Taxon: Oxalis debilis Kunth **Family:** Oxalidaceae

Common Name(s): large flower pink sorrel
pink shamrock

Synonym(s): Oxalis debilis Kunth var. corymbosa
Oxalis debilis Kunth var. debilis

Assessor: Chuck Chimera **Status:** Assessor Approved **End Date:** 10 Apr 2019

WRA Score: 9.0 **Designation:** H(Hawai'i) **Rating:** High Risk

Keywords: Perennial Herb, Disturbance Weed, Shade Tolerant, Rarely Seed, Spreads Vegetatively

Qsn #	Question	Answer Option	Answer
101	Is the species highly domesticated?	y=-3, n=0	n
102	Has the species become naturalized where grown?		
103	Does the species have weedy races?		
201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
202	Quality of climate match data	(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
203	Broad climate suitability (environmental versatility)	y=1, n=0	n
204	Native or naturalized in regions with tropical or subtropical climates	y=1, n=0	y
205	Does the species have a history of repeated introductions outside its natural range?	y=-2, ?=-1, n=0	y
301	Naturalized beyond native range	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		
304	Environmental weed		
305	Congeneric weed	n=0, y = 1*multiplier (see Appendix 2)	y
401	Produces spines, thorns or burrs	y=1, n=0	n
402	Allelopathic		
403	Parasitic	y=1, n=0	n
404	Unpalatable to grazing animals	y=1, n=-1	n
405	Toxic to animals		
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
409	Is a shade tolerant plant at some stage of its life cycle	y=1, n=0	y

Qsn #	Question	Answer Option	Answer
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y=1, n=0	n
411	Climbing or smothering growth habit	y=1, n=0	n
412	Forms dense thickets		
501	Aquatic	y=5, n=0	n
502	Grass	y=1, n=0	n
503	Nitrogen fixing woody plant	y=1, n=0	n
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y=1, n=0	y
601	Evidence of substantial reproductive failure in native habitat	y=1, n=0	n
602	Produces viable seed	y=1, n=-1	n
603	Hybridizes naturally		
604	Self-compatible or apomictic		
605	Requires specialist pollinators		
606	Reproduction by vegetative fragmentation	y=1, n=-1	y
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	1
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)		
702	Propagules dispersed intentionally by people		
703	Propagules likely to disperse as a produce contaminant	y=1, n=-1	y
704	Propagules adapted to wind dispersal	y=1, n=-1	n
705	Propagules water dispersed		
706	Propagules bird dispersed	y=1, n=-1	n
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)	y=-1, n=1	n

Supporting Data:

Qsn #	Question	Answer
101	**Is the species highly domesticated?**	**n**
	Source(s)	**Notes**
	Hanelt, P. (ed.). 2001. Mansfeld's Encyclopedia of Agricultural and Horticultural Crops, Volume 2. Springer-Verlag, Berlin, Heidelberg, New York	[Cultivated but not domesticated] "Tropical South America; naturalized as troublesome weed in SE Asia, India, W Europe and elsewhere. In SE Asia sometimes cultivated as ground cover and green manure, in Indonesia also as pot herb and for salads. The plant has also medicinal properties. The tuberous roots are edible. Also grown for ornamental purposes in Europe."

102	Has the species become naturalized where grown?	
	Source(s)	**Notes**
	WRA Specialist. (2019). Personal Communication	NA

103	Does the species have weedy races?	
	Source(s)	**Notes**
	WRA Specialist. (2019). 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**
	USDA, ARS, Germplasm Resources Information Network. 2019. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 5 Apr 2019]	"Oxalis debilis Kunth var. corymbosa (DC.) Lourteig Native Southern America CARIBBEAN: Trinidad and Tobago [Trinidad] NORTHERN SOUTH AMERICA: French Guiana, Guyana, Venezuela BRAZIL: Brazil [Ceará, Espírito Santo, Minas Gerais, Pará, Rio Grande do Sul, Santa Catarina, São Paulo, Bahia, Paraná, Rio de Janeiro, Pernambuco] WESTERN SOUTH AMERICA: Bolivia, Ecuador, Peru SOUTHERN SOUTH AMERICA: Argentina, [Buenos Aires, Catamarca, Chaco, Corrientes, Entre Ríos, Misiones, Salta, San Juan, Santa Fe, Tucumán] Paraguay, Uruguay"

