

Taxon: <i>Zingiber officinale</i> Roscoe	Family: Zingiberaceae
Common Name(s): Canton ginger common ginger culinary ginger ginger green ginger Jamaican ginger stem ginger true ginger	Synonym(s): <i>Amomum zingiber</i> L. <i>Curcuma longifolia</i> Wall

Assessor: Chuck Chimera	Status: Assessor Approved	End Date: 25 May 2023
WRA Score: 3.0	Designation: L	Rating: Low Risk

Keywords: Domesticated Herb, Naturalized Elsewhere, Shade Tolerant, Rarely Seeds, Spreads Vegetatively

Qsn #	Question	Answer Option	Answer
101	Is the species highly domesticated?	y=-3, n=0	y
102	Has the species become naturalized where grown?	y=1, n=-1	y
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	y = 1*multiplier (see Appendix 2), n= question 205	y
302	Garden/amenity/disturbance weed	n=0, y = 1*multiplier (see Appendix 2)	n
303	Agricultural/forestry/horticultural weed		
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	y=1, n=-1	y

Qsn #	Question	Answer Option	Answer
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
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	y
601	Evidence of substantial reproductive failure in native habitat	y=1, n=0	n
602	Produces viable seed		
603	Hybridizes naturally	y=1, n=-1	n
604	Self-compatible or apomictic	y=1, n=-1	n
605	Requires specialist pollinators	y=-1, n=0	n
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	1
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)		
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)	y=-1, n=1	y

Supporting Data:

Qsn #	Question	Answer
101	Is the species highly domesticated?	y
	Source(s)	Notes
	Guzman, C. C. de & Siemonsma, J. S. (eds.). (1999). Plant resources of South-East Asia, No.13. Spices. Backhuys Publishers, Leiden, The Netherlands	"Ginger has been grown in tropical Asia since ancient times. Wild forms of ginger have not been found and its origin is uncertain, although it is thought to come from India."
	Nair, K. P. (2019). Turmeric (<i>Curcuma Longa</i> L.) and Ginger (<i>Zingiber Officinale</i> Rosc.)-World's Invaluable Medicinal Spices: The Agronomy and Economy of Turmeric and Ginger. Springer Nature, Cham, Switzerland	"There is no wild state in which ginger occurs in nature. The most probable place of its origin is Southeast Asia, but it has been cultivated from time immemorial in India and China. No definite information exists on the primary center of domestication. On account of the ease of transporting the ginger rhizome over long distances, it has spread throughout the tropical and subtropical regions of the Southern Hemisphere. In fact, ginger is the most widely cultivated spice (Lawrence 1984)."

102	Has the species become naturalized where grown?	y
	Source(s)	Notes
	Mbaveng, A. T., & Kuete, V. (2017). <i>Zingiber officinale</i> . In Medicinal Spices and Vegetables from Africa (pp. 627-639). Academic Press, London, UK	" <i>Z. officinale</i> has become naturalized in many countries, and now has a wide distribution throughout tropical and subtropical parts of the world."
	CABI. (2023). Invasive Species Compendium. Wallingford, UK: CAB International. https://www.cabidigitallibrary.org/product/qi . [Accessed 22 May 2023]	" <i>Z. officinale</i> is a perennial herb widely cultivated in the tropics and which occasionally naturalizes. It mostly spreads vegetatively since many cultivars seldom flower or are sterile (Sutarno et al., 1999; Flowers of India, 2016). It is listed as invasive in Taiwan (Taiwan Invasive Species Database, 2016) and as a weed in Puerto Rico and Queensland, Australia (Randall, 2012). No information on impacts could be found."

103	Does the species have weedy races?	
	Source(s)	Notes
	CABI. (2023). Invasive Species Compendium. Wallingford, UK: CAB International. https://www.cabidigitallibrary.org/product/qi . [Accessed 22 May 2023]	[Potential weed of unspecified impacts in a few locations] " <i>Z. officinale</i> is a perennial herb widely cultivated in the tropics and which occasionally naturalizes. It mostly spreads vegetatively since many cultivars seldom flower or are sterile (Sutarno et al., 1999; Flowers of India, 2016). It is listed as invasive in Taiwan (Taiwan Invasive Species Database, 2016) and as a weed in Puerto Rico and Queensland, Australia (Randall, 2012). No information on impacts could be found."

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
	Lim, T.K. (2016). Edible Medicinal And Non-Medicinal Plants. Volume 12, Modified Stems, Roots, Bulbs. Springer, Dordrecht	"The species is reported to be indigenous in Southeast Asia (Ravindran and Babu 2005) and is distributed from India to South Central China (Govaert 2014). It is widely cultivated in the tropics and subtropics in Asia, Africa and the Caribbean."

Qsn #	Question	Answer
202	Quality of climate match data	High
	Source(s)	Notes
	Lim, T.K. (2016). Edible Medicinal And Non-Medicinal Plants. Volume 12, Modified Stems, Roots, Bulbs. Springer, Dordrecht	"The species is reported to be indigenous in Southeast Asia (Ravindran and Babu 2005) and is distributed from India to South Central China (Govaert 2014). It is widely cultivated in the tropics and subtropics in Asia, Africa and the Caribbean."

