UF IFAS UNIVERSITY of FLORIDA

Assessment of Non-native Plants in Florida's Natural Areas

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Assessment date 2/21/2020 Assessment completed by Petri and Lieurance

	Zingiber officinale (rarely produces seeds) **ALL ZONES**	**Answer**	**Score**
1.01	Is the species highly domesticated?	n	0
1.02	Has the species become naturalised where grown?		
1.03	Does the species have weedy races?		
2.01	Species suited to Florida's USDA climate zones (0-low; 1-intermediate; 2-high) North Zone: suited to Zones 8, 9 Central Zone: suited to Zones 9, 10 South Zone: suited to Zone 10	2	
2.02	Quality of climate match data (0-low; 1-intermediate; 2-high)	2	
2.03	Broad climate suitability (environmental versatility)	y	1
2.04	Native or naturalized in habitats with periodic inundation North Zone: mean annual precipitation 50-70 inches Central Zone: mean annual precipitation 40-60 inches South Zone: mean annual precipitation 40-60 inches	y	1
2.05	Does the species have a history of repeated introductions outside its natural range?	y	
3.01	Naturalized beyond native range	y	2
3.02	Garden/amenity/disturbance weed	y	2
3.03	Weed of agriculture	unk	
3.04	Environmental weed	n	0
3.05	Congeneric weed	y	2
4.01	Produces spines, thorns or burrs	n	0
4.02	Allelopathic	unk	0
4.03	Parasitic	n	0
4.04	Unpalatable to grazing animals	unk	-1
4.05	Toxic to animals	unk	0
4.06	Host for recognised pests and pathogens	y	1
4.07	Causes allergies or is otherwise toxic to humans	n	0
4.08	Creates a fire hazard in natural ecosystems	unk	0
4.09	Is a shade tolerant plant at some stage of its life cycle	n	0
4.10	Grows on infertile soils (oligotrophic, limerock, or excessively draining soils). North & Central Zones: infertile soils; South Zone: shallow limerock or Histisols.	n	0
4.11	Climbing or smothering growth habit	n	0
4.12	Forms dense thickets	unk	0
5.01	Aquatic	n	0

5.02	Grass	n	0
5.03	Nitrogen fixing woody plant	n	0
5.04	Geophyte	n	0
6.01	Evidence of substantial reproductive failure in native habitat	n	0
6.02	Produces viable seed	y	1
6.03	Hybridizes naturally	n	-1
6.04	Self-compatible or apomictic	unk	-1
6.05	Requires specialist pollinators	unk	0
6.06	Reproduction by vegetative propagation	y	1
6.07	Minimum generative time (years)	1	1
7.01	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	unk	-1
7.02	Propagules dispersed intentionally by people	y	1
7.03	Propagules likely to disperse as a produce contaminant	n	-1
7.04	Propagules adapted to wind dispersal	n	-1
7.05	Propagules water dispersed	unk	-1
7.06	Propagules bird dispersed	n	-1
7.07	Propagules dispersed by other animals (externally)	n	-1
7.08	Propagules dispersed by other animals (internally)	n	-1
8.01	Prolific seed production	n	-1
8.02	Evidence that a persistent propagule bank is formed (>1 yr)	n	-1
8.03	Well controlled by herbicides	unk	1
8.04	Tolerates, or benefits from, mutilation or cultivation	y	1
8.05	Effective natural enemies present in U.S.	unk	1
	Total Score	**4**	
	Implemented Pacific Second Screening	**Yes**	
	Risk Assessment Results	**Low Risk**	

section	# questions answered	satisfy minimum?
A	10	yes
B	7	yes
C	18	yes
total	35	yes

	Reference	Source data
1.01	1. Sutarno et al. 1999, Zingiber officiale Record from Prosebase. In: Plant Resources of South-East Asia, Guzman et al.; https://edepot.wur.nl/411253 [Accessed 2/10/20]	1. Domestication has not reduced invasion risk, but ginger has been used medicinally in Asia since ancient times and is still used in folk medicine
1.02		
1.03		
2.01	1. Sutarno et al. 1999, Zingiber officiale Record from Prosebase. In: Plant Resources of South-East Asia, Guzman et al.; https://edepot.wur.nl/411253 [Accessed 2/10/20] 2. Invasive Species Compendium, CABI; https://www.cabi.org/isc/datasheet/57537 [Accessed 2/10/20] 3. Missouri Botanical Gardens; http://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?kempercode=a763 [Accessed 2/10/20] 3. UW-Madison, Master Gardener Program 2018; https://wimastergardener.org/article/ginger-zingiber-officinale/ [Accessed 2/11/20] 4. Stephens 2018, IFAS EDIS Document; https://edis.ifas.ufl.edu/mv067 [Accessed 2/11/20]	No computer analysis was performed 1. Rhizome viability is gradually reduced and may become zero after short periods below 0C 2. Northern latitudinal limit is the 35th parallel 3. Recommended for USDA Zones 9 to 12, and possibly Zone 8 4. Ginger was grown in Gainesville, FL (Zone 8b) and persisted for 2 years, and gardeners have reported growing for home use throughout the state
2.02	1, 3-4. Invasive Species Compendium, CABI; https://www.cabi.org/isc/datasheet/57537 [Accessed 2/10/20] 1, 3-4. Sutarno et al. 1999, Zingiber officiale Record from Prosebase. In: Plant Resources of South-East Asia, Guzman et al.; https://edepot.wur.nl/411253 [Accessed 2/10/20] 2. Missouri Botanical Gardens; http://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?kempercode=a763 [Accessed 2/10/20]	No computer analysis was performed 1. Suited to Koppen-Geiger climates Af, Am, Aw, Cw, and Cf and Florida has all of those climates except Cw 2. Recommended for USDA Zones 9 to 12, which overlaps all but part of N. Florida 3. Thought to be native to India or other parts of southern Asia 4. Listed as introduced to Australia, Japan, Ecuador, Seychelles, Madagascar, Cuba, Ecuador, Comoros, Philippines, Costa Rica, The Democratic Republic of the Congo, Soa Tome and Principe, and Yemen
2.03	1-2. Invasive Species Compendium, CABI; https://www.cabi.org/isc/datasheet/57537 [Accessed 2/10/20] 3. GBIF; https://www.gbif.org/species/2757280 [Accessed 2/10/20]	1. Suited to Koppen-Geiger climates Af, Am, Aw, Cw, and Cf 2. Thought to be native to India or other parts of southern Asia 3. Listed as introduced to Australia, Japan, Ecuador, Seychelles, Madagascar, Cuba, Ecuador, Comoros, Philippines, Costa Rica, The Democratic Republic of the Congo, Soa Tome and Principe, and Yemen
2.04	1. Sutarno et al. 1999, Zingiber officiale Record from Prosebase. In: Plant Resources of South-East Asia, Guzman et al.; https://edepot.wur.nl/411253 [Accessed 2/10/20] 2. PFAF Plant Database; https://pfaf.org/user/Plant.aspx?LatinName=Zingiber+officinale [Accessed 2/11/20]	1. Optimum rainfall is 2500-3000 mm (98.4-118.1in), well-distributed over the year; below 2000mm supplemental irrigation is necessary, but that may still be insufficient without high humidity 2. Tolerates rainfall 700-4000mm (27.5-157.5in)
2.05	1-3. Sutarno et al. 1999, Zingiber officiale Record from Prosebase. In: Plant Resources of South-East Asia, Guzman et al.; https://edepot.wur.nl/411253 [Accessed 2/10/20] 4. GBIF; https://www.gbif.org/species/2757280 [Accessed 2/10/20]	1. Boundaries of native range are unknown, but thought to be from India or southeast Asia 2. During the 13th-14th Centuries ginger was one of the most commonly traded spices from India to Europe and East Africa 3. During the 16th Century, it was traded from East Africa to West Africa and other regions of the tropics; at this time, it was also introduced by the Spanish to Jamaica 4. Listed as introduced to Australia, Japan, Ecuador, Seychelles, Madagascar, Cuba, Ecuador, Comoros, Philippines, Costa Rica, The Democratic Republic of the Congo, Soa Tome and Principe, and Yemen