202	Quality of climate match data	High
	Source(s)	**Notes**
	USDA, ARS, Germplasm Resources Information Network. 2019. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 5 Apr 2019]	

Qsn #	Question	Answer
203	**Broad climate suitability (environmental versatility)**	**n**
	Source(s)	**Notes**
	Wu, Z.Y., Raven,P.H. & Hong, D.Y. (eds.). 2008. Flora of China. Vol. 11 (Oxalidaceae through Aceraceae). Science Press & Missouri Botanical Garden Press, Beijing & St. Louis	"Cultivated and also escaped as a common weed of cultivated grounds and open habitats; near sea level to 2300 m."
	Dave's Garden. (2019). Oxalis Species, Lilac Oxalis, Pink Wood Sorrel - Oxalis debilis subsp. corymbosa. https://davesgarden.com/guides/pf/go/60788/. [Accessed 9 Apr 2019]	"Hardiness: USDA Zone 9a: to -6.6 °C (20 °F) USDA Zone 9b: to -3.8 °C (25 °F) USDA Zone 10a: to -1.1 °C (30 °F) USDA Zone 10b: to 1.7 °C (35 °F) USDA Zone 11: above 4.5 °C (40 °F)"
	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 to South America; in Hawai'i naturalized and sometimes locally common, usually in relatively wet, shaded sites, 10-850 m, on all of the main islands except Ni'ihau and Kaho'olawe."

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 to South America; in Hawai'i naturalized and sometimes locally common, usually in relatively wet, shaded sites, 10-850 m, on all of the main islands except Ni'ihau and Kaho'olawe. First collected on O'ahu in 1864-1865 (Mann & Brigham 37, BISH)."
	USDA, ARS, Germplasm Resources Information Network. 2019. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 5 Apr 2019]	"Native Southern America CARIBBEAN: Trinidad and Tobago [Trinidad] NORTHERN SOUTH AMERICA: French Guiana, Guyana, Venezuela BRAZIL: Brazil [Ceará, Espírito Santo, Minas Gerais, Pará, Rio Grande do Sul, Santa Catarina, São Paulo, Bahia, Paraná, Rio de Janeiro, Pernambuco] WESTERN SOUTH AMERICA: Bolivia, Ecuador, Peru SOUTHERN SOUTH AMERICA: Argentina, [Buenos Aires, Catamarca, Chaco, Corrientes, Entre Ríos, Misiones, Salta, San Juan, Santa Fe, Tucumán] Paraguay, Uruguay"

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	**Notes**
	Wu, Z.Y., Raven,P.H. & Hong, D.Y. (eds.). 2008. Flora of China. Vol. 11 (Oxalidaceae through Aceraceae). Science Press & Missouri Botanical Garden Press, Beijing & St. Louis	"native to tropical South America, cultivated as an ornamental and naturalized in warm temperate areas in many parts of the world"

