Taxon: Verbena litoralis Kunth

Family: Verbenaceae

Common Name(s): Brazilian vervain
common verbena
oī
ōwī
seashore vervain

Synonym(s): Verbena gentryi Moldenke
Verbena longifolia M. Martens &

Assessor: Chuck Chimera **Status:** In Progress **End Date:** 10 Mar 2020

WRA Score: 16.0 **Designation:** H(Hawai'i) **Rating:** High Risk

Keywords: Tropical Herb, Pasture Weed, Environmental Weed, Low Palatability, Self-Compatible

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		
303	Agricultural/forestry/horticultural weed	n=0, y = 2*multiplier (see Appendix 2)	y
304	Environmental weed	n=0, y = 2*multiplier (see Appendix 2)	y
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	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	y=1, n=0	n

Qsn #	Question	Answer Option	Answer
408	Creates a fire hazard in natural ecosystems		
409	Is a shade tolerant plant at some stage of its life cycle		
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)		
411	Climbing or smothering growth habit	y=1, n=0	n
412	Forms dense thickets		
501	Aquatic	y=5, n=0	n
502	Grass	y=1, n=0	n
503	Nitrogen fixing woody plant	y=1, n=0	n
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y=1, n=0	n
601	Evidence of substantial reproductive failure in native habitat	y=1, n=0	n
602	Produces viable seed	y=1, n=-1	y
603	Hybridizes naturally		
604	Self-compatible or apomictic	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	2
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)		
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	n
705	Propagules water dispersed	y=1, n=-1	y
706	Propagules bird dispersed		
707	Propagules dispersed by other animals (externally)		
708	Propagules survive passage through the gut		
801	Prolific seed production (>1000/m2)		
802	Evidence that a persistent propagule bank is formed (>1 yr)		
803	Well controlled by herbicides	y=-1, n=1	y
804	Tolerates, or benefits from, mutilation, cultivation, or fire	y=1, n=-1	y
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)		

Supporting Data:

Qsn #	Question	Answer
101	**Is the species highly domesticated?**	**n**
	Source(s)	**Notes**
	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 of domestication] "Native from Mexico through Central America to South America, widely naturalized; in Hawai'i the most common naturalized Verbena..."

102	**Has the species become naturalized where grown?**	
	Source(s)	**Notes**
	WRA Specialist. (2020). Personal Communication	NA

103	**Does the species have weedy races?**	
	Source(s)	**Notes**
	WRA Specialist. (2020). Personal Communication	NA

Qsn #	Question	Answer
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**
	USDA, ARS, Germplasm Resources Information Network, 2016. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 10 Mar 2020]	"Native: Northern America Northern Mexico: Mexico - Chihuahua, - Nuevo Leon, - San Luis Potosi, - Sinaloa, - Sonora, - Tamaulipas Southern Mexico: Mexico - Aguascalientes, - Chiapas, - Guanajuato, - Guerrero, - Hidalgo, - Jalisco, - Mexico, - Michoacan, - Morelos, - Nayarit, - Oaxaca, - Puebla, - Queretaro, - Tabasco, - Veracruz, - Revillagigedo, - Federal District Southern America Brazil: Brazil - Minas Gerais, - Parana, - Rio de Janeiro, - Rio Grande do Sul, - Santa Catarina Mesoamerica: Belize; Costa Rica; El Salvador; Guatemala; Honduras; Nicaragua; Panama Northern South America: Venezuela Southern South America: Argentina - Cordoba, - Mendoza, - Buenos Aires, - Catamarca, - Chaco, - Corrientes, - Entre Rios, - Formosa, - Jujuy, - La Pampa, - La Rioja, - Misiones, - Neuquen, - Rio Negro, - Salta, - San Juan, - San Luis, - Santa Fe, - Santiago del Estero, - Tucuman; Chile - Juan Fernandez, - Atacama, - Coquimbo, - Santiago, - Tarapaca, - Valparaiso; Paraguay; Uruguay Western South America: Bolivia - Cochabamba, - La Paz, - Santa Cruz, - Tarija; Colombia; Ecuador - Azuay, - Canar, - Carchi, - Chimborazo, - Cotopaxi, - El Oro, - Galapagos Islands, - Guayas, - Imbabura, - Loja, - Los Rios, - Morona-Santiago, - Napo, - Pastaza, - Pichincha, - Tungurahua, - Zamora-Chinchipe; Peru - Amazonas, - Ancash, - Arequipa, - Cajamarca, - Cuzco, - Huanuco, - Junin, - La Libertad, - Lima, - Loreto, - Piura, - San Martin, - Tacna"