203	Broad climate suitability (environmental versatility)	y
	Source(s)	Notes
	Guzman, C. C. de & Siemonsma, J. S. (eds.). (1999). Plant resources of South-East Asia, No.13. Spices. Backhuys Publishers, Leiden, The Netherlands	"Ginger is grown in the tropics from sea-level up to 1500 m altitude, but is mostly found at low altitudes. The crop prefers warm, sunny conditions, and though it may benefit from shade during hot periods, especially when young, shading is generally considered unnecessary. The optimum rainfall is 2500-3000 mm, well-distributed over the year. Below 2000 mm, supplementary irrigation is necessary, but ginger seldom succeeds as an irrigated crop in dry areas, because the required humidity cannot be maintained profitably. Ginger is very sensitive to waterlogging. "
	Lim, T.K. (2016). Edible Medicinal And Non-Medicinal Plants. Volume 12, Modified Stems, Roots, Bulbs. Springer, Dordrecht	"In tropical Asia, ginger is found in warm, humid monsoon forests. It requires a frost-free climate and 1500 mm of rain annually or supplementary irrigation."
	WRA Specialist. (2023). Personal Communication	Can grow over a range in excess of 1000 m in regions with tropical climates.

204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	Notes
	Guzman, C. C. de & Siemonsma, J. S. (eds.). (1999). Plant resources of South-East Asia, No.13. Spices. Backhuys Publishers, Leiden, The Netherlands	"Ginger is grown in the tropics from sea-level up to 1500 m altitude, but is mostly found at low altitudes. The crop prefers warm, sunny conditions, and though it may benefit from shade during hot periods, especially when young, shading is generally considered unnecessary. The optimum rainfall is 2500-3000 mm, well-distributed over the year. Below 2000 mm, supplementary irrigation is necessary, but ginger seldom succeeds as an irrigated crop in dry areas, because the required humidity cannot be maintained profitably. Ginger is very sensitive to waterlogging."
	Lim, T.K. (2016). Edible Medicinal And Non-Medicinal Plants. Volume 12, Modified Stems, Roots, Bulbs. Springer, Dordrecht	"The species is reported to be indigenous in Southeast Asia (Ravindran and Babu 2005) and is distributed from India to South Central China (Govaert 2014). It is widely cultivated in the tropics and subtropics in Asia, Africa and the Caribbean."

Qsn #	Question	Answer
205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	Notes
	Lim, T.K. (2016). Edible Medicinal And Non-Medicinal Plants. Volume 12, Modified Stems, Roots, Bulbs. Springer, Dordrecht	"It is widely cultivated in the tropics and subtropics in Asia, Africa and the Caribbean."
	Nair, K. P. (2019). Turmeric (<i>Curcuma Longa</i> L.) and Ginger (<i>Zingiber Officinale</i> Rosc.)-World's Invaluable Medicinal Spices: The Agronomy and Economy of Turmeric and Ginger. Springer Nature, Cham, Switzerland	"On account of the ease of transporting the ginger rhizome over long distances, it has spread throughout the tropical and subtropical regions of the Southern Hemisphere. In fact, ginger is the most widely cultivated spice (Lawrence 1984)."
	Gallaher, T.J., Brock, K., Kennedy, B.H., Imada, C.T., Imada, K., & Walvoord, N. (2023). Plants of Hawai'i. http://www.plantsofhawaii.org.. [Accessed 22 May 2023]	"Only found in cultivation "

301	Naturalized beyond native range	y
	Source(s)	Notes
	Gallaher, T.J., Brock, K., Kennedy, B.H., Imada, C.T., Imada, K., & Walvoord, N. (2023). Plants of Hawai'i. http://www.plantsofhawaii.org.. [Accessed 22 May 2023]	"Only found in cultivation "
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"References: Federated States of Micronesia-N-230, Puerto Rico-CW-261, Australia-CN-368, Africa-W-760, Taiwan-N-777, Costa Rica-I-975, United States of America-N-101, Australia-N-945, Mexico-N-791, Belize-N-850, Australia-W-869, Costa Rica-CN-872, Mozambique-nC-943, Gal pagos Islands-CN-1157, China-N-1215, French Guiana-N-1346, Taiwan-N-1403, Cuba-NI-1505, Global-CD-1611, Taiwan-W-1748, Myanmar-N-1796, Borneo-N-1796, Cambodia-N-1796, Sri Lanka-N-1796, Sao Tome and Principe-N-1805, El Salvador-N-1849, Cameroon-A-1867, -I-, Cuba-I-2055, Australia-W-1977, Costa Rica-W-1977, Cuba-W-1977, Democratic Republic of the Congo-W-1977, Japan-W-1977, Taiwan-W-1977."
	Mbaveng, A. T., & Kuete, V. (2017). <i>Zingiber officinale</i> . In Medicinal Spices and Vegetables from Africa (pp. 627-639). Academic Press, London, UK	"Z. officinale has become naturalized in many countries, and now has a wide distribution throughout tropical and subtropical parts of the world."
	CABI. (2023). Invasive Species Compendium. Wallingford, UK: CAB International. https://www.cabidigitallibrary.org/product/qi . [Accessed 22 May 2023]	"Z. officinale is a perennial herb widely cultivated in the tropics and which occasionally naturalizes. It mostly spreads vegetatively since many cultivars seldom flower or are sterile (Sutarno et al., 1999; Flowers of India, 2016). It is listed as invasive in Taiwan (Taiwan Invasive Species Database, 2016) and as a weed in Puerto Rico and Queensland, Australia (Randall, 2012). No information on impacts could be found."

Qsn #	Question	Answer
302	Garden/amenity/disturbance weed	n
	Source(s)	Notes
	CABI. (2023). Invasive Species Compendium. Wallingford, UK: CAB International. https://www.cabidigitallibrary.org/product/qi . [Accessed 23 May 2023]	"Z. officinale is a perennial herb widely cultivated in the tropics and which occasionally naturalizes. It mostly spreads vegetatively since many cultivars seldom flower or are sterile (Sutarno et al., 1999; Flowers of India, 2016). It is listed as invasive in Taiwan (Taiwan Invasive Species Database, 2016) and as a weed in Puerto Rico and Queensland, Australia (Randall, 2012). No information on impacts could be found."
	Taiwan Invasive Species Database (2023). Taiwan Invasive Species Database. St. Louis, Missouri and Cambridge, Massachusetts: Missouri Botanical Garden and Harvard University Herbaria. http://www.efloras.org/florataxon.aspx?flora_id=102&taxon_id=200028468 . [Accessed 23 May 2023]	Included in database with no description, or evidence of impacts.

303	Agricultural/forestry/horticultural weed	
	Source(s)	Notes
	Ndam, L. M., Enang, J. E., Mih, A. M., & Egbe, A. E. (2014). Weed diversity in maize (<i>Zea mays</i> L.) fields in South Western Cameroon. <i>International Journal of Current Microbiology and Applied Sciences</i> , 3(11), 173-180	"A total of 53 weed species belonging to 28 angiosperm families were recorded from the study area (Table 1)." [Includes "Zingiber officinalis" [sic] but with no evidence or description of impacts]
	CABI. (2023). Invasive Species Compendium. Wallingford, UK: CAB International. https://www.cabidigitallibrary.org/product/qi . [Accessed 23 May 2023]	"Z. officinale is a perennial herb widely cultivated in the tropics and which occasionally naturalizes. It mostly spreads vegetatively since many cultivars seldom flower or are sterile (Sutarno et al., 1999; Flowers of India, 2016). It is listed as invasive in Taiwan (Taiwan Invasive Species Database, 2016) and as a weed in Puerto Rico and Queensland, Australia (Randall, 2012). No information on impacts could be found." [No evidence or description of impacts provided]
	WRA Specialist. (2023). Personal Communication	Zingiber officinale is generally not considered a weedy plant. It is cultivated in controlled environments and is not known to aggressively spread or invade natural habitats. However, in certain situations, ginger plants can exhibit weed-like characteristics.

304	Environmental weed	n
	Source(s)	Notes
	CABI. (2023). Invasive Species Compendium. Wallingford, UK: CAB International. https://www.cabidigitallibrary.org/product/qi . [Accessed 23 May 2023]	"Z. officinale is a perennial herb widely cultivated in the tropics and which occasionally naturalizes. It mostly spreads vegetatively since many cultivars seldom flower or are sterile (Sutarno et al., 1999; Flowers of India, 2016). It is listed as invasive in Taiwan (Taiwan Invasive Species Database, 2016) and as a weed in Puerto Rico and Queensland, Australia (Randall, 2012). No information on impacts could be found." [No evidence]
	Randall, R.P. (2017). <i>A Global Compendium of Weeds</i> . 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence

305	Congeneric weed	y
	Source(s)	Notes

Qsn #	Question	Answer
	CABI. (2023). Invasive Species Compendium. Wallingford, UK: CAB International. https://www.cabdigitallibrary.org/product/qi . [Accessed]	"Z. montanum 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, Z. montanum is considered a naturalized weed and cultivation escape (Acevedo-Rodríguez and Strong, 2005, Randall, 2012)."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	Several Zingiber species included in references of naturalized or weedy plants.

401	Produces spines, thorns or burrs	n
	Source(s)	Notes
	Guzman, C. C. de & Siemonsma, J. S. (eds.). (1999). Plant resources of South-East Asia, No.13. Spices. Backhuys Publishers, Leiden, The Netherlands	[No evidence] "Erect, slender, perennial herb usually grown as an annual, with a thickened, fleshy, subterranean rhizome and with one or more aerial leafy stems, up to 1.25 m tall. Rhizome robust, fleshy, up to 2 cm thick, growing horizontally underground but at shallow depth, irregularly branched but normally only in the vertical plane, covered with deciduous, thin scales which leave ring-like scars; epidermis corky, pale yellow to reddish, irregularly wrinkled in the dried rhizome; flesh pale yellow, aromatic; on dried rhizomes scars of leafy stems visible as shallow cup-like holes. Stem erect, unbranched, mainly formed by the leaf sheaths, pale green, often reddish at base; scales covering the lower part oblong, about 6 cm × 1 cm, scarcely white-pilose outside, with prominent parallel veins and scarios margins. Leaves distichous; sheath prominently veined, densely appressed pilose, especially so in the upper part, with white, scarios, glabrous margins; ligule up to 5 mm long, bilobed, glabrous to sparsely pilose, scarios; blade linear to lanceolate, up to 30 cm × 2 cm, acuminate at apex, finely parallel-veined, glabrous above, scarcely pilose below, light to dark green. Inflorescence arises direct from rhizome, spiciform, 15-30 cm long; scape slender, 10-20 cm long, below the spike covered with scales as on the leafy stem bases, the upper ones sometimes with short leafy tips; spike ovoid to narrow ellipsoidal, 4-7 cm × 1.5-2.5 cm, light green; bracts appressed, ovate to elliptical, 2-3 cm × 1.5-2 cm, yellow-green, margin scarios, incurved, the lower ones with slender whitish acute tips, glabrous, finely parallel-lined; in the axil of each bract one flower may be produced. Flowers fragile, short-lived, surrounded by a spatha-like bracteole; bracteole narrower and slightly longer than the bract, usually persisting and enclosing the fruit; calyx tubular-spathaceous, 10-12 mm long, whitish; corolla tubular, pale yellow, widening at top into 3 lobes, tube 18-25 mm long, dorsal lobe long ovate, 15-25 mm × 7-8 mm, with beak-like rounded apex curved over the anther, ventral lobes oblong, 13-15 mm × 2-3 mm, apex rounded, 3-veined, strongly recurved; labellum about circular in outline, 12-15 mm in diameter, tubular at base (tube 3-4 mm), 3-lobed above; central lobe obovate, 12 mm × 9 mm, side lobes elliptical, 5 mm × 3.5 mm; labellum pale yellow outside, inside dark purple or red at top and at margins, mixed with yellowish spots, scattered pilose at throat; filament about 1.5 mm long, anther 2-celled, ellipsoidal, 7-9 mm × 3 mm, pale yellow, connectivum prolonged into a slender, curved, purple, beak-like appendage 7 mm long, enclosing the upper part of the style; ovary globose, 2 mm in diameter, 3-locular; style filiform, 3.5 cm long, white, slightly recurved and widening at top, ending in a funnel-shaped white stigma which is ringed with stiff hairs around its upper margin; 2-3 fleshy, sublinear, white nectaries, 5 mm long, are situated against the style on top of the ovary. Fruit a thin-walled capsule, 3-valved, red. Seed small, arillate, black."