301	Naturalized beyond native range	y
	Source(s)	**Notes**

Qsn #	Question	Answer
	Wu, Z.Y., Raven,P.H. & Hong, D.Y. (eds.). 2008. Flora of China. Vol. 11 (Oxalidaceae through Aceraceae). Science Press & Missouri Botanical Garden Press, Beijing & St. Louis	"Cultivated and also escaped as a common weed of cultivated grounds and open habitats; near sea level to 2300 m. Naturalized in Anhui, Fujian, Gansu (cultivated), Guangdong, Guangxi, Guizhou, Hainan, Hebei (cultivated), Henan (cultivated), Hubei (cultivated), Hunan, Jiangsu, Jiangxi, Shandong (cultivated), Shanxi (cultivated), Sichuan, Taiwan, Xinjiang (cultivated), Yunnan, Zhejiang [native to tropical South America, cultivated as an ornamental and naturalized in warm temperate areas in many parts of the world]."
	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 to South America; in Hawai'i naturalized and sometimes locally common, usually in relatively wet, shaded sites, 10-850 m, on all of the main islands except Ni'ihau and Kaho'olawe. First collected on O'ahu in 1864-1865 (Mann & Brigham 37, BISH)."
	USDA, ARS, Germplasm Resources Information Network. 2019. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 5 Apr 2019]	"Naturalized Africa MACARONESIA: Cape Verde, Portugal, [Azores, Madeira Islands] Spain [Canary Islands] EAST TROPICAL AFRICA: Tanzania WEST-CENTRAL TROPICAL AFRICA: Democratic Republic of the Congo, Sao Tome and Principe SOUTH TROPICAL AFRICA: Mozambique WESTERN INDIAN OCEAN: Mauritius, Reunion Asia-Temperate CHINA: China EASTERN ASIA: Japan Asia-Tropical INDIAN SUBCONTINENT: Bhutan, India, Nepal, Pakistan, Sri Lanka INDO-CHINA: Thailand MALESIA: Indonesia, [Jawa, Sumatera] Malaysia (Malaya), Philippines Australasia AUSTRALIA: Australia NEW ZEALAND: New Zealand Europe NORTHERN EUROPE: United Kingdom MIDDLE EUROPE: Switzerland SOUTHEASTERN EUROPE: Italy SOUTHWESTERN EUROPE: France, Portugal, Spain Northern America SOUTHEASTERN U.S.A.: United States [Alabama, Florida, Georgia, Louisiana, South Carolina, Mississippi] SOUTH-CENTRAL U.S.A.: United States [Texas] Southern America CARIBBEAN: West Indies CENTRAL AMERICA: Panama"

302	Garden/amenity/disturbance weed	y
	Source(s)	**Notes**
	Orchard, A,E. (ed.). (1994). Flora of Australia. Vol. 49, Oceanic islands 1. Australian Government Publishing Service, Canberra	"A native of South America now widespread as a weed of disturbed ground throughout temperate and warm temperate regions."

Qsn #	Question	Answer
	Wu, Z.Y., Raven,P.H. & Hong, D.Y. (eds.). 2008. Flora of China. Vol. 11 (Oxalidaceae through Aceraceae). Science Press & Missouri Botanical Garden Press, Beijing & St. Louis	"Cultivated and also escaped as a common weed of cultivated grounds and open habitats; near sea level to 2300 m."
	Hanelt, P. (ed.). 2001. Mansfeld's Encyclopedia of Agricultural and Horticultural Crops, Volume 2. Springer-Verlag, Berlin, Heidelberg, New York	"naturalized as troublesome weed in SE Asia,"
	Dave's Garden. (2019). Oxalis Species, Lilac Oxalis, Pink Wood Sorrel - Oxalis debilis subsp. corymbosa. https://davesgarden.com/guides/pf/go/60788/. [Accessed 9 Apr 2019]	"On Jan 30, 2005, grovespirit from Sunset Valley, TX (Zone 9a) wrote: … What I don't like about this plant: In good growing conditions, it spreads and reproduces like crazy, to the point of becoming somewhat invasive. Therefore, grow it in a pot or container unless you want it to colonize the entire area."
	Queensland Government. (2019). Weeds of Australia. Oxalis debilis Kunth var. corymbosa. http://keyserver.lucidcentral.org. [Accessed 9 Apr 2019]	"Pink shamrock (Oxalis debilis var. corymbosa) is regarded as a minor environmental weed in Queensland, and as a "sleeper weed" in other parts of Australia."

303	Agricultural/forestry/horticultural weed	
	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	"Oxalis debilis Kunth var. corymbose… Weed of: Bananas, Orchards and Plantations"
	Queensland Government. (2019). Weeds of Australia. Oxalis debilis Kunth var. corymbosa. http://keyserver.lucidcentral.org. [Accessed 9 Apr 2019]	"Pink shamrock (Oxalis debilis var. corymbosa) is regarded as a minor environmental weed in Queensland, and as a "sleeper weed" in other parts of Australia."
	WRA Specialist. (2019). Personal Communication	A weed of crops, with unknown impacts on yield

304	Environmental weed	
	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 Hawai'i naturalized and sometimes locally common, usually in relatively wet, shaded sites, 10-850 m, on all of the main islands except Ni'ihau and Kaho'olawe." [Impacts unspