

Taxon: <i>Zinnia peruviana</i> (L.) L.	Family: Asteraceae
Common Name(s): field zinnia Peruvian zinnia wild zinnia	Synonym(s): <i>Chrysogonum peruvianum</i> L. <i>Zinnia pauciflora</i> L. <i>Zinnia tenuiflora</i> Jacq. <i>Zinnia verticillata</i> Andrews

Assessor: Assessor	Status: Assessor Approved	End Date: 20 Apr 2021
WRA Score: 7.0	Designation: H(HPWRA)	Rating: High Risk

Keywords: Annual Herb, Disturbance Weed, Wildflower, Self-Compatible, Wind-dispersed

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

Qsn #	Question	Answer Option	Answer
409	Is a shade tolerant plant at some stage of its life cycle	y=1, n=0	n
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	y=1, n=0	y
501	Aquatic	y=5, n=0	n
502	Grass	y=1, n=0	n
503	Nitrogen fixing woody plant	y=1, n=0	n
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y=1, n=0	n
601	Evidence of substantial reproductive failure in native habitat	y=1, n=0	n
602	Produces viable seed	y=1, n=-1	y
603	Hybridizes naturally		
604	Self-compatible or apomictic	y=1, n=-1	y
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	n
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	y
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant		
704	Propagules adapted to wind dispersal	y=1, n=-1	y
705	Propagules water dispersed	y=1, n=-1	n
706	Propagules bird dispersed	y=1, n=-1	n
707	Propagules dispersed by other animals (externally)	y=1, n=-1	n
708	Propagules survive passage through the gut	y=1, n=-1	n
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		
804	Tolerates, or benefits from, mutilation, cultivation, or fire	y=1, n=-1	n
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
	Torres, A. M. (1963). Taxonomy of zinnia. Brittonia, 15(1): 1-25	No evidence
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	No evidence

102	Has the species become naturalized where grown?	
	Source(s)	Notes
	WRA Specialist. (2021). Personal Communication	NA

103	Does the species have weedy races?	
	Source(s)	Notes
	WRA Specialist. (2021). 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
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Native from southeastern Arizona and Mexico south to Peru and Argentina and the West Indies"

202	Quality of climate match data	High
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	

Qsn #	Question	Answer
203	Broad climate suitability (environmental versatility)	y
	Source(s)	Notes
	Nash, D.L.& Williams, L.O. 1976. Flora of Guatemala. Fieldiana: Botany. Vol. 24 - Part XII. Field Museum of Natural History	"Damp, open or brushy, often rocky slopes, sometimes in oak forest, 800-2,000 m.; Chiquimula; Guatemala; Huehuetenango; Jalapa; Jutiapa; El Quiche. Southern Arizona; Mexico; Honduras; Nicaragua; West Indies; South America. " [Elevation range exceeds 1000 m]
	Torres, A. M. (1963). Taxonomy of zinnia. Brittonia, 15(1): 1-25	"Southeastern Arizona, Mexico, Central America, West Indies; Colombia and Ecuador to Peru and Argentina, at elevations up to 3000 meters, flowering from April to October in North America and about December to May in South America." [Elevation range exceeds 1000 m. Environmentally versatile]

204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"In the Hawaiian Islands, naturalized on Moloka'i, Lana'i, Maui, Kaho'olawe, Hawai'i. "

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	Notes
	Queensland Government. (2021). Weeds of Australia. <i>Zinnia peruviana</i> . https://keyserver.lucidcentral.org/weeds . [Accessed 20 Apr 2021]	"Widely naturalised in eastern Australia (i.e. in large parts of Queensland and northern New South Wales, and occasionally also in parts of central and southern New South Wales). Also naturalized in China, southern Africa, beyond its native range in south-eastern USA (i.e. Florida, Georgia, South Carolina and North Carolina) and on some Pacific islands (e.g. the Gal pagos Islands and Hawaii)."

301	Naturalized beyond native range	y
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"In the Hawaiian Islands, naturalized on Moloka'i, Lana'i, Maui, Kaho'olawe, Hawai'i."
	Torres, A. M. (1963). Taxonomy of zinnia. Brittonia, 15(1): 1-25	"One species, <i>Z. peruviana</i> , is native to South America and has become naturalized in several other regions including Australia and Hawaii."
	Foxcroft, L. C., Richardson, D. M., & Wilson, J. R. (2008). Ornamental plants as invasive aliens: problems and solutions in Kruger National Park, South Africa. Environmental Management, 4 (1): 32-51	"Table 2 Ornamental alien plant species recorded per camp in the Kruger National Park, indicating the number of camps in which each species has been recorded, as well as mode of introduction" ... "Zinnia peruviana - Evidence of naturalization? = Yes"