402	Allelopathic	
-----	--------------	--

Qsn #	Question	Answer
	Source(s)	Notes
	Lim, T.K. (2016). Edible Medicinal And Non-Medicinal Plants. Volume 12, Modified Stems, Roots, Bulbs. Springer, Dordrecht	
	Basalingamma, P., Kumar, N. H., & Jagannath, S. (2015). Allelopathic efficacy of aqueous extracts of <i>Zingiber officinale</i> Rosc. on germination, vigour, growth and yield of <i>Vigna radiata</i> L. Journal of Applied Biology and Biotechnology, 3(5), 048-051	[Possibly. Extracts demonstrate allelopathic effects] "In the present study efficacy of aqueous extracts of rhizome, stem and leaves of <i>Zingiber officinale</i> were studied on germination, growth and yield parameters of <i>Vigna radiata</i> . Seed germination and its associated parameters like vigour index, tolerance index, root and shoot length, fresh and dry weight were found to be decreased considerably as the concentration of stem and leaves extracts increased, when compared to control. Where as in rhizome extract the maximum values were observed in 10% concentration for all parameters when compared to control. On the converse the phytotoxicity was found to be increased in stem and leaves extracts as the concentration increased when compared to control. All the measured yield parameters like height of the plant, number of leaves per plant, number of branches per pant, number of pods per plant and number of seeds per pod were found to be decreased as the concentration of leaves and stem extracts increased when compared to control. On the other hand in rhizome extract the maximum values were observed in 10% concentration when compare to control and all other concentrations. In all the above parameters were studied the maximum and minimum values were recorded in control and 50% concentrations in stem and leaves extracts whereas in rhizome extract maximum and minimum values were recorded in 10% and 50% concentrations respectively."
	WRA Specialist. (2023). Personal Communication	A number of studies, including the one cited in this assessment, demonstrate allelopathic properties of <i>Zingiber officinale</i> extracts. It is unclear whether or not whole plants are allelopathic on neighboring vegetation.

403	Parasitic	n
	Source(s)	Notes
	Guzman, C. C. de & Siemonsma, J. S. (eds.). (1999). Plant resources of South-East Asia, No.13. Spices. Backhuys Publishers, Leiden, The Netherlands	"Erect, slender, perennial herb usually grown as an annual, with a thickened, fleshy, subterranean rhizome and with one or more aerial leafy stems, up to 1.25 m tall." [Zingiberaceae. No evidence]

404	Unpalatable to grazing animals	y
	Source(s)	Notes
	The Spruce. (2023). 18 Deer-Resistant Shade Plants to Have in Your Garden. https://www.thespruce.com/deer-resistant-shade-plants-7499831 . [Accessed 24 May 2023]	"Unlike the unrelated culinary ginger (<i>Zingiber officinale</i>), eating wild ginger is not recommended. Despite this, the plant makes a fantastic deer-resistant addition to any shade garden."

405	Toxic to animals	n
	Source(s)	Notes
	Mathews, R. (2023). Can Dogs Eat Ginger, Should They? Published: November 9, 2022. A-Z Animals. https://webcache.googleusercontent.com/search?q=cache:is0gZ--R6TEJ:https://a-z-animals.com/blog/can-dogs-eat-ginger-should-they/&cd=24&hl=en&ct=clnk&gl=us . [Accessed 24 May 2023]	"Ginger is not toxic to dogs, but feeding them small amounts is important. Large amounts of ginger can create bloating and stomach ache plus vomiting and diarrhoea."

Qsn #	Question	Answer
	Iwu, M.M. (2014). Handbook of African Medicinal Plants, Second Edition. CRC Press, Boca Raton, FL	"Toxicity – No serious toxicity has been reported from using dry ginger, the oil, or any of its active constituents. Large doses have been reported as capable of causing CNS depression and cardiac arrhythmias."
	Quattrocchi, U. (2012). CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"Veterinary medicine, flowers of <i>Bauhinia vahlii</i> mixed with rhizome of <i>Zingiber officinale</i> and seeds of pepper pounded and given to treat fever of animals."
	WRA Specialist. (2023). Personal Communication	Consuming ginger root may cause problems for certain animals, but leaves are not reported to be toxic, and it is unlikely that animals would consume roots from growing plants.

406	Host for recognized pests and pathogens	
	Source(s)	Notes
	Guzman, C. C. de & Siemonsma, J. S. (eds.). (1999). Plant resources of South-East Asia, No. 13. Spices. Backhuys Publishers, Leiden, The Netherlands	"In general, diseases are more damaging in ginger than pests, so disease prevention or control is an essential component of commercial ginger growing. The most important diseases are rhizome rots, often caused by <i>Pythium</i> spp., <i>Fusarium</i> spp. and <i>Rosellinia</i> spp. The main symptom is degeneration of rhizomes into a black, putrefying mass, whereas aboveground the leaf tips, sheaths, margins, and gradually whole leaves turn yellow, followed by desiccation and death. Another widespread and serious disease is bacterial wilt, caused by <i>Pseudomonas solanacearum</i> , which occurs for instance in Indonesia, Malaysia, the Philippines and Thailand. The symptoms include progressive yellowing and wilting from the lower leaves to the whole plant, with badly affected stems and rhizomes yielding a milky exudate when cut. Leaf spots caused by <i>Colletotrichum</i> spp., <i>Helminthosporium</i> spp., <i>Cercospora</i> spp. and <i>Septoria</i> spp. are also common. Most insect pests are only of local importance. However, foliage pests may become damaging in a specific location or season. The most important foliage pest in Asia, especially India, is the shoot borer <i>Dichocrocis punctiferalis</i> . In the Philippines the shoot borer <i>Ostrinia furnacalis</i> is an important insect pest. Ginger is also attacked by nematodes (<i>Meloidogyne</i> spp.), inducing the formation of galls or swellings on the roots. Severe infestations may lead to the death of the crop. Control measures for the above diseases and pests include choosing a well-drained site for ginger cultivation, practising crop rotation and selecting healthy rhizomes and treating them with fungicides before planting. "

407	Causes allergies or is otherwise toxic to humans	n
	Source(s)	Notes
	Iwu, M.M. (2014). Handbook of African Medicinal Plants, Second Edition. CRC Press, Boca Raton, FL	"Toxicity – No serious toxicity has been reported from using dry ginger, the oil, or any of its active constituents. Large doses have been reported as capable of causing CNS depression and cardiac arrhythmias."
	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
	WRA Specialist. (2023). Personal Communication	Roots may be allergenic, but people are unlikely to come into contact with rhizomes from growing plants. Foliage not reported to be toxic or allergenic.

408	Creates a fire hazard in natural ecosystems	n
-----	---	---

Qsn #	Question	Answer
	Source(s)	Notes
	Lim, T.K. (2016). Edible Medicinal And Non-Medicinal Plants. Volume 12, Modified Stems, Roots, Bulbs. Springer, Dordrecht	[No evidence. An herbaceous plant not grown in fire prone habitats] "In tropical Asia, ginger is found in warm, humid monsoon forests. It requires a frost-free climate and 1500 mm of rain annually or supplementary irrigation." ... "A herbaceous perennial with slender, erect leafy shoot, 0.6 cm diameter and growing 50-100 cm high"

409	Is a shade tolerant plant at some stage of its life cycle	y
	Source(s)	Notes
	CABI. (2023). Invasive Species Compendium. Wallingford, UK: CAB International. https://www.cabdigitallibrary.org/product/qi . [Accessed 22 May 2023]	"Although high temperatures are required, at least during a part of the season the plant thrives best in partial shade. Full sun may cause damage to the leaves and subsequently poor plant growth."
	Lim, T.K. (2016). Edible Medicinal And Non-Medicinal Plants. Volume 12, Modified Stems, Roots, Bulbs. Springer, Dordrecht	"Light shade is required."
	Guzman, C. C. de & Siemonsma, J. S. (eds.). (1999). Plant resources of South-East Asia, No.13. Spices. Backhuys Publishers, Leiden, The Netherlands	"The crop prefers warm, sunny conditions, and though it may benefit from shade during hot periods, especially when young, shading is generally considered unnecessary. "

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	n
	Source(s)	Notes
	Lim, T.K. (2016). Edible Medicinal And Non-Medicinal Plants. Volume 12, Modified Stems, Roots, Bulbs. Springer, Dordrecht	"It thrives best on well-drained, loamy or alluvial fertile soils and likes the addition of well-rotted manure or compost. It is intolerant of waterlogging."
	Guzman, C. C. de & Siemonsma, J. S. (eds.). (1999). Plant resources of South-East Asia, No.13. Spices. Backhuys Publishers, Leiden, The Netherlands	"The preferred soils are medium loams with an adequate supply of organic matter, but ginger is grown on a wide range of soils with a pH of 6.0-7.0. As it is an exhaustive crop, the soil fertility must be high or manure should be applied. "

411	Climbing or smothering growth habit	n
	Source(s)	Notes
	Guzman, C. C. de & Siemonsma, J. S. (eds.). (1999). Plant resources of South-East Asia, No.13. Spices. Backhuys Publishers, Leiden, The Netherlands	"Erect, slender, perennial herb usually grown as an annual, with a thickened, fleshy, subterranean rhizome and with one or more aerial leafy stems, up to 1.25 m tall."

