacterial wilt pathogen <i>Ralstonia solanacearum</i> (Rs) race 4 (ginger strains) by several methods of inoculation, including tests to simulate natural infection." ... "The kahili ginger strain of Rs (A4679) wilted all 11 ginger species tested when plants were inoculated without wounding (Fig. 2). Shampoo ginger, beehive ginger, spiral ginger, and kahili ginger were highly susceptible and died within 38 d."

Summary of Risk Traits:

High Risk / Undesirable Traits

- Thrives in tropical climates
- Possibly naturalizing and invasive in Costa Rica
- Other Zingiber species are regarded as invasive
- Shade tolerant
- Tolerates many soil types
- Seeds, when produced, may be dispersed by birds or other animals
- Spreads by rhizomes
- Limited ecological information makes accurate risk prediction difficult

Low Risk Traits

- Unarmed (no spines, thorns or burrs)
- Non-toxic
- Ornamental
- Seeds, if produced, lose viability quickly
- Herbicides may provide effective control

Second Screening Results for Low Stature Shrubby Life Form

(A) Reported as a weed of cultivated lands? Possibly. Reported as an escape in Costa Rica. Limited information on impacts at this time

Outcome = Evaluate