Qsn #	Question	Answer
	Queensland Government. (2021). Weeds of Australia. <i>Zinnia peruviana</i> . https://keyserver.lucidcentral.org/weeds . [Accessed 20 Apr 2021]	"Widely naturalised in eastern Australia (i.e. in large parts of Queensland and northern New South Wales, and occasionally also in parts of central and southern New South Wales). Also naturalised in China, southern Africa, beyond its native range in south-eastern USA (i.e. Florida, Georgia, South Carolina and North Carolina) and on some Pacific islands (e.g. the Gal pagos Islands and Hawaii)."
	Staples, G.W., Imada, C.T., & Herbst, D.R. (2002). New Hawaiian plant records for 2000. Bishop Museum Occasional Papers 68: 3-18	[Molokai and Hawaii islands] "Previously documented from the islands of Lānaʻi, Maui, and Kahoʻolawe (Wagner et al. 1999: 379), the following collections extend the range of <i>Zinnia peruviana</i> to the islands of Molokaʻi and Hawaiʻi. Although the specimen from Molokaʻi was collected in 1948 and was annotated by the authors of the Manual in 1984, it seems to have been overlooked when the account of <i>Zinnia</i> was written (Wagner et al. 1990). Fosberg noted that the species was "said to be very abundant at other seasons." Material examined. MOLOKAʻI: Nāʻiwa, road above ʻUmpipaʻa, weedy along stony roadside, 22 Feb 1948, F.R. Fosberg 29558. HAWAII: South Kohala Distr., collected east of Queen Kāʻahumanu Highway between Mauna Lani Drive and Puakō turnoff, elev. 200 ft, 4 Feb 1991, E. Funk s.n. (BISH 662876)."

302	Garden/amenity/disturbance weed	y
	Source(s)	Notes
	Haselwood, E.L., Motter, G.G., & Hirano, R.T. (eds.). (1983) Handbook of Hawaiian Weeds. University of Hawaii Press, Honolulu, HI	"A weed in cultivated areas and wastelands."
	PlantNET. (2021). New South Wales Flora Online - <i>Zinnia peruviana</i> (L.) L. National Herbarium of NSW, Royal Botanic Garden, Sydney. http://plantnet.rbgsyd.nsw.gov.au . [Accessed 20 Apr 2021]	"Garden escape, weed of roadsides and disturbed sites, not common, north from Holbrook. Native of C & S Amer."
	Myburgh, W. J., & Bredenkamp, G. J. (2005). The distribution and extent of declared weeds and invader plants in the macro channel of the Olifants River System, Mpumalanga. Koedoe-African Protected Area Conservation and Science, 48(1): 67-75	"Most of the alien species are opportunistic in nature and can be described as agrestal weeds. occurring mainly in disturbed areas." ... "Annual weedy species such as <i>Tagetes minuta</i> . <i>Bidens pilosa</i> . <i>Gomphrena celosioides</i> . <i>Bidens formosa</i> . <i>Schkuhria pinnata</i> . <i>Conyza bonariensis</i> . <i>Zinnia peruviana</i> and <i>Richardia brasiliensis</i> were associated with disturbed open areas. either on the macro channel banks or in the channel bed. These species are typical examples of agrestal weeds. which are not thought to pose a serious threat to undisturbed natural areas."
	Wagner, W.L., Herbst, D.R. & Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawaiʻi Press and Bishop Museum Press, Honolulu, HI.	"naturalized in low elevation, relatively dry, disturbed sites"
	Richardson, F. J., Richardson, R. G., & Shepherd, R. C. H. (2011). Weeds of the South-East: An Identification Guide for Australia. Second Edition. RG and FJ Richardson, Victoria, Australia	"Occasional garden escapes along roadsides and in other disturbed sites."
	Liogier, A.H. & Martorell, L.F. (2000). Flora of Puerto Rico and adjacent islands: a systematic synopsis. Second Edition Revised. La Editorial, UPR, San Juan, Puerto Rico	"On waste grounds and hillsides at lower elevations in dry regions..."

Qsn #	Question	Answer
	van Hoven. W., Orban, B., Deutschländer, M., & Kurpershoek, C. (2009). An Ecological Study of the Plant Communities and Animal Populations of Sable Hills Waterfront Estate, with Management Recommendations. Centre for Wildlife Management, University of Pretoria, Pretoria. SA	"The other weeds, <i>Zinnia peruviana</i> , <i>Conyza bonariensis</i> and <i>Bidens pilosa</i> , are growing in the veld like a grass layer. These weeds should be outcompeted by the grasses once overgrazing has been minimised. Residents can be made aware to also remove these weeds from their gardens, especially <i>Zinnia peruviana</i> ." [Invasion of disturbed habitat facilitated by overgrazing]

303	Agricultural/forestry/horticultural weed	n
	Source(s)	Notes
	Tamado, T., & Milberg, P. (2000). Weed flora in arable fields of eastern Ethiopia with emphasis on the occurrence of <i>Parthenium hysterophorus</i> . <i>Weed Research</i> , 40(6): 507-521	"Appendix 1 Weed species of crop fields in eastern Ethiopia, their family, frequency, field uniformity and life form" [<i>Zinnia peruviana</i> at a frequency of 3%. No negative impacts specified in this study]
	Martin, T. G., Campbell, S., & Grounds, S. 2006. Weeds of Australian rangelands. <i>The Rangeland Journal</i> , 28(1): 3-26	"Appendix 1. List of 622 non-native plant species that occur in the rangelands, including 153 species, representing 94 taxa (Table 2), which pose a threat to rangeland biodiversity" [<i>Zinnia peruviana</i> listed, but not included among those plants "known to have an impact on rangeland biodiversity"]
	Vibrans, H. (1998). Native maize field weed communities in south-central Mexico. <i>Weed Research</i> 38: 153-166	"Appendix 1. List of the weed species found in the maize fields of Puebla and Tlaxcala" [<i>Zinnia peruviana</i> only reported to cover 0.1 m ² and not documented to cause any negative impacts]

304	Environmental weed	n
	Source(s)	Notes
	Medeiros, A. C., Loope, L. L., & Chimera, C. G. 1993. Kanaio Natural Area Reserve biological inventory and management recommendations. Prepared for Natural Area Reserve System, State of Hawaii	"Common bright-flowered annual of overgrazed rocky areas, 1100-1800 ft (335-550 m) elevation." [Not identified as a significant environmental threat to the flora and fauna of the natural area reserve]
	Pl@ntNet. (2021). Plantinvasivekruger - Asteraceae - <i>Zinnia peruviana</i> (L.) L. http://publish.plantnet-project.org . [Accessed 20 Apr 2021]	"Invasive weed with low ecological impact." ... "Controlled by cultivation at seedling stage. It is rarely a problematic."
	Myburgh, W. J., & Bredenkamp, G. J. (2005). The distribution and extent of declared weeds and invader plants in the macro channel of the Olifants River System, Mpumalanga. <i>Koedoe-African Protected Area Conservation and Science</i> , 48(1): 67-75	"Most of the alien species are opportunistic in nature and can be described as agrestal weeds. occurring mainly in disturbed areas." ... "Annual weedy species such as <i>Tagetes minuta</i> , <i>Bidens pilosa</i> , <i>Gomphrena celosioides</i> , <i>Bidens formosa</i> , <i>Schkuhria pinnata</i> , <i>Conyza bonariensis</i> , <i>Zinnia peruviana</i> and <i>Richardia brasiliensis</i> were associated with disturbed open areas. either on the macro channel banks or in the channel bed. These species are typical examples of agrestal weeds. which are not thought to pose a serious threat to undisturbed natural areas." [Not considered an environmental weed]
	New Hope Group. 2014. New Acland Coal Mine Stage 3 Project – Environmental Impact Statement. New Hope Group, Brookwater Qld. http://www.newhopegroup.com.au/ . [Accessed 3 Apr 2014]	"Table 2 Pest Plants of Management Concern Identified at the Study area" ... " <i>Zinnia peruviana</i> ... Particularly abundant and invasive in some natural grassland and woodland areas"

Qsn #	Question	Answer
	Queensland Government. (2021). Weeds of Australia. <i>Zinnia peruviana</i> . https://keyserver.lucidcentral.org/weeds . [Accessed 20 Apr 2021]	"Wild zinnia (<i>Zinnia peruviana</i>) is regarded as an environmental weed in Queensland." [Possibly, but no impacts specified]
	Batianoff, G. N., & Butler, D. W. (2002). Assessment of invasive naturalized plants in south-east Queensland. <i>Plant Protection Quarterly</i> , 17(1), 27-34	[Regarded as more of a disturbance weed than invasive] "Appendix. List of invasive naturalized plants in south-east Queensland" [<i>Zinnia peruviana</i> score = 3.1. Plants scoring a 3 were considered "common, invasive? (needs disturbance)" and plants with a score of 4 are those regarded as "generally invasive"]
	Van der Walt, K. (2015). Population biology and ecology of the critically endangered succulent <i>Adenium swazicum</i> . PhD Dissertation. University of the Witwatersrand, Johannesburg	[Suspected of competing with an endangered plant in South Africa] "Furthermore, dense infestations of weedy alien species such as <i>Bidens pilosa</i> and <i>Zinnia peruviana</i> were also observed during the summer periods." ... "Encroachment by alien plants is considered a severe threat for numerous plant species on a national scale (Von Staden 2009); however, only population D was threatened by extensive invasions of pioneer alien plant species such as <i>Zinnia peruviana</i> and <i>Bidens pilosa</i> , which during summer formed dense stands often covering <i>A. swazicum</i> plants completely."
	Stone, C.P., Smith, C.W., & Tunison, J.T. (eds.). (1992). <i>Alien Plant Invasions in Native Ecosystems of Hawai'i: Management and Research</i> . Cooperative National Park Resources Studies Unit, University of Hawaii, Manoa, Honolulu, HI	Not regarded as a significant environmental weed

305	Congeneric weed	
	Source(s)	Notes
	Torres, A. M. (1963). Taxonomy of zinnia. <i>Brittonia</i> , 15(1): 1-25	" <i>Zinnia elegans</i> " ... "It is not as weedy as <i>Z. peruviana</i> but has become naturalized in parts of Florida, Central America and South America as well as in Australia where it was thought to be native by Bailey. It does not have a well-developed pappus as does <i>Z. peruviana</i> and apparently lacks the ability to do as well in the varied habitats where the latter flourishes."
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). <i>Manual of the flowering plants of Hawaii</i> . Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	" <i>Zinnia palmeri</i> " ... "Native to central Mexico; in Hawai'i naturalized only on Koko Crater, O'ahu."
	Randall, R.P. (2017). <i>A Global Compendium of Weeds</i> . 3rd Edition. Perth, Western Australia. R.P. Randall	Several <i>Zinnia</i> species are listed as naturalized or weeds of minor significance

401	Produces spines, thorns or burrs	n
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). <i>Manual of the flowering plants of Hawaii</i> . Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Annual herbs 2-9 dm tall, strigose to hirsute. Leaves narrowly lanceolate to broadly ovate or elliptic, usually 3-7 cm long, 0.6-3 cm wide, base cuneate to truncate, subsessile."

402	Allelopathic	n
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Qsn #	Question	Answer
	Source(s)	Notes
	Morikawa, C. I. O., Miyaura, R., Tapia Y Figueroa, M. D. L., Rengifo Salgado, E. L., & Fujii, Y. (2012). Screening of 170 Peruvian plant species for allelopathic activity by using the Sandwich Method. <i>Weed Biology and Management</i> , 12 (1): 1-11	"The percentages of elongation of the radicle and hypocotyl of the lettuce seedlings for all the tested species are given in Table 2. The mean and standard deviation of the percentages were calculated and the criteria of the SDV were evaluated. The criteria of *, **, ***, and **** in Table 2 refer to radicle elongation that is lower than the mean value minus..." ... "Table 2. Allelopathic activity of the 176 samples (170 species) of Peruvian plants by the Sandwich Method" [<i>Zinnia peruviana</i> not shown to have a significant inhibitory effect]

403	Parasitic	n
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Annual herbs 2-9 dm tall..." [Asteraceae]

404	Unpalatable to grazing animals	
	Source(s)	Notes
	van Hoven. W., Orban, B., Deutschländer, M., & Kurpershoek, C. (2009). An Ecological Study of the Plant Communities and Animal Populations of Sable Hills Waterfront Estate, with Management Recommendations. Centre for Wildlife Management, University of Pretoria, Pretoria. SA	[Possibly unpalatable] "The indigenous herbs are not present on Sable Hills due to the heavy infestation of alien-invasive herbaceous species throughout Sable Hills. These alien-invasive herbaceous species are blackjack <i>Bidens pilosa</i> , red-star zinnia <i>Zinnia peruviana</i> and flax-leaf fleabane <i>Conyza bonariensis</i> . The invasion of these alien herbaceous species also influence the occurrence of more palatable grass species" ... "There are other alien weeds occurring on Sable Hills that becomes a nuisance (reduces carrying capacity for animals as it has no nutritional value for the animals), but is not required by law to remove. These plants are: <ul style="list-style-type: none"> • Redstar zinnia <i>Zinnia peruviana</i> • Flax-leaf fleabane <i>Conyza bonariensis</i> • Smelter's bush <i>Flaveria bidentis</i> • Blackjack <i>Bidens pilosa</i>"
	High Country Gardens. (2021). Peruvian Zinnia Seeds. https://www.highcountrygardens.com/wildflower-seeds/individual-species/peruvian-zinnia-seeds . [Accessed 20 Apr 2021]	[Suggests plants may be unpalatable to deer] "This Southwestern native wildflower is easy to grow and deer resistant."

405	Toxic to animals	n
	Source(s)	Notes
	Quattrocchi, U. (2012). CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	No evidence
	Wagstaff, D.J. (2008). International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	No evidence

Qsn #	Question	Answer
406	Host for recognized pests and pathogens	
	Source(s)	Notes
	Johnson, C.N. & Kessler, J.R. (2007). Greenhouse Production of Bedding Plant Zinnias. ANR-1311. Alabama Cooperative Extension System, Alabama A&M University and Auburn University. www.aces.edu	"Table 3. Description of Common Zinnia Diseases" ... "Alternaria Leaf Blight, Alternaria zinniae" ... "Bacterial Leaf Spot, Xanthomonas campestris pv. zinniae" ... "Botrytis Blight, Botrytis cinerea" ... "Powdery Mildew, Erysiphe cichoreacearum"

407	Causes allergies or is otherwise toxic to humans	
	Source(s)	Notes
	BoDD. (2021). Compositae — 23 Wedelia - Zinnia (Daisy or Sunflower family). http://www.botanical-dermatology-database.info/BotDermFolder/COMP-23.html . [Accessed 20 Apr 2021]	"Shelmire (1939a) reported a species of this genus as a minor skin sensitiser, but gave no clinical details. Potentially allergenic sesquiterpene lactones have been reported from the following species: Zinnia haageana Regel Zinnia peruviana L." [Potential dermatological effects]
	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
	Wagstaff, D.J. (2008). International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	No evidence

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R. & Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Annual herbs 2-9 dm tall, strigose to hirsute." ... "naturalized in low elevation, relatively dry, disturbed sites" [Despite occurrence in seasonally fire-prone habitat, unlikely, given growth habit]
	Pl@ntNet. (2021). Plantinvasivekruger - Asteraceae - Zinnia peruviana (L.) L. http://publish.plantnet-project.org . [Accessed 20 Apr 2021]	No evidence. Not listed among impacts

409	Is a shade tolerant plant at some stage of its life cycle	n
	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	"Zinnias are annuals easily grown in hot weather; in Hawaii they thrive in the sunny, leeward sides of the islands."
	Pl@ntNet. (2021). Plantinvasivekruger - Asteraceae - Zinnia peruviana (L.) L. http://publish.plantnet-project.org . [Accessed 20 Apr 2021]	"Occurs in dry land, village and roadside. Prefers well drained soil and full sun."

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y

Qsn #	Question	Answer
	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	"Any reasonably fertile garden soil will suffice, and once established they should be kept on the dry side."

411	Climbing or smothering growth habit	n
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Annual herbs 2-9 dm tall, strigose to hirsute. Leaves narrowly lanceolate to broadly ovate or elliptic, usually 3-7 cm long, 0.6-3 cm wide, base cuneate to truncate, sessile."

412	Forms dense thickets	y
	Source(s)	Notes
	PlantNET. (2021). New South Wales Flora Online - <i>Zinnia peruviana</i> (L.) L. National Herbarium of NSW, Royal Botanic Garden, Sydney. http://plantnet.rbg Syd.nsw.gov.au . [Accessed 20 Apr 2021]	"Garden escape, weed of roadsides and disturbed sites, not common" [No evidence]
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"naturalized in low elevation, relatively dry, disturbed sites" [No evidence]
	Richardson, F. J., Richardson, R. G., & Shepherd, R. C. H. (2011). Weeds of the South-East: An Identification Guide for Australia. Second Edition. RG and FJ Richardson, Victoria, Australia	"Occasional garden escapes along roadsides and in other disturbed sites." [No evidence]
	Van der Walt, K. (2015). Population biology and ecology of the critically endangered succulent <i>Adenium swazicum</i> . PhD Dissertation. University of the Witwatersrand, Johannesburg	[Forms dense cover that is suspected of impacting <i>A. swazicum</i>] "only population D was threatened by extensive invasions of pioneer alien plant species such as <i>Zinnia peruviana</i> and <i>Bidens pilosa</i> , which during summer formed dense stands often covering <i>A. swazicum</i> plants completely."

501	Aquatic	n
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"naturalized in low elevation, relatively dry, disturbed sites" [Terrestrial]

Qsn #	Question	Answer
502	Grass	n
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Annual herbs 2-9 dm tall, strigose to hirsute." [Asteraceae]

503	Nitrogen fixing woody plant	n
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Annual herbs 2-9 dm tall, strigose to hirsute." [Asteraceae]

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	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	"...care must be taken when transplanting because zinnias are sensitive to root disturbance."

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	Notes
	Torres, A. M. (1963). Taxonomy of zinnia. <i>Brittonia</i> , 15(1): 1-25	No evidence

602	Produces viable seed	y
	Source(s)	Notes
	Galíndez, G., Ortega-Baes, P., Daws, M. I., Sühling, S., Scopel, A. L., & Pritchard, H. W. (2009). Seed mass and germination in Asteraceae species of Argentina. <i>Seed Science and Technology</i> , 3 (3): 786-790	"For <i>P. hysterophorus</i> and <i>Z. peruviana</i> their lower light requirement for germination, high germination percentages and shorter mean times to germinate may partly explain their wide distribution in different habitats (Tamado et al., 2002)."
	Pl@ntNet. (2021). Plantinvasivekruger - Asteraceae - <i>Zinnia peruviana</i> (L.) L. http://publish.plantnet-project.org . [Accessed 20 Apr 2021]	" <i>Z. peruviana</i> multiplies by seeds. Seeds are dispersed by wind."

603	Hybridizes naturally	
	Source(s)	Notes

Qsn #	Question	Answer
	Boyle, T. H., & Stimart, D. P. (1982). Interspecific hybrids of <i>Zinnia elegans</i> Jacq. and <i>Z. angustifolia</i> HBK: embryology, morphology and powdery mildew resistance. <i>Euphytica</i> , 31(3): 857-867	[Artificial hybridization possible within genus] "Reciprocal crosses between 13 cultivars of <i>Zinnia elegans</i> Jacq. and one source of <i>Z. angustifolia</i> HBK resulted in interspecific hybrids. Florets examined 14 days after pollination showed that all 13 cross combinations of <i>Z. angustifolia</i> x <i>Z. elegans</i> yielded embryos in 47.2% of the florets pollinated. Six cross combinations of <i>Z. elegans</i> x <i>Z. angustifolia</i> produced embryos in 4.6% of the total <i>Z. elegans</i> florets pollinated. Interspecific crosses resulted in seed propagated hybrids when <i>Z. angustifolia</i> was the maternal parent. Hybrids were obtained from reciprocal crosses between the two species when embryos were excised and cultured. Morphologically, most hybrids resembled <i>Z. angustifolia</i> but were sterile."
	Stimart D. & Boyle T. (2007) <i>Zinnia</i> . In: Anderson N.O. (eds) <i>Flower Breeding and Genetics</i> . Springer, Dordrecht	[Possibly. Artificial hybrid created. Natural hybrids not documented] "Four interspecific hybrids have been reported: <i>Z. haageana</i> x <i>Z. violacea</i> , <i>Z. peruviana</i> x <i>Z. violacea</i> , <i>Z. angustifolia</i> x <i>Z. violacea</i> , and <i>Z. angustifolia</i> x <i>Z. haageana</i> ." ... "Shahin et al. (1971) crossed diploid (2n = 2x = 24) accessions of <i>Z. peruviana</i> (as ♀) and <i>Z. violacea</i> and obtained F1 hybrids. The F1 hybrids were more vigorous than either parent and most hybrids resembled <i>Z. violacea</i> more than <i>Z. peruviana</i> . Intercrosses between F1 hybrids and backcrosses to both parents failed to produce viable seeds. Microscopic examination of pollen mother cells revealed irregular meiosis. There have been no further reports of interspecific hybrids between these two species."

604	Self-compatible or apomictic	y
	Source(s)	Notes
	Stimart D. & Boyle T. (2007) <i>Zinnia</i> . In: Anderson N.O. (eds) <i>Flower Breeding and Genetics</i> . Springer, Dordrecht	" <i>Zinnia peruviana</i> is apparently self-compatible (Torres, 1964) as are some lines of <i>Z. violacea</i> ."
	Boyle, T. H., & Stimart, D. P. 1986. Self-incompatibility and interspecific incompatibility: relationships in intra- and interspecific crosses of <i>Zinnia elegans</i> Jacq. and <i>Z. angustifolia</i> HBK (Compositae). <i>Theoretical and Applied Genetics</i> , 73(2): 305-315	[Other <i>Zinna</i> species are self-incompatible] "Intraspecific and reciprocal interspecific crosses involving <i>Zinnia angustifolia</i> clones and <i>Z. elegans</i> lines showed that in both species, sporophytic self-incompatibility (SI) systems were present. Intensity of SI varied among clones and lines, and high self seed set was associated with a concomitant decrease in callose fluorescence in papillae and pollen tubes."