202	Quality of climate match data	High
	Source(s)	**Notes**
	USDA, ARS, Germplasm Resources Information Network, 2016. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 10 Mar 2020]	

203	Broad climate suitability (environmental versatility)	y
	Source(s)	**Notes**
	CABI. (2020). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"In Chile, its native environment, this species typically grows at low altitude in valleys and coastal areas but can be found between 500 and 2000 m in the coastal mountain areas. It prefers dry, sunny, arid areas and can withstand long periods of drought and has a USDA Hardiness Zone 9 rating. The plant does not tolerate snow, but can tolerate occasional freezing spells of about - 5° C (the typical morning frost of central Chile)(Belov, 2012)."

Qsn #	Question	Answer
	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.	[Elevation ranges exceeds 2000 m, demonstrating environmental versatility] "in Hawai'i the most common naturalized Verbena occurring in dry to wet, disturbed habitats, 10-2,280 m, on Midway Atoll and all of the main islands"

Qsn #	Question	Answer
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.	"Native from Mexico through Central America to South America, widely naturalized; in Hawai'i the most common naturalized Verbena occurring in dry to wet, disturbed habitats, 10-2,280 m, on Midway Atoll and all of the main islands. First collected in 1837, specific locality unknown (Barclay s.n., BM)."
	USDA, ARS, Germplasm Resources Information Network, 2016. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 10 Mar 2020]	"Native: Northern America Northern Mexico: Mexico - Chihuahua, - Nuevo Leon, - San Luis Potosi, - Sinaloa, - Sonora, - Tamaulipas Southern Mexico: Mexico - Aguascalientes, - Chiapas, - Guanajuato, - Guerrero, - Hidalgo, - Jalisco, - Mexico, - Michoacan, - Morelos, - Nayarit, - Oaxaca, - Puebla, - Queretaro, - Tabasco, - Veracruz, - Revillagigedo, - Federal District Southern America Brazil: Brazil - Minas Gerais, - Parana, - Rio de Janeiro, - Rio Grande do Sul, - Santa Catarina Mesoamerica: Belize; Costa Rica; El Salvador; Guatemala; Honduras; Nicaragua; Panama Northern South America: Venezuela Southern South America: Argentina - Cordoba, - Mendoza, - Buenos Aires, - Catamarca, - Chaco, - Corrientes, - Entre Rios, - Formosa, - Jujuy, - La Pampa, - La Rioja, - Misiones, - Neuquen, - Rio Negro, - Salta, - San Juan, - San Luis, - Santa Fe, - Santiago del Estero, - Tucuman; Chile - Juan Fernandez, - Atacama, - Coquimbo, - Santiago, - Tarapaca, - Valparaiso; Paraguay; Uruguay Western South America: Bolivia - Cochabamba, - La Paz, - Santa Cruz, - Tarija; Colombia; Ecuador - Azuay, - Canar, - Carchi, - Chimborazo, - Cotopaxi, - El Oro, - Galapagos Islands, - Guayas, - Imbabura, - Loja, - Los Rios, - Morona-Santiago, - Napo, - Pastaza, - Pichincha, - Tungurahua, - Zamora-Chinchipe; Peru - Amazonas, - Ancash, - Arequipa, - Cajamarca, - Cuzco, - Huanuco, - Junin, - La Libertad, - Lima, - Loreto, - Piura, - San Martin, - Tacna Naturalized: Africa Southern Africa: South Africa Western Indian Ocean: Mauritius; Reunion Australasia Australia: Australia Europe Southeastern Europe: Italy Southwestern Europe: Spain Northern America : United States Southern America Caribbean: Puerto Rico"

205	**Does the species have a history of repeated introductions outside its natural range?**	**y**

Qsn #	Question	Answer
	Source(s)	**Notes**
	CABI. (2020). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"Verbena litoralis is a short-lived herbaceous plant, native to many of the tropical areas of Central and South America. Although the species has spread to other countries from its native environment, and is sometimes regarded as an invasive threat (in Australia and some states of the USA), it often seems to be restricted to disturbed habitats like roadsides, stream banks, tracks and waste places."

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.	"Native from Mexico through Central America to South America, widely naturalized; in Hawai'i the most common naturalized Verbena occurring in dry to wet, disturbed habitats, 10-2,280 m, on Midway Atoll and all of the main islands. First collected in 1837, specific locality unknown (Barclay s.n., BM)."
	USDA, ARS, Germplasm Resources Information Network, 2016. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 10 Mar 2020]	"Naturalized: Africa Southern Africa: South Africa Western Indian Ocean: Mauritius; Reunion Australasia Australia: Australia Europe Southeastern Europe: Italy Southwestern Europe: Spain Northern America : United States Southern America Caribbean: Puerto Rico"

302	Garden/amenity/disturbance weed	
	Source(s)	**Notes**
	CABI. (2020). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	[A disturbance-adapted weed that has some negative environmental impacts] "Although the species has spread to other countries from its native environment, and is sometimes regarded as an invasive threat (in Australia and some states of the USA), it often seems to be restricted to disturbed habitats like roadsides, stream banks, tracks and waste places."

303	Agricultural/forestry/horticultural weed	y
	Source(s)	**Notes**
	Bentley, J. W., Webb, M., Nina, S., & Pérez, S. (2005). Even useful weeds are pests: Ethnobotany in the Bolivian Andes. International Journal of Pest Management, 51(3), 189-207	"Annex A. Weeds in Cochabamba, Pest status and uses." ... "Verbena litoralis ... Not usually serious, but is a weed in wheat in Sacabamba. Also grows on field edges and in fallows"

Qsn #	Question	Answer
	Motooka, P., Castro, L., Nelson, D., Nagai, G. & Ching,L. 2003. Weeds of Hawaii's Pastures and Natural Areas: An Identification and Management Guide. CTAHR, UH Manoa, Honolulu, HI	"Environmental impact: Displaces forages in pastures and native species in disturbed forest sites."
	Haselwood, E.L., Motter, G.G., & Hirano, R.T. (eds.). 1983. Handbook of Hawaiian Weeds. University of Hawaii Press, Honolulu, HI	"Habitat: Found at all elevations. A weed in postures, rangelands, and cultivated areas."
	Hosaka, E. Y., Thistle, A. & Wadsworth, H. A. 1954. Noxious Plants of Hawaiian Ranges. Extension Bulletin 62. University of Hawaii, Honolulu	"Why a pest: This is a moderately fast-growing plant that becomes troublesome in some regions, especially in the middle elevations. Heavy stands of verbena occupy space that should be in grass."

304	Environmental weed	y
	Source(s)	**Notes**
	US Fish and Wildlife Service. 2010. Endangered and Threatened Wildlife and Plants; Determination of Endangered Status for 48 Species on Kauai and Designation of Critical Habitat; Final Rule. 50 CFR Part 17. Federal Register Vol. 75, No. 70	"Lysimachia scopulensis, a shrub in the myrsine family (Myrsinaceae), is found on cliffs in lowland diverse mesic forest pockets at elevations between 2,950 and 3,200 ft (900 and 975 m) within the dry cliff ecosystem (Wood 2007d; TNCH 2007)." ... "Schiedea attenuata, a shrub in the pink family (Caryophyllaceae), occurs on cliffs at elevations between 2,297 and 2,625 ft (700 and 900 m) in the dry cliff ecosystem (Wagner et al. 1994, pp. 187– 190; TNCH 2007)." ... "Dry Cliff Ecosystem: The nonnative plant threats to the species inhabiting the dry cliff ecosystem include the understory and subcanopy species Andropogon glomeratus, Erigeron karvinskianus, Kalanchoe pinnata, Lantana camara, Lonicera japonica, Passiflora tarminiana, Rubus argutus, and Verbena litoralis (vervain) (Wood 2007d; HBMP 2007)." ... "Verbena litoralis is a perennial herb up to 6.5 ft (2 m) tall, and is naturalized in a wide range of habitats in Hawaii (Wagner et al. 1999, p. 1325). It displaces native vegetation through competition."

305	Congeneric weed	y
	Source(s)	**Notes**
	Queensland Government. 2011. Weeds of Australia - Purpletop - Verbena bonariensis. http://keyserver.lucidcentral.org/weeds/data/03030800-0b07-490a-8d04-0605030c0f01/media/Html/Verbena_bonariensis.htm. [Accessed 10 Mar 2020]	"A common weed of roadsides, pastures, grasslands, open woodlands, riparian vegetation, crops, orchards, gardens, disturbed sites and waste areas in warmer temperate, sub-tropical and occasionally also tropical environments." ... "Purpletop (Verbena bonariensis) is regarded as an environmental weed in Victoria, New South Wales, Queensland, Tasmania and the ACT."

401	Produces spines, thorns or burrs	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.	[No evidence] "Erect or ascending perennial herbs 4-20 dm tall, sometimes somewhat woody toward base; stems few to many-branched, glabrous or sparsely strigillose. Leaves decussate, lanceolate to oblanceolate, 3-10 cm long, 1-1.5 cm wide, both surfaces finely scaberulous, margins coarsely serrate, apex acute, base attenuate."

Qsn #	Question	Answer
402	**Allelopathic**	**n**
	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. Weed Biology and Management, 12 (1): 1-11	"Table 2. Allelopathic activity of the 176 samples (170 species) of Peruvian plants by the Sandwich Method" [Verbena litoralis does not did not exhibit statistically significant inhibitory effects]

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.	"Erect or ascending perennial herbs 4-20 dm tall, sometimes somewhat woody toward base; stems few to many-branched, glabrous or sparsely strigillose." [No evidence. Verbenaceae]

404	**Unpalatable to grazing animals**	
	Source(s)	**Notes**
	Motooka, P., Castro, L., Nelson, D., Nagai, G. & Ching,L. 2003. Weeds of Hawaii's Pastures and Natural Areas: An Identification and Management Guide. CTAHR, UH Manoa, Honolulu, HI	"Goats will not browse on seashore vervain (An Peischel)."
	Bentley, J. W., Webb, M., Nina, S., & Pérez, S. (2005). Even useful weeds are pests: Ethnobotany in the Bolivian Andes. International Journal of Pest Management, 51(3), 189-207	"Verbena litoralis ... Fodder. Sheep eat a little."
	Richard, E., & Juliá, J. P. (2000). El tapir (Tapirus terrestris): dieta y manejo en un bosque secundario de la ecoregión de selvas pedemontanas. Estatus en Argentina. Manejo de Fauna Silvestre en Amazonia y Latinoamérica. CITES Paraguay, Fundación Moisés Bertoni y University of Florida.	Leaves & stems are consumed by tapirs

405	**Toxic to animals**	**n**
	Source(s)	**Notes**
	Hosaka, E. Y., Thistle, A. & Wadsworth, H. A. 1954. Noxious Plants of Hawaiian Ranges. Extension Bulletin 62. University of Hawaii, Honolulu	[Non-toxic, but palatability low] "Why a pest: This is a moderately fast-growing plant that becomes troublesome in some regions, especially in the middle elevations. Heavy stands of verbena occupy space that should be in grass. Young shoots are often eaten by stock, especially horses, but the palatability is low."
	Wagstaff, D.J. 2008. International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	No evidence