412	Forms dense thickets	
	Source(s)	Notes
	CABI. (2023). Invasive Species Compendium. Wallingford, UK: CAB International. https://www.cabdigitallibrary.org/product/qi . [Accessed 24 May 2023]	[Speculative and unconfirmed] "Presumably because this species is listed as invasive in Taiwan and weedy elsewhere (Randall, 2012) it is likely to form dense enough stands to alter habitat. However, no evidence could be found to support impacts to habitat or biodiversity."

Qsn #	Question	Answer
501	Aquatic	n
	Source(s)	Notes
	Guzman, C. C. de & Siemonsma, J. S. (eds.). (1999). Plant resources of South-East Asia, No.13. Spices. Backhuys Publishers, Leiden, The Netherlands	[Terrestrial] "Ginger is grown in the tropics from sea-level up to 1500 m altitude, but is mostly found at low altitudes."
502	Grass	n
	Source(s)	Notes
	USDA, Agricultural Research Service, National Plant Germplasm System. (2023). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/ . [Accessed 22 May 2023]	"Genus: Zingiber Family: Zingiberaceae Subfamily: Zingiberoideae Tribe: Zingibereae"
503	Nitrogen fixing woody plant	n
	Source(s)	Notes
	USDA, Agricultural Research Service, National Plant Germplasm System. (2023). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/ . [Accessed 22 May 2023]	"Genus: Zingiber Family: Zingiberaceae Subfamily: Zingiberoideae Tribe: Zingibereae"
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y
	Source(s)	Notes
	Guzman, C. C. de & Siemonsma, J. S. (eds.). (1999). Plant resources of South-East Asia, No.13. Spices. Backhuys Publishers, Leiden, The Netherlands	"Erect, slender, perennial herb usually grown as an annual, with a thickened, fleshy, subterranean rhizome and with one or more aerial leafy stems, up to 1.25 m tall. Rhizome robust, fleshy, up to 2 cm thick, growing horizontally underground but at shallow depth, irregularly branched but normally only in the vertical plane, covered with deciduous, thin scales which leave ring-like scars; epidermis corky, pale yellow to reddish, irregularly wrinkled in the dried rhizome; flesh pale yellow, aromatic; on dried rhizomes scars of leafy stems visible as shallow cup-like holes."
	KewScience. (2023). Plants of the World Online - <i>Zingiber officinale</i> Roscoe. http://powo.science.kew.org/ . [Accessed 22 May 2023]	"The native range of this species is India to S. Central China. It is a perennial or rhizomatous geophyte and grows primarily in the seasonally dry tropical biome."
601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	Notes
	Guzman, C. C. de & Siemonsma, J. S. (eds.). (1999). Plant resources of South-East Asia, No.13. Spices. Backhuys Publishers, Leiden, The Netherlands	"Ginger has been grown in tropical Asia since ancient times. Wild forms of ginger have not been found and its origin is uncertain, although it is thought to come from India. It was brought to Europe and East Africa by Arab traders from India. Together with pepper, ginger was one of the most commonly traded spices during the 13th-14th Centuries. From East Africa, the Portuguese brought ginger to West Africa and other regions of the tropics during the 16th Century. At about the same period the Spanish introduced ginger into Jamaica, which still produces high quality ginger. At present, ginger is cultivated throughout the humid tropics. "

Qsn #	Question	Answer
602	Produces viable seed	
	Source(s)	Notes
	Guzman, C. C. de & Siemonsma, J. S. (eds.). (1999). Plant resources of South-East Asia, No.13. Spices. Backhuys Publishers, Leiden, The Netherlands	"Breeding of ginger has been severely hampered by poor flowering and seed set."
	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	"Ginger rarely flowers and almost never sets seed, so propagation is always by vegetative means, usually by rhizome division."
	Ravindran, P. N. & Nirmal Babu, K. (eds.). (2005). Ginger: The Genus Zingiber. CRC Press, Boca Raton, FL	"The species is sterile and does not set seeds"
	Jaramillo, T. (2021-22). Zingiber officinale L. Monograph. Colegio Bolivar, Cali, Colombia	"There is no natural fruit or seed set in Zingiber officinale due to sterile pollen grains and self-incompatibility reactions. Nevertheless, artificial pollination and supplementation of required chemicals and nutrients to young flowers along with In vitro pollination helps the development of fruit and future plants generated from these fruits (Babu et al. 1992; Valsala et al. 1997)."
	WRA Specialist. (2023). Personal Communication	For all intents and purposes, seed set is functionally absent.

603	Hybridizes naturally	n
	Source(s)	Notes
	Subbarayudu, S., Shankar Naik, B., Sunitibala Devi, H., Bhau, B. S., & Shaik Sha Valli Khan, P. (2014). Microsporogenesis and pollen formation in Zingiber officinale Roscoe. Plant Systematics and Evolution, 300, 619-632	"Zingiber officinale Roscoe, the common ginger, is an invaluable horticultural crop cultivated majorly in China, India, Brazil, Jamaica and Nigeria. Its pungent aromatic rhizome is used all over the world as a spice, culinary herb, condiment, home remedy and medicinal agent. This species does not produce seeds and so is difficult to breed its new genotypes through sexual hybridization."
	Ravindran, P. N. & Nirmal Babu, K. (eds.). (2005). Ginger: The Genus Zingiber. CRC Press, Boca Raton, FL	No evidence of interspecific hybrids naturally occurring

604	Self-compatible or apomictic	n
	Source(s)	Notes
	Nair, K. P. (2019). Turmeric (<i>Curcuma Longa</i> L.) and Ginger (<i>Zingiber Officinale</i> Rosc.)-World's Invaluable Medicinal Spices: The Agronomy and Economy of Turmeric and Ginger. Springer Nature, Cham, Switzerland	"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."