3.01	1. Randall 2017, A global compendium of weeds. In: A global compendium of weeds, Department of Agriculture and Food Western Australia; https://www.cabdirect.org/cabdirect/abstract/20173071957 [Accessed 2/10/20] 1-2. Invasive Species Compendium, CABI; https://www.cabi.org/isc/datasheet/57537 [Accessed 2/10/20]	1. Plants occasionally naturalize from cultivated plants such as in Central Africa, but these locations are often near cultivation areas making it difficult to distinguish whether plants are cultivated or escape 2. Boundaries of native range are unknown, but thought to be from India or southeast Asia
3.02	1. GBIF, Global Register of Introduced and Invasive Species-Cuba; https://www.gbif.org/species/2757280 [Accessed 2/10/20] 1. eFloras, Taiwan Invasive Species Database; http://www.efloras.org/florataxon.aspx?flora_id=102&taxon_id=200028468 [Accessed 2/10/20] 1-2. Invasive Species Compendium, CABI; https://www.cabi.org/isc/datasheet/57537 [Accessed 2/10/20] 2. Randall 2017, A global compendium of weeds. In: A global compendium of weeds, Department of Agriculture and Food Western Australia; https://www.cabdirect.org/cabdirect/abstract/20173071957 [Accessed 2/10/20] 3. Dave's Garden; https://davesgarden.com/guides/pf/go/55488/#b [Accessed 2/12/20]	1. Listed as invasive in Cuba and Taiwan but no evidence of impact is given 2. Listed as a weed in Puerto Rico and Queensland, Australia 3. One grower from Osprey, Florida commented that ginger started taking over their neighbor's garden and required lots of Round-Up and digging to get rid of it
3.03	1. Randall 2017, A global compendium of weeds. In: A global compendium of weeds, Department of Agriculture and Food Western Australia; https://www.cabdirect.org/cabdirect/abstract/20173071957 [Accessed 2/10/20]	1. Noted as a "Weed of cereals" but no further explanation is given or could be found from other sources
3.04	1. GBIF, Global Register of Introduced and Invasive Species-Cuba; https://www.gbif.org/species/2757280 [Accessed 2/10/20] 1. eFloras, Taiwan Invasive Species Database; http://www.efloras.org/florataxon.aspx?flora_id=102&taxon_id=200028468 [Accessed 2/10/20] 1. Invasive Species Compendium, CABI; https://www.cabi.org/isc/datasheet/57537 [Accessed 2/10/20]	1. Listed as invasive in Cuba and Taiwan but no explanation of impact can be found
3.05	1-4. Invasive Species Compendium, CABI, Shampoo Ginger (Zingiber zerumbet); https://www.cabi.org/isc/datasheet/57539 [Accessed 2/11/20] 1. eFloras, Taiwan Invasive Species Database; http://www.efloras.org/florataxon.aspx?flora_id=102&taxon_id=200028468 [Accessed 2/10/20] 3. PIER 2005; http://www.hear.org/pier/wra/pacific/zingiber_zerumbet_htmlwra.htm [Accessed 2/11/20] 4. FLORIDATA 2003; https://floridata.com/plant/596 [Accessed 2/11/20] 5-6. Invasive Species Compendium, CABI, Cassumunar Ginger (Zingiber montanum); https://www.cabi.org/isc/datasheet/57536 [Accessed 2/11/20] 5. Rahman et al. 2010, Status, distribution, and diversity of invasive forest undergrowth species in the tropics: A study from Northeastern Bangladesh; http://www.koreascience.or.kr/article/JAKO201022350101869.page [Accessed 2/11/20] 6. Randall 2017, A global compendium of weeds. In: A global compendium of weeds, Department of Agriculture and Food Western Australia; https://www.cabdirect.org/cabdirect/abstract/20173071957 [Accessed 2/10/20] 7. Invasive Species Compendium, CABI, Wild Ginger (Zingiber capitatum); https://www.cabi.org/isc/datasheet/121135 [Accessed 2/11/20]	1. Z. zerumbet is listed as invasive in Taiwan but no explanation of impacts are given 2. Z. zerumbet is naturalized in Puerto Rico, Florida, and Hawaii 3. Z. zerumbet was evaluated AWRA for Hawaii and found to be a low invasion risk 4. In Florida, Z. zerumbet is not considered an invasive, but will spread in gardens and may overrun other plants 5. Z. montanum listed as 'moderately invasive' in northeastern Bangladesh, based on a forest undergrowth vegetation survey in a national park in 2010 6. Z. montanum is considered a naturalized weed and cultivation escape in Puerto Rico and the Greater Antilles 7. Z. capitatum is listed as an invasive transformer species in Cuba, but this is thought to be a misidentification
4.01	1. Sutarno et al. 1999, Zingiber officiale Record from Prosebase. In: Plant Resources of South-East Asia, Guzman et al.; https://edepot.wur.nl/411253 [Accessed 2/10/20]	1. These features are not in the description of the species