406	**Host for recognized pests and pathogens**	
	Source(s)	**Notes**

Qsn #	Question	Answer
	Mônaco, A. D. A., Carneiro, R. G., Kranz, W. M., Gomes, J. C., Scherer, A., Nakamura, K. C., Moritz, M. P. & Santiago, D. C. (2008). Host reaction of weed species to Meloidogyne paranaensis. Nematologia Brasileira, 32(4), 279-284	"Meloidogyne paranaensis was first detected in coffee crops in Brazil, and it is of great importance mainly because of severity of its damages to different crops and its broad geographical distribution. Weeds may be hosts of nematode, maintaining high inoculum level in soil, which makes important to know their reaction to that parasite. The present paper had the objective to study the reaction of 38 species of weeds to M. paranaensis. Five trials were managed in a completely randomized with 10 replicates in a greenhouse. The plants were inoculated with a suspension of 5,000 or 1,557 eggs and second stagejuvenile (J2) and kept during 55, 57 and 58 days in greenhouses. After these periods the eggs and J2 were extracted and counted from root systems and the reproduction factor (RF) was calculated. The identification of the plant species were made after herbarization. The species Rhynchelitrum repens, Ambrosia elatior, Senna obtusifolia, Sorghum halepense, Ipomoea quamoclit, Porophyllum ruderale, Leonurus sibiricus, Solanum americanum, Emilia sonchifolia, Erechtites hieraciifolius, Commelina benghalensis, Sonchus oleraceus, Richardia brasiliensis, Sida rhombifolia were resistent to the pathogen. Amaranthus hybridus, Portulaca oleracea, Raphanus raphanistrum, Bidens sulbalternans, Amaranthus deflexus, Eleusine indica, Cleome affinis, Setaria geniculata, Ageratum conyzoides, Hyptis lophanta, Chenopodium album, Momordica charantia, Talinum paniculatum, Verbena litoralis, Lepidium pseudodidymum, Digitaria horizontalis, Ipomoea triloba, Amaranthus viridis, Polygonum persicaria, Chenopodium carinatum, Physalis angulata were considered susceptible. Brachiaria decumbens, Cenchrus echinatus, Leonotis nepetaefolia were immune to M. paranaensis."
	Krugner, R., Ledbetter, C. A., Chen, J., & Shrestha, A. (2012). Phenology of Xylella fastidiosa and its vector around California almond nurseries: An assessment of plant vulnerability to almond leaf scorch disease. Plant Disease, 96(10), 1488-1494	[Verbena litoralis among the host plants] "Management of almond leaf scorch disease requires knowledge of all possible infection pathways. The disease is caused by the xylem-limited bacterium Xylella fastidiosa, which is transmitted by several species of sharpshooters. The objectives of this research were to elucidate the fate of bacteria in planta after inoculations in almond nursery plants and to determine patterns of insect vector population dynamics and temporal distribution of X. fastidiosa–infected plants relative to host plant assemblages in habitats surrounding commercial nurseries." ... "A total of 87 plant samples tested positive for X. fastidiosa (6.3%) using enzyme-linked immunosorbent assay (ELISA), with a higher number of X. fastidiosa–infected plants found in weedy alfalfa fields than in other habitat types. Among plant species infected by X. fastidiosa, 33% were winter annuals, 45% were biennials or perennials, and 22% were summer annuals. Collectively, these findings identified a potential pathway for X. fastidiosa infection of almonds in nursery situations."

407	Causes allergies or is otherwise toxic to humans	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.	"Verbena litoralis has been used medicinally in Hawai'i especially as a mash applied to cuts and bruises and also to sprained and fractured areas."

Qsn #	Question	Answer
	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
	CABI. (2020). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	No evidence

408	Creates a fire hazard in natural ecosystems	
	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.	[May contribute to fuel load in dry areas, but probably relatively unimportance compared to flammable grasses] "in Hawai'i the most common naturalized Verbena occurring in dry to wet, disturbed habitats"
	CABI. (2020). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	[No evidence. May contribute to fuel load, but relative importance compared to grasses is probably minimal] "it often seems to be restricted to disturbed habitats like roadsides, stream banks, tracks and waste places."

409	Is a shade tolerant plant at some stage of its life cycle	
	Source(s)	**Notes**
	Dave's Garden. (2020). Vervain - Verbena litoralis. http://davesgarden.com/guides/pf/go/105816. [Accessed 10 Mar 2020]	"Sun Exposure: Sun to Partial Shade"
	Woodson, Jr., R.E.,Schery, R.W. and Moldenke, H.N. 1973. Flora of Panama. Part IX. Family 168. Verbenaceae. Annals of the Missouri Botanical Garden 60(1): 41-148	[Generally in high light environments, but also occurs in dense woodland, suggesting potential shade tolerance] "Grassland and wayside weed" ... "Wet roadside in sun" ... "In second growth, cultivated areas, and roadside" ... "Dense woodland in cloud forest"

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	
	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.	[Does not appear to be substrate-limited] "in Hawai'i the most common naturalized Verbena occurring in dry to wet, disturbed habitats"

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.	"Erect or ascending perennial herbs 4-20 dm tall, sometimes somewhat woody toward base; stems few to many-branched, glabrous or sparsely strigillose."