605	Requires specialist pollinators	n
	Source(s)	Notes
	Melati, Palupi, E. R. & Bermawie, N. (2015). Floral Biology of Ginger (<i>Zingiber officinale</i> Rosc.). Int. J. Curr. Res. Biosci. Plant Biol., 2(4): 1-10	"No pollinator to visit when the flower is blooming."
	Ravindran, P. N. & Nirmal Babu, K. (eds.). (2005). Ginger: The Genus Zingiber. CRC Press, Boca Raton, FL	"The flowers are usually cross-pollinated. The pollination in the species of Zingiber 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
606	Reproduction by vegetative fragmentation	y
	Source(s)	Notes
	Guzman, C. C. de & Siemonsma, J. S. (eds.). (1999). Plant resources of South-East Asia, No.13. Spices. Backhuys Publishers, Leiden, The Netherlands	"Ginger is propagated vegetatively by pieces of rhizome called seed pieces or sets. They are normally produced by cutting rhizomes into 3-6 cm long pieces of 30-60 g, with at least one growing point or bud."
607	Minimum generative time (years)	1
	Source(s)	Notes
	Guzman, C. C. de & Siemonsma, J. S. (eds.). (1999). Plant resources of South-East Asia, No.13. Spices. Backhuys Publishers, Leiden, The Netherlands	"The first shoots of ginger appear 10-15 days after planting the rhizomes, and new shoots appear continuously until about 4 weeks after planting. Each shoot has about 8-12 leaves. Flowering is cultivar-dependent. Some cultivars flower rarely, others regularly, especially when grown undisturbed as perennials. In Malaysia ginger flowers only rarely. Ginger fruits are seldom produced." [Rarely produces seeds, but capable of vegetative reproduction at an early age]
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	n
	Source(s)	Notes
	Guzman, C. C. de & Siemonsma, J. S. (eds.). (1999). Plant resources of South-East Asia, No.13. Spices. Backhuys Publishers, Leiden, The Netherlands	"Breeding of ginger has been severely hampered by poor flowering and seed set." [Propagated primarily using rhizome fragments. No evidence that they are accidentally dispersed]
702	Propagules dispersed intentionally by people	y
	Source(s)	Notes
	Guzman, C. C. de & Siemonsma, J. S. (eds.). (1999). Plant resources of South-East Asia, No.13. Spices. Backhuys Publishers, Leiden, The Netherlands	"At present, ginger is cultivated throughout the humid tropics."
	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	"By 1999 the ginger industry had become the fastest-growing produce industry in Hawai'i, with much of the crop being exported fresh to U.S. mainland markets and lesser amounts to Canada and Europe."
703	Propagules likely to disperse as a produce contaminant	n
	Source(s)	Notes
	Guzman, C. C. de & Siemonsma, J. S. (eds.). (1999). Plant resources of South-East Asia, No.13. Spices. Backhuys Publishers, Leiden, The Netherlands	"Ginger fruits are seldom produced." [No evidence, and unlikely given lack of seed production]
704	Propagules adapted to wind dispersal	n
	Source(s)	Notes
	Guzman, C. C. de & Siemonsma, J. S. (eds.). (1999). Plant resources of South-East Asia, No.13. Spices. Backhuys Publishers, Leiden, The Netherlands	"Fruit a thin-walled capsule, 3-valved, red. Seed small, arillate, black." ... "Ginger fruits are seldom produced." [Seeds, if produced, not adapted for wind dispersal]
705	Propagules water dispersed	

Qsn #	Question	Answer
	Source(s)	Notes
	WRA Specialist. (2023). Personal Communication	It may be possible that rhizome fragments could be dispersed by water if plants are grown in proximity to riparian habitats. No direct evidence found.

706	Propagules bird dispersed	
	Source(s)	Notes
	Guzman, C. C. de & Siemonsma, J. S. (eds.). (1999). Plant resources of South-East Asia, No.13. Spices. Backhuys Publishers, Leiden, The Netherlands	"Fruit a thin-walled capsule, 3-valved, red. Seed small, arillate, black." ... "Ginger fruits are seldom produced." [Although seeds may be adapted for bird dispersal, they are rarely, if ever, produced]

707	Propagules dispersed by other animals (externally)	
	Source(s)	Notes
	Guzman, C. C. de & Siemonsma, J. S. (eds.). (1999). Plant resources of South-East Asia, No.13. Spices. Backhuys Publishers, Leiden, The Netherlands	"Fruit a thin-walled capsule, 3-valved, red. Seed small, arillate, black." ... "Ginger fruits are seldom produced." [Unknown. Arillate seeds may be adapted for ant dispersal, but are rarely produced]

708	Propagules survive passage through the gut	
	Source(s)	Notes
	Guzman, C. C. de & Siemonsma, J. S. (eds.). (1999). Plant resources of South-East Asia, No.13. Spices. Backhuys Publishers, Leiden, The Netherlands	"Fruit a thin-walled capsule, 3-valved, red. Seed small, arillate, black." ... "Ginger fruits are seldom produced." [Unknown, but seeds rarely produced]