605	Requires specialist pollinators	n
	Source(s)	Notes
	Galetto, L., & Bernardello, G. (2003). Nectar sugar composition in angiosperms from Chaco and Patagonia (Argentina): an animal visitor's matter?. <i>Plant Systematics and Evolution</i> , 238(1-4): 69-86	"Appendix 1. Analysed species from the Argentinean Chaco region, indicating nectar sugar ratio (sucrose/fructose + glucose), percentages of sucrose, fructose, and glucose in nectar, floral visitors, and literature from where data were taken" [Floral visitors for <i>Zinnia</i> include butterflies & bees]
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). <i>Manual of the flowering plants of Hawaii</i> . Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"At least the central peduncles often inflated below the heads, rays usually maroon, sometimes burnt orange, rusty red, scarlet, or yellow, obovate, 8-25 mm long; disk corollas purple to blackish toward apex, ca. 4 mm long;" [No evidence from floral morphology]

606	Reproduction by vegetative fragmentation	n
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Qsn #	Question	Answer
	Source(s)	Notes
	PI@ntNet. (2021). Plantinvasivekruger - Asteraceae - <i>Zinnia peruviana</i> (L.) L. http://publish.plantnet-project.org . [Accessed 20 Apr 2021]	" <i>Z. peruviana</i> multiplies by seeds. Seeds are dispersed by wind." [No evidence of vegetative reproduction]
	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	"Zinnias are propagated from seed..."

607	Minimum generative time (years)	1
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R. & Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Annual herbs 2-9 dm tall..." [Able to reach maturity in 1 growing season]

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y
	Source(s)	Notes
	PlantNET. (2021). New South Wales Flora Online - <i>Zinnia peruviana</i> (L.) L. National Herbarium of NSW, Royal Botanic Garden, Sydney. http://plantnet.rbg Syd.nsw.gov.au . [Accessed 20 Apr 2021]	"Garden escape, weed of roadsides and disturbed sites" [Adapted to disturbed sites, but achenes lack means of external attachment]
	Richardson, F. J., Richardson, R. G., & Shepherd, R. C. H. (2011). Weeds of the South-East: An Identification Guide for Australia. Second Edition. RG and FJ Richardson, Victoria, Australia	"Occasional garden escapes along roadsides and in other disturbed sites." [Possibly moved along heavily trafficked corridors]

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	"The name <i>Zinnia peruviana</i> , used indiscriminately for all cultivated zinnias, is incorrect; the majority of cultivated strains derive from other species, although genuine <i>Z. peruviana</i> (Linnaeus) Linnaeus is cultivated to a limited extent."

703	Propagules likely to disperse as a produce contaminant	
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Major Pathway/s: Contaminant, Herbal, Ornamental"
	WRA Specialist. (2021). Personal Communication	Unlikely, but possible if cultivated with other annual flowers or if occurring in areas cultivated for hay production

704	Propagules adapted to wind dispersal	y
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Qsn #	Question	Answer
	Source(s)	Notes
	Pl@ntNet. (2021). Plantinvasivekruger - Asteraceae - <i>Zinnia peruviana</i> (L.) L. http://publish.plantnet-project.org . [Accessed 20 Apr 2021]	"Z. peruviana multiplies by seeds. Seeds are dispersed by wind."

705	Propagules water dispersed	n
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Ray achenes 9-10 mm long, disk achenes 7-9 mm long" ... "naturalized in low elevation, relatively dry, disturbed sites" [Achene morphology and distribution of plant suggests water is an unlikely dispersal vector]

706	Propagules bird dispersed	n
	Source(s)	Notes
	Pl@ntNet. (2021). Plantinvasivekruger - Asteraceae - <i>Zinnia peruviana</i> (L.) L. http://publish.plantnet-project.org . [Accessed 2 Apr 2014]	"Fruits are achenes, oblong and flattened, black in colour." ... "Z. peruviana multiplies by seeds. Seeds are dispersed by wind."

707	Propagules dispersed by other animals (externally)	n
	Source(s)	Notes
	Pl@ntNet. (2021). Plantinvasivekruger - Asteraceae - <i>Zinnia peruviana</i> (L.) L. http://publish.plantnet-project.org . [Accessed 4 Apr 2014]	"Fruits are achenes, oblong and flattened, black in colour." ... "Z. peruviana multiplies by seeds. Seeds are dispersed by wind." [No evidence, and achenes lack means of external attachment]

708	Propagules survive passage through the gut	n
	Source(s)	Notes
	Pl@ntNet. (2021). Plantinvasivekruger - Asteraceae - <i>Zinnia peruviana</i> (L.) L. http://publish.plantnet-project.org . [Accessed 4 Apr 2014]	"Fruits are achenes, oblong and flattened, black in colour." ... "Z. peruviana multiplies by seeds. Seeds are dispersed by wind." [No evidence, and achenes not adapted for internal dispersal]