412	Forms dense thickets	

Qsn #	Question	Answer
	Source(s)	**Notes**
	Hosaka, E. Y., Thistle, A. & Wadsworth, H. A. 1954. Noxious Plants of Hawaiian Ranges. Extension Bulletin 62. University of Hawaii, Honolulu	[Able to form heavy stands] "Why a pest: This is a moderately fast-growing plant that becomes troublesome in some regions, especially in the middle elevations. Heavy stands of verbena occupy space that should be in grass."

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.	[Terrestrial herb] "Erect or ascending perennial herbs 4-20 dm tall," ... "occurring in dry to wet, disturbed habitats, 10-2,280 m"

502	Grass	n
	Source(s)	**Notes**
	USDA, Agricultural Research Service, National Plant Germplasm System. (2020). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 10 Mar 2020]	Section: Verbenaca Family: Verbenaceae

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.	"Erect or ascending perennial herbs 4-20 dm tall" [Verbenaceae]

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	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.	"Erect or ascending perennial herbs 4-20 dm tall, sometimes somewhat woody toward base; stems few to many-branched, glabrous or sparsely strigillose."
	DiTomaso, J. & Healy, E. A. (2003). Aquatic and Riparian Weeds of the West. UCANR Publications, Oakland, CA	"Roots and Underground Structures: Taprooted."

Qsn #	Question	Answer
601	**Evidence of substantial reproductive failure in native habitat**	**n**
	Source(s)	**Notes**
	CABI. (2020). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	[No evidence] "Verbena litoralis is a short-lived herbaceous plant, native to many of the tropical areas of Central and South America. Although the species has spread to other countries from its native environment, and is sometimes regarded as an invasive threat (in Australia and some states of the USA), it often seems to be restricted to disturbed habitats like roadsides, stream banks, tracks and waste places. Information on its effects on other plant species is not well reported, nor is there any evidence to suggest it has any serious impacts on specific environments or ecosystems."

602	Produces viable seed	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	"Propagation: By seed."

603	Hybridizes naturally	
	Source(s)	**Notes**
	Nesom, G.L. 2010. Taxonomic notes on Verbena bonariensis (Verbenaceae) and related species in the USA. Phytoneuron 2010-12: 1–16	"Michael (1997) noted that such corolla morphology occurs in sterile plants that apparently are hybrid between V. litoralis and fertile V. brasiliensis-like plants. He identified the latter as V. quadrangularis, the sterile hybrids as as V. xbrasiliensis. O'Leary et al. (2007) studied "numerous specimens" of V. brasiliensis (as "V. litoralis var. brevibracteata") and found none with aberrant features. Since the putative hybrid shows no other morphological features suggestive of hybridization with V. litoralis, V. brasiliensis is maintained here as the name of this widespread adventive."
	Munir, A. A. (2002). A taxonomic revision of the genus Verbena L.(Verbenaceae) in Australia. Journal of the Adelaide Botanic Garden, 20: 21-103	"The genus Verbena is distributed mainly in temperate, subtropical and tropical America with a few species respectively in Europe, Asia and North Africa. There are many cultivated forms and numerous natural and artificial hybrids."

604	Self-compatible or apomictic	y
	Source(s)	**Notes**
	Chamorro, S., Heleno, R., Olesen, J. M., McMullen, C. K., & Traveset, A. (2012). Pollination patterns and plant breeding systems in the Galápagos: a review. Annals of Botany, 110: 1489-1501	"TABLE 1. Compilation of known information regarding the breeding systems of the Gala´pagos vascular flora" [Verbena litoralis - Autonomously self-pollinates = Yes; Self-compatible = Yes]

605	Requires specialist pollinators	n
	Source(s)	**Notes**

Qsn #	Question	Answer
	Chamorro, S., Heleno, R., Olesen, J. M., McMullen, C. K., & Traveset, A. (2012). Pollination patterns and plant breeding systems in the Galápagos: a review. Annals of Botany, 110: 1489-1501	"TABLE 1. Compilation of known information regarding the breeding systems of the Gala´pagos vascular flora" [Verbena litoralis - Autonomously self-pollinates = Yes; Self-compatible = Yes]
	CABI. (2020). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"The colourful flowers are attractive to bees and no doubt other insects, although no information is available on specific floral visitors."

606	Reproduction by vegetative fragmentation	n
	Source(s)	**Notes**
	DiTomaso, J. & Healy, E. A. (2003). Aquatic and Riparian Weeds of the West. UCANR Publications, Oakland, CA	"Reproduce by seed"

607	Minimum generative time (years)	2
	Source(s)	**Notes**
	CABI. (2020). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	“Short-lived perennial" [Probably 1-2 years]

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	
	Source(s)	**Notes**
	CABI. (2020). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"...it often seems to be restricted to disturbed habitats like roadsides, stream banks, tracks and waste places." ... "Nutlets c. 1.5 mm long, oblong, faintly ribbed dorsally, brown, finely white papillate on flattened ventral surface … [Seeds lack means of attachment, but are small & may adhere to equipment, machinery, or footwear when growing along roadsides or other heavily trafficked corridors]

702	Propagules dispersed intentionally by people	y
	Source(s)	**Notes**
	CABI. (2020). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"The species is not known to be sold currently in Australia as an ornamental but the genus was very popular in the past with many hundreds of cultivars. Therefore, although its popularity has decreased over the years, trade in seed has been a significant pathway and should not be discounted as a potential source of introduction. The plant may also still be used for its medicinal properties."

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	"Dispersed by: Humans, Animals, Livestock, Sheep, Vehicles, Water, Escapee"

Qsn #	Question	Answer
	CABI. (2020). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"First recorded from New South Wales in 1902, from Queensland in 1909 (The Council of Heads of Australasian Herbaria, 2012) and from New Zealand in 1911 (Webb et al., 1988). The species was probably introduced to these areas (and others) by accident as a contaminant in ship ballast or in packing material." [May have occurred in the past. Unknown if this still occurs]

704	Propagules adapted to wind dispersal	n
	Source(s)	**Notes**
	CABI. (2020). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"The small nuts produced by V. litoralis are unlikely to be moved far by the wind."

705	Propagules water dispersed	y
	Source(s)	**Notes**
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Dispersed by: Humans, Animals, Livestock, Sheep, Vehicles, Water, Escapee"
	CABI. (2020). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	[Possibly, when occurring along streams] "...it often seems to be restricted to disturbed habitats like roadsides, stream banks, tracks and waste places." ... "The small nuts produced by V. litoralis are unlikely to be moved far by the wind. Whether they can float or not is unknown."
	Osunkoya, O. O., Ali, S., Nguyen, T., Perrett, C., Shabbir, A., Navie, S., Belgeri, A., Dhileepan, K. & Adkins, S. (2014). Soil seed bank dynamics in response to an extreme flood event in a riparian habitat. Ecological Research, 29(6), 1115-1129	[Verbena litoralis collected in pre- and post-flood seed banks along riparian corridors, suggesting dispersal by water] "The study documented changes in the soil seed-bank along riparian corridors before and after a major flood event in January 2011 in southeast Queensland, Australia." ... "Seed-banks of weedy and/or exotic species were no more affected by the flood than those of native and/or non invasive species. Overall, the studied riparian zone showed evidence of a quick recovery of its seed-bank over time, and can be considered to be resilient to an extreme flood event." ... "A full list of species for which the differences in abundance between pre-flood and post flood conditions were highest is presented in Table 3."

706	Propagules bird dispersed	
	Source(s)	**Notes**
	Baldwin, P. H. (1947). Foods of the Hawaiian goose. The Condor, 49(3), 108-120	[Unknown if seeds remain viable after passage through nene] "Verbena litoralis" ... "Found in droppings from Mauna Loa in H. N. P., Humuula, and Puuwaawaa. Seeds and green parts taken. A little used plant in view of its availability."