801	Prolific seed production (>1000/m2)	n
	Source(s)	Notes
	Guzman, C. C. de & Siemonsma, J. S. (eds.). (1999). Plant resources of South-East Asia, No.13. Spices. Backhuys Publishers, Leiden, The Netherlands	"Breeding of ginger has been severely hampered by poor flowering and seed set."
	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	"Ginger rarely flowers and almost never sets seed, so propagation is always by vegetative means, usually by rhizome division."
	Ravindran, P. N. & Nirmal Babu, K. (eds.). (2005). Ginger: The Genus Zingiber. CRC Press, Boca Raton, FL	"The species is sterile and does not set seeds"

802	Evidence that a persistent propagule bank is formed (>1 yr)	
	Source(s)	Notes
	Guzman, C. C. de & Siemonsma, J. S. (eds.). (1999). Plant resources of South-East Asia, No.13. Spices. Backhuys Publishers, Leiden, The Netherlands	"Fruit a thin-walled capsule, 3-valved, red. Seed small, arillate, black." ... "Ginger fruits are seldom produced." [Seed and rhizome longevity unknown]

803	Well controlled by herbicides	y
	Source(s)	Notes

Qsn #	Question	Answer
	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	[Although there is no evidence that this species has been controlled chemically, herbicides are effective at controlling invasive Hedychium species and would likely work on other ginger taxa] "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
	Guzman, C. C. de & Siemonsma, J. S. (eds.). (1999). Plant resources of South-East Asia, No.13. Spices. Backhuys Publishers, Leiden, The Netherlands	"Ginger is propagated vegetatively by pieces of rhizome called seed pieces or sets. They are normally produced by cutting rhizomes into 3 -6 cm long pieces of 30-60 g, with at least one growing point or bud. Medium to large-sized seed pieces produce more vigorous plantlets and higher yields than small ones. " [Presumably Yes. Regeneration from rhizomes is common in this genus]

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	y
	Source(s)	Notes
	Nelson, S. (2013). Bacterial Wilt of Edible Ginger in Hawai'i. PD-99. CTAHR, University of Hawaii at Manoa, Honolulu, Hawaii	"An important factor in the decline of ginger root acreage and sales since 2006 was bacterial wilt, a plant disease that devastates ginger. Farms with pathogen-infested soils cannot be replanted successfully. Epidemics of bacterial wilt cause major crop losses and discourage growers from farming edible ginger. In Hawai'i, ginger growers farm this crop nomadically, moving from infested locations to wilt-free fields or lands not previously cultivated with edible ginger. Pathogen-free ginger seed can be difficult to obtain, inhibiting new farmers from starting a farm. Furthermore, pathogen-contaminated shoes or tools can spread the disease to new areas, forcing ginger growers to quarantine fields and keep visitors out. Disease onset can be rapid and severe, causing great crop loss."
	Guzman, C. C. de & Siemonsma, J. S. (eds.). (1999). Plant resources of South-East Asia, No.13. Spices. Backhuys Publishers, Leiden, The Netherlands	"Another widespread and serious disease is bacterial wilt, caused by <i>Pseudomonas solanacearum</i> , which occurs for instance in Indonesia, Malaysia, the Philippines and Thailand. The symptoms include progressive yellowing and wilting from the lower leaves to the whole plant, with badly affected stems and rhizomes yielding a milky exudate when cut."
	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	"In Hawai'i the soil is generally sterilized before the crop is sown to destroy burrowing nematodes that can infect the rhizomes."

Summary of Risk Traits:

Ginger has been grown in tropical Asia since ancient times, and wild forms have not been found. It is now cultivated worldwide as an important spice plant in tropical climates with annual rainfall of 2500-3000 mm. It rarely, if ever, produces seeds in cultivation, and is propagated vegetatively by pieces of rhizome called seed pieces or sets. It's long history of cultivation with no reports of negative impacts, and its lack of seed production, contribute to its low risk of invasiveness in the Hawaiian Islands or other tropical island ecosystems.

High Risk / Undesirable Traits

- Thrives and spreads in regions with tropical climates
- Reported to be naturalized where introduced (but no evidence in the Hawaiian Islands to date)
- Reported to be a weed in a few locations, but no evidence of negative impacts has been found.
- Other *Zingiber* species are invasive weeds.
- Possibly allelopathic.
- Unpalatable to deer, and probably other browsing animals.
- Shade tolerant, but also grows in full sun (could potentially establish in intact forest understory).
- May reproduce by seed, but this rarely occurs in cultivation.
- Propagated and reproduces vegetatively from rhizomes and fragments.
- Rhizomes spread intentionally through cultivation, and potentially by water or discarded garden waste.
- Seeds, if produced, are arillate, and might be dispersed by birds or ants (although this vector is unlikely to play an important role in spread).
- Capable of resprouting from rhizomes if foliage is removed or damaged.

Low Risk Traits

- A widely cultivated food plant with no confirmed reports of invasiveness or negative impacts.
- Unarmed (no spines, thorns, or burrs)
- Plants in cultivation are non-toxic, although contact with or excessive consumption of rhizomes may cause sickness or an allergic reaction.
- Lack of seed production reduces the risk of long distance or accidental dispersal.
- Herbicides may provide effective control if needed.
- Bacterial wilt, and nematodes, would likely prevent or limit the spread of cultivated ginger into unmanaged or natural areas.