801	Prolific seed production (>1000/m2)	n
	Source(s)	Notes
	Ayele, S., Nigatu, L., Tana, T., & Adkins, S. W. 2013. Impact of parthenium weed (<i>Parthenium hysterophorus</i> L.) on the above ground and soil seed bank communities of rangelands in Southeast Ethiopia. <i>International Research Journal of Agricultural Science and Soil Science</i> , 3(7): 262-274	"Table 2. Mean germinable soil seed bank (seedlings m-2) of grasses, non-grass species and parthenium weed at five <i>P. hysterophorus</i> infestation levels in rangelands in south-eastern Ethiopia" ... [<i>Zinnia peruviana</i> recorded at densities of 46.7 and 9.2 in this study]
	Chimera, C. G. 2004. Investigating seed dispersal and seed predation in a Hawaiian dry forest community. M.Sc. Thesis, University of Hawaii at Manoa, Honolulu, HI	"Table 2.2. Mean density (seeds m-2) under trees and in exposed sites (Exp.), and percentage of total seed rain for all species collected in 180 seed traps in KNAR from April 2003 to March 2004." [<i>Zinnia peruviana</i> recorded at densities of 1.8 seeds m-2]

Qsn #	Question	Answer
802	Evidence that a persistent propagule bank is formed (>1 yr)	
	Source(s)	Notes
	Royal Botanic Gardens Kew. (2021) Seed Information Database (SID). Version 7.1. http://data.kew.org/sid/ . [Accessed 20 Apr 2021]	[Possibly. Unknown from field conditions] "Storage Behaviour: Orthodox p Storage Conditions: 89% viability following drying to mc's in equilibrium with 15% RH and freezing for 2 months at -20°C at RBG Kew, WP"

803	Well controlled by herbicides	
	Source(s)	Notes
	CABI. (2021). <i>Zinnia peruviana</i> . In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"Members of the <i>Zinnia</i> genus can be controlled or weakened by chemicals and nutrient adjustment. Certain pesticides burn <i>Zinnia</i> leaves and excess soil nitrogen levels lead to weakened stems (Johnson and Kessler, 2007)." [Johnson CN, Kessler JR, 2007. Greenhouse protection of bedding plant <i>Zinnias</i> . Alabama, USA: Alabama A&M and Auburn Universities, ANR 1311. http://www.aces.edu/pubs/docs/A/ANR-1311/ANR-1311.pdf]

804	Tolerates, or benefits from, mutilation, cultivation, or fire	n
	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	"Zinnias are propagated from seed sown in place or started in seedling flats or individual pots; care must be taken when transplanting because zinnias are sensitive to root disturbance." [Suggests minor disturbance through cultivation results in seedling mortality]

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	Notes
	Ramadan, M. M., Murai, K. T., & Johnson, T. (2011). Host range of <i>Secusio extensa</i> (Lepidoptera: Arctiidae), and potential for biological control of <i>Senecio madagascariensis</i> (Asteraceae). <i>Journal of Applied Entomology</i> , 135(4): 269-284	" <i>Secusio extensa</i> (Lepidoptera: Arctiidae) was evaluated as a potential biological control agent for Madagascar fireweed, <i>Senecio madagascariensis</i> (Asteraceae), which has invaded over 400 000 acres of rangeland in the Hawaiian Islands and is toxic to cattle and horses." ... "The moth was introduced from southeastern Madagascar into containment facilities in Hawaii, and host specificity tests were conducted on 71 endemic and naturalized species (52 genera) in 12 tribes of Asteraceae and 17 species of non-Asteraceae including six native shrubs and trees considered key components of Hawaiian ecosystems. No-choice feeding tests indicated that plant species of the tribe Senecioneae were suitable hosts..." ... "Table 2 Results of no-choice larval-feeding tests with <i>Secusio extensa</i> " ... " <i>Zinnia peruviana</i> - Suitability for Development = Negative sign () indicates unsuitability for development" [Will not impact <i>Zinnia peruviana</i>]

Summary of Risk Traits:

High Risk / Undesirable Traits

- Thrives in tropical climates
- Elevation range exceeds 1000 m
- Widely naturalized, including on the Hawaiian Islands of Molokai, Lanai, Maui, Kahoolawe and Hawaii
- Disturbance weed
- A potential environmental weed in South Africa (may impact an endangered plant species)
- Possible skin allergen
- Tolerates many soil types
- Forms dense cover that may impact rare plants (South Africa)
- Produces wind-dispersed seeds
- Self-compatible
- Annual (reaches maturity in <1 year)
- Adapted to and dispersed along heavily disturbed corridors

Low Risk Traits

- Unarmed (lacks spines, thorns, or burrs)
- Non-toxic
- Ornamental
- Requires full sun
- Does not spread vegetatively
- Seedlings do not tolerate root disturbance