Qsn #	Question	Answer
707	**Propagules dispersed by other animals (externally)**	
	Source(s)	**Notes**
	CABI. (2020). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"Nutlets c. 1.5 mm long, oblong, faintly ribbed dorsally, brown, finely white-papillate on flattened ventral surface". ... "Biotic transmission is unlikely, but is still unknown." [Seeds are small, but lack means of external attachment]

708	**Propagules survive passage through the gut**	
	Source(s)	**Notes**
	Baldwin, P. H. (1947). Foods of the Hawaiian goose. The Condor, 49(3), 108-120	[Unknown if seeds remain viable after passage through nene] "Verbena litoralis" ... "Found in droppings from Mauna Loa in H. N. P., Humuula, and Puuwaawaa. Seeds and green parts taken. A little used plant in view of its availability."

801	**Prolific seed production (>1000/m2)**	
	Source(s)	**Notes**
	Hosaka, E. Y., Thistle, A. & Wadsworth, H. A. 1954. Noxious Plants of Hawaiian Ranges. Extension Bulletin 62. University of Hawaii, Honolulu	"Dissemination: Many seeds are produced. These when ripe fall to the ground and produce new plants."

802	**Evidence that a persistent propagule bank is formed (>1 yr)**	
	Source(s)	**Notes**
	Royal Botanic Gardens Kew. (2020) Seed Information Database (SID). Version 7.1. Available from: http://data.kew.org/sid/. [Accessed 10 Mar 2020]	Orthodox seeds. Longevity under natural conditions unknown

803	**Well controlled by herbicides**	**y**
	Source(s)	**Notes**
	Motooka, P., Castro, L., Nelson, D., Nagai, G. & Ching,L. 2003. Weeds of Hawaii's Pastures and Natural Areas: An Identification and Management Guide. CTAHR, UH Manoa, Honolulu, HI	"Management: Sensitive to foliar application of 2,4-D."
	Santos, G. L., Kageler, D., Gardner, D. E., & Stone, C. P. (1986). Herbicidal control of selected alien plant species in Hawaii Volcanoes National Park: a preliminary report. Technical Report 60. Cooperative National Park Resources Studies Unit. Honolulu, HI	"Table 10. Responses of non-target native and introduced plants to herbicide treatments to control Rubus argutus" [Verbena litoralis controlled by 2% Garlon 4. H = heavily impacted (death)]
	DiTomaso, J. M., Kyser, G. B., Oneto, et al. 2013. Weed Control in Natural Areas in the Western United States. Weed Research and Information Center, University of California, Davis, CA	2,4-D & Imazapyr provide excellent control. Glyphosate provides poor to fair control. Imazapic provides fair control. Excellent control, generally better than 95%. F = Fair control, 50-80%. P = Poor control, below 50%

804	**Tolerates, or benefits from, mutilation, cultivation, or fire**	**y**

Qsn #	Question	Answer
	Source(s)	**Notes**
	Kubiak, P. J. 2009. Fire responses of bushland plants after the January 1994 wildfires in northern Sydney. Cunninghamia, 11(1): 131-165	[Resprouts after fires] "Appendix 1. Observations on fire responses (after 100% leaf scorch) of vascular plants in the Lane Cove River (LCR) (observations mainly Jan 1994 – Oct 1999) and Narrabeen Lagoon (NL) (Mar – Oct 1994) catchments, following the fires of January 1994." [Verbena litoralis - Fire Response: R = R = majority of adult plants resprouted after the fires;]

805	**Effective natural enemies present locally (e.g. introduced biocontrol agents)**	
	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.	[Unknown, but does not appear to be limited by natural controls] "in Hawai'i the most common naturalized Verbena occurring in dry to wet, disturbed habitats, 10-2,280 m, on Midway Atoll and all of the main islands."

Summary of Risk Traits:

High Risk / Undesirable Traits
• Elevation range exceeds 2000 m, demonstrating environmental versatility
• Thrives in tropical climates
• Widely naturalized in the Hawaiian Islands & elsewhere
• Pasture weed
• Environmental weed (competes with native plants)
• Other Verbena species are invasive
• Low palatability
• Reproduces by seeds
• Self-compatible
• Adult plants can resprout after fires

Low Risk Traits
• Unarmed (no spines, thorns or burrs)
• Medicinal uses
• Not reported to spread vegetatively
• Herbicides provide effective control