4.02	1. Bharath et al. 2014, Allelopathic efficacy of Zingiber officinale aqueous leaf, stem, and rhizome extract on early seedling growth of Zea Mays; https://www.longdom.org/articles/allelopathic-efficacy-of-zingiber-officinale-rosc-aqueous-leaf-stemand-rhizome-extract-on-early-seedling-growth-of-zea-m.pdf [Accessed 2/12/20] 2. Han et al. 2008, Allelopathic effect of ginger on seed germination and seedling growth of soybean and chive; https://www.sciencedirect.com/science/article/pii/S0304423808000071 [Accessed 2/12/20]	No evidence of allelopathy in natural settings 1. Laboratory study showed inhibitory effect of ginger aqueous leaf, stem, and rhizome extracts on Maize germination and seedlings, possibly due to the presence of allelochemicals 2. Similar laboratory study showed ginger extracts, which have allelochemicals, inhibited the growth of soybeans and chives
4.03	1. Online Parasitic Plants Database; http://www.omnisterra.com/bot/pp_home.cgi [Accessed 2/12/20] 2. USDA, PLANTS Database; https://plants.sc.egov.usda.gov/core/profile?symbol=ZIOF# [Accessed 2/10/20]	No direct evidence 1. Not listed as being a parasitic plant 2. In the family Zingiberaceae
4.04	1. Farooq et al.2008, Ethnoveterinary practices for the treatment of parasitic diseases in livestock in Cholistan desert (Pakistan); https://www.sciencedirect.com/science/article/pii/S0378874108001797 [Accessed 2/12/20] 2. Qadir et al. 2010, Use of medicinal plants to control Haemonchus contortus infection in small ruminants; https://search.proquest.com/openview/23d2bcad6783f0089759542fefe335b7/1.pdf?cbl=746332&pq-origsite=gscholar [Accessed 2/12/20] 3. Risdianto et al. 2019, Inclusion of ginger and turmeric mixture combined with Lactobacillus spp. isolated from rumen fluid of cattle on health status and growth of broiler; http://apps.webofknowledge.com/full_record.do?product=WOS&search_mode=GeneralSearch&qid=6&SID=5FELHFroLry1v1osHLm&page=1&doc=1 [Accessed 2/13/20]	No evidence of grazing on naturally growing plants 1. In Pakistan, ginger, purchased from city herbal shops, is occasionally used in ethnoveterinary practice for treating parasitic diseases in livestock 2. Crude aqueous extract of dried ginger was administered to sheep to prevent nematodes 3. Ginger extract was fed to broiler (chickens) to improve body resistance and increase production performance
4.05	1. Farooq et al.2008, Ethnoveterinary practices for the treatment of parasitic diseases in livestock in Cholistan desert (Pakistan); https://www.sciencedirect.com/science/article/pii/S0378874108001797 [Accessed 2/12/20] 2. Qadir et al. 2010, Use of medicinal plants to control Haemonchus contortus infection in small ruminants; https://search.proquest.com/openview/23d2bcad6783f0089759542fefe335b7/1.pdf?cbl=746332&pq-origsite=gscholar [Accessed 2/12/20] 3. Risdianto et al. 2019, Inclusion of ginger and turmeric mixture combined with Lactobacillus spp. isolated from rumen fluid of cattle on health status and growth of broiler; http://apps.webofknowledge.com/full_record.do?product=WOS&search_mode=GeneralSearch&qid=6&SID=5FELHFroLry1v1osHLm&page=1&doc=1 [Accessed 2/13/20]	No evidence of feeding on naturally growing plants 1. In Pakistan, ginger, purchased from city herbal shops, is occasionally used in ethnoveterinary practice for treating parasitic diseases in livestock 2. Crude aqueous extract of dried ginger was administered to sheep to prevent nematodes 3. Ginger extract was fed to broiler (chickens) to improve body resistance and increase production performance
4.06	1. Biosecurity New Zealand 2019, Import risk analysis: Ginger (Zingiber officinale, Zingiber zerumbet) fresh produce; https://www.biosecurity.govt.nz/dmsdocument/36837/direct [Accessed 2/14/20] 1. GBIF; https://www.gbif.org/ [Accessed 2/17/20] 2. Invasive Species Compendium, CABI, Fall Armyworm (Spodoptera frugiperda); https://www.cabi.org/isc/datasheet/29810 [Accessed 2/11/20] 3-5. Sutarno et al. 1999, Zingiber officiale Record from Prosebase. In: Plant Resources of South-East Asia, Guzman et al.; https://edepot.wur.nl/411253 [Accessed 2/10/20]	1. In New Zealand, a risk assessment for pests associated with ginger imports called for further consideration of Pantoea ananatis (bacteria) and Pratylenchus zeae (nematodes); both of which are present in North America 2. Main host plant for Spodoptera frugiperda 3. Diseases are more damaging in ginger than pests, of particular concern are rhizome rots, often caused by Pythium spp., Fusarium spp., and Rosellinia spp., and bacterial wilt, caused by Pseudomonas solanacearum 4. Leaf spots caused by Colletotrichum spp., Helminthosporum spp., Cercospora spp., and Septoria spp. are also common 5. As far as pests, ginger is attached by nematodes (Meloidogyne spp.) and the shoot borer Ostinia furnacalis

4.07	1-2. Sutarno et al. 1999, Zingiber officiale Record from Prosebase. In: Plant Resources of South-East Asia, Guzman et al.; https://edepot.wur.nl/411253 [Accessed 2/10/20] 2. Kumar et al. 2011, A review on pharacological and phytochemical properties of Zingiber officinale; https://www.researchgate.net/profile/Gaurav_Kumar78/publication/215802856_A_Review_on_Pharmacological_and_Phytochemical_Properties_of_Zingiber_officinale_Roscoe_Zingiberaceae/links/0912f50af20751f73f000000.pdf [Accessed 2/12/20]	1. Ginger is widely used as a spice and is eaten fresh, dried or powdered, or preserved 2. Ginger has been used medicinally since ancient times and is still used as an agent for antimicrobial, anticancer, antioxidant, antidiabetic, analgesic, anti-inflammatory, and immunomodulartory treatments.
4.08		No evidence
4.09	1. Sutarno et al. 1999, Zingiber officiale Record from Prosebase. In: Plant Resources of South-East Asia, Guzman et al.; https://edepot.wur.nl/411253 [Accessed 2/10/20] 2. Stephens 2018, IFAS EDIS Document; https://edis.ifas.ufl.edu/mv067 [Accessed 2/11/20] 3. Wilson & Ovid 1993, Growth and yield responses of ginger as affected by shade and fertilizer applications; https://www.tandfonline.com/doi/abs/10.1080/01904169309364631 [Accessed 2/12/20]	1. Crop prefers warm, sunny conditions and shading is generally considered unnecessary; though young plants may benefit from shade during hot periods 2. Ginger does best in 'partial to complete shade' as full sun causes the leaves to become brown-tipped 3. Yield of ginger was increased under 66% shade compared to full sun
4.10	1-3. Sutarno et al. 1999, Zingiber officiale Record from Prosebase. In: Plant Resources of South-East Asia, Guzman et al.; https://edepot.wur.nl/411253 [Accessed 2/10/20] 3. Hawaii Cooperative Extension Service, Ginger root production in Hawaii; https://www.ctahr.hawaii.edu/oc/freepubs/pdf/CFS-GIN-3A.pdf [Accessed 2/12/20] 4. UW-Madison, Master Gardener Program 2018; https://wimastergardener.org/article/ginger-zingiber-officinale/ [Accessed 2/11/20]	No evidence of soil nutrient tolerance outside of cultivation, but likely tolerant to excessively draining soils 1. Preferred soils are medium loam 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 2. As an exhaustive crop, the soil fertilize must be high or manure should be applied 3. Planting in a well-drained site is important for preventing diseases and pests 4. Ginger plants must be regularly fertilized during the growing season unless soil are very fertile
4.11	1. Sutarno et al. 1999, Zingiber officiale Record from Prosebase. In: Plant Resources of South-East Asia, Guzman et al.; https://edepot.wur.nl/411253 [Accessed 2/10/20]	1. Erect, slender, perennial herb usually grown as an annual, with a thickened, fleshy, subterranean rhizome with one or more aerial leafy stems
4.12	1. Sutarno et al. 1999, Zingiber officiale Record from Prosebase. In: Plant Resources of South-East Asia, Guzman et al.; https://edepot.wur.nl/411253 [Accessed 2/10/20] 2. Randall 2017, A global compendium of weeds. In: A global compendium of weeds, Department of Agriculture and Food Western Australia; https://www.cabdirect.org/cabdirect/abstract/20173071957 [Accessed 2/10/20] 2. Invasive Species Compendium, CABI; https://www.cabi.org/isc/datasheet/57537 [Accessed 2/10/20]	1. Herbaceous perennial with leafy stems that can grow up to 1.25 m tall, particularly when left to grow as a perennial 2. As the species is listed as invasive in Taiwan and weedy elsewhere, it is "likely to form dense enough stands to alter habitat"; however, "no evidence could be found to support impacts to habitat or biodiversity"
5.01	1. USDA, PLANTS Database; https://plants.sc.egov.usda.gov/core/profile?symbol=ZIOF# [Accessed 2/10/20] 2. Sutarno et al. 1999, Zingiber officiale Record from Prosebase. In: Plant Resources of South-East Asia, Guzman et al.; https://edepot.wur.nl/411253 [Accessed 2/10/20]	1. In the family Zingiberaceae 2. Erect, slender, perennial herb usually grown as an annual, with a thickened, fleshy, subterranean rhizome with one or more aerial leafy stems
5.02	1. USDA, PLANTS Database; https://plants.sc.egov.usda.gov/core/profile?symbol=ZIOF# [Accessed 2/10/20]	1. In the family Zingiberaceae
5.03	1. USDA, PLANTS Database; https://plants.sc.egov.usda.gov/core/profile?symbol=ZIOF# [Accessed 2/10/20]	1. In the family Zingiberaceae
5.04	1. Sutarno et al. 1999, Zingiber officiale Record from Prosebase. In: Plant Resources of South-East Asia, Guzman et al.; https://edepot.wur.nl/411253 [Accessed 2/10/20]	1. Ginger has a subterranean rhizome, but no tubers, corms, or bulbs
6.01	1. Invasive Species Compendium, CABI; https://www.cabi.org/isc/datasheet/57537 [Accessed 2/10/20] 1-2. Sutarno et al. 1999, Zingiber officiale Record from Prosebase. In: Plant Resources of South-East Asia, Guzman et al.; https://edepot.wur.nl/411253 [Accessed 2/10/20]	1. Exact native range is unknown, but thought to be native to India or other parts of southern Asia 2. Ginger has been used medicinally since ancient times and is still used in folk medicine today, so it's unlikely to have lasted this long without viable reproduction

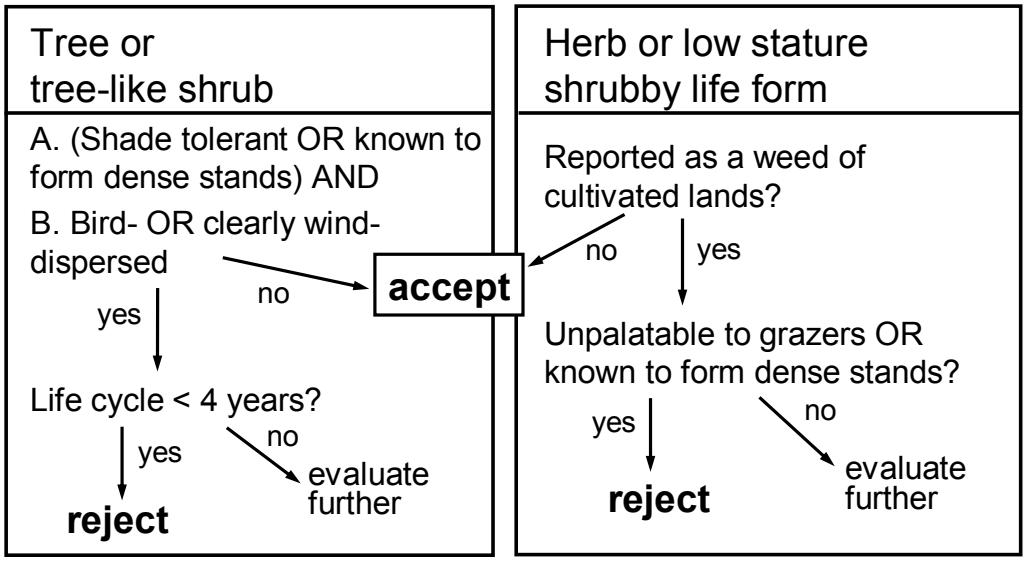
6.02	1. Sutarno et al. 1999, Zingiber officiale Record from Prosebase. In: Plant Resources of South-East Asia, Guzman et al.; https://edepot.wur.nl/411253 [Accessed 2/10/20] 2. Invasive Species Compendium, CABI; https://www.cabi.org/isc/datasheet/57537 [Accessed 2/10/20] 3. Adaniya et al. 1989, Effects of day length on flowering and rhizome swelling in ginger; https://www.jstage.jst.go.jp/article/jjshs1925/58/3/58_3_649/_pdf [Accessed 2/14/20]	1. Some cultivars rarely flower, others regularly flower especially when grown undisturbed as perennials; ginger fruits are seldom produced 2. Mostly spreads vegetatively since many cultivars seldom flower or are sterile 3. Ginger rarely flowers in temperate regions, but in Japan, it flowers when grown in a heated greenhouse during autumn; ginger more commonly flowers in subtropical regions
6.03	1. Subbarayudu et al. 2014, Microsporogenesis and pollen formation in Zingiber officinale; https://link.springer.com/article/10.1007/s00606-013-0907-6 [Accessed 2/13/20]	1. Even in a laboratory study it was concluded that, since ginger produces few to no seeds "it is very difficult to breed new genotypes through sexual hybridization"
6.04	1. Jayachandran & Vijayagopal 1979, Attempts on breaking self incompatibility in ginger; Agri Res J Kerala Volume: 17 Issue 3; Cited in: Nair 2016, Variation in pollen fertility and chromosome number among germplasm collections of ginger; https://www.tandfonline.com/doi/full/10.1080/00087114.2015.1109957 [Accessed 2/14/20] 2. Sutarno et al. 1999, Zingiber officiale Record from Prosebase. In: Plant Resources of South-East Asia, Guzman et al.; https://edepot.wur.nl/411253 [Accessed 2/10/20] 3. Peter et al. 2007, Breeding of spice crops; http://nsdl.niscair.res.in/jspui/bitstream/123456789/471/1/revised%20Breeding%20of%20spices.pdf [Accessed 2/14/20]	No direct evidence, due to limited information on successful fruit production 1. Artificial self-pollinating tests were conducted in cultivar 'Rio-De-Janeiro', however none set fruit or seeds 2. Ginger cultivars rarely or never produce fruit 3. Flowers are "hermaphrodite with pin and thrum type incompatibility, and dehisced pollen grains did not reach the stigma head', thus no seed set was formed by selfing
6.05	1-2. Melati et al. 2015, Floral Biology of Ginger; http://www.ijcrbp.com/vol-2-4/Melati,%20et%20al.pdf [Accessed 2/14/20]	No direct evidence, due to limited information on successful fruit production 1. During a field study, no pollinators were observed on flowering ginger 2. The family Zingiberaceae is pollinated by many animals, including bees, hawmoths, and birds
6.06	1. Sutarno et al. 1999, Zingiber officiale Record from Prosebase. In: Plant Resources of South-East Asia, Guzman et al.; https://edepot.wur.nl/411253 [Accessed 2/10/20]	1. Herb with a thickened, fleshy, subterranean rhizome capable of producing new shoots
6.07	1-3. Sutarno et al. 1999, Zingiber officiale Record from Prosebase. In: Plant Resources of South-East Asia, Guzman et al.; https://edepot.wur.nl/411253 [Accessed 2/10/20] 4. Lincy et al. 2008, Relationship between vegetative and rhizome characters and final rhizome yield in micropropagated ginger plants over two generations; https://www.sciencedirect.com/science/article/pii/S0304423808001957 [Accessed 2/14/20]	Regeneration suggested to occur in 4-7 weeks normally and around 6 months for micropropagations, which are both shorter than one year 1. First shoots appear 10-15 days after planting the rhizomes, and new shoots appear continuously until about 4 weeks after planting 2. Shoots are able to be cut from parent plants and transplanted again after 3-5 weeks or when sprouts are 1-2 cm long 3. Micropropagation likely results in slower development but a field study found that by the second generation, the differences had disappeared 4. The aerial morphological characters for micropropagated ginger reached their maximum vegetative growth stage as 6 months
7.01	1. Invasive Species Compendium, CABI; https://www.cabi.org/isc/datasheet/57537 [Accessed 2/10/20] 1. Tropicos, Vascular Plants of Ecuador; http://legacy.tropicos.org/Project/CE [Accessed 2/10/20] 1. Tropicos, Flora Mesoamericana; http://legacy.tropicos.org/Project/FM [Accessed 2/10/20] 2. Sutarno et al. 1999, Zingiber officiale Record from Prosebase. In: Plant Resources of South-East Asia, Guzman et al.; https://edepot.wur.nl/411253 [Accessed 2/10/20] 2. Missouri Botanical Gardens; http://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?kempercode=a763 [Accessed 2/10/20]	No direct evidence, does occur in disturbed areas but vegetative propagules likely to be too large for accidental transport 1. Outside of cultivated areas, most Ecuadorian and Central American herbarium records list occurrences in disturbed forests near villages 2. Ginger rarely or never produces seeds, and recommended size of rhizome for transplant is 1-2 in

7.02	1. Amazon; https://www.amazon.com/Ginger-Plant-Zingiber-officinale-Khing/dp/B00NQNJDNS [Accessed 2/11/20] 1. Etsy; https://www.etsy.com/market/zingiber_officinale [Accessed 2/12/20] 1. Logee's Plants for Home & Garden; https://www.logees.com/edible-ginger-root-zingiber-officinale.html [Accessed 2/11/20] 1. Easy to Grow Bulbs; https://www.easytogrowbulbs.com/products/ginger-officinale-culinary?variant=31581092300 [Accessed 2/12/20] 2. Sutarno et al. 1999, Zingiber officiale Record from Prosebase. In: Plant Resources of South-East Asia, Guzman et al.; https://edepot.wur.nl/411253 [Accessed 2/10/20] 2. Invasive Species Compendium, CABI; https://www.cabi.org/isc/datasheet/57537 [Accessed 2/10/20]	1. Available for sale online 2. Ginger has been intentionally introduced throughout the humid tropics as a crop
7.03	1. Randall 2017, A global compendium of weeds. In: A global compendium of weeds, Department of Agriculture and Food Western Australia; https://www.cabdirect.org/cabdirect/abstract/20173071957 [Accessed 2/10/20]	No direct evidence 1. Noted as a "Weed of cereals" but no further explanation is given or could be found from other sources
7.04	1. USDA, PLANTS Database; https://plants.sc.egov.usda.gov/core/profile?symbol=ZIOF# [Accessed 2/10/20] 1. PIER 2005; http://www.hear.org/pier/wra/pacific/zingiber_zerumbet_htmlwra.htm [Accessed 2/11/20] 2. Sutarno et al. 1999, Zingiber officiale Record from Prosebase. In: Plant Resources of South-East Asia, Guzman et al.; https://edepot.wur.nl/411253 [Accessed 2/10/20]	No direct evidence; reproduction occurs almost exclusively vegetatively and rhizomes are not likely wind dispersed 1. In the family Zingiberaceae which does not have features adapted for wind dispersal 2. Breeding of ginger is "severely hampered by poor flowering and seed set," rather cultivars are considered uniform due to vegetative propagation
7.05		No evidence
7.06	1. Missouri Botanical Gardens; http://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?kempercode=a763 [Accessed 2/10/20] 2. Sutarno et al. 1999, Zingiber officiale Record from Prosebase. In: Plant Resources of South-East Asia, Guzman et al.; https://edepot.wur.nl/411253 [Accessed 2/10/20]	No direct evidence, fruit production is rare and vegetative propagules likely to be too large 1. Recommended rhizome size for new propagation is 1-2 in 2. Breeding of ginger is "severely hampered by poor flowering and seed set," rather cultivars are considered uniform due to vegetative propagation
7.07		No evidence of dispersal or attachment mechanisms
7.08		No evidence, internal dispersal of vegetative propagules unlikely
8.01	1-2. Sutarno et al. 1999, Zingiber officiale Record from Prosebase. In: Plant Resources of South-East Asia, Guzman et al.; https://edepot.wur.nl/411253 [Accessed 2/10/20] 2. Tropical Biodiversity 2014; http://blogs.reading.ac.uk/tropical-biodiversity/2014/02/ginger-zingiber-officinale-rosc-aromatic-spice-and-medicinal-herb/ [Accessed 2/12/20]	1. Breeding of ginger is "severely hampered by poor flowering and seed set," rather cultivars are considered uniform due to vegetative propagation 2. Produces a flowering spike (scape) directly from the rhizome and in the axil of each bract one flower may be produced
8.02	1. Sutarno et al. 1999, Zingiber officiale Record from Prosebase. In: Plant Resources of South-East Asia, Guzman et al.; https://edepot.wur.nl/411253 [Accessed 2/10/20] 2. Akamine 1962, Storage of fresh ginger rhizomes; https://scholarspace.manoa.hawaii.edu/bitstream/10125/53868/CtahrpsAgExpRes130.pdf [Accessed 2/17/20]	No direct evidence 1. Ginger rarely or never produces seeds 2. Artificial storage of rhizomes, found that rhizomes could be kept viable for at least 6 months in a room at 55F and 65% relative humidity
8.03	1. Heap 2020, International survey of herbicide resistant weeds; http://weedscience.com/Summary/Species.aspx [Accessed 2/17/20] 2. Dave's Garden; https://davesgarden.com/guides/pf/go/55488/#b [Accessed 2/12/20]	No direct evidence of containment in large scale, natural areas 1. Not listed as resistant to herbicides 2. One grower from Osprey, Florida commented that ginger started taking over their neighbor's garden but they removed it with Round-Up and digging
8.04	1. Sutarno et al. 1999, Zingiber officiale Record from Prosebase. In: Plant Resources of South-East Asia, Guzman et al.; https://edepot.wur.nl/411253 [Accessed 2/10/20] 1. Missouri Botanical Gardens; http://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?kempercode=a763 [Accessed 2/10/20]	1. Shoots can resprout from 1-2 in pieces of rhizome, 10-15 days after planting, and new shoots will continue to appear for about 4 weeks, thus it's likely that if connected plants are broken up there would be a benefit to this treatment

8.05	1. Invasive Species Compendium, CABI; https://www.cabi.org/isc/datasheet/57537 [Accessed 2/10/20] 1. Shameem & Prathapan 2014, A new species of Chaeridiona Baly infesting ginger and turmeric in India and redescription of Chaeridiona pseudometallica; https://www.ncbi.nlm.nih.gov/pubmed/24943635 [Accessed 2/10/20] 2. GBIF; https://www.gbif.org/ [Accessed 2/17/20]	1. Natural enemies include Chaeridiona mayuri (India), Conogethes punctiferalis (Asia), Ostrinia furnacalis (Asia, Europe, and Oceania) but none of these are specific to this species 1. None of the three previously mentioned species are currently present in the U.S.

Pacific second screening: decision rules for species with WRA scores between 1 and 6

(from Daehler *et al*. 2004)



Vines must pass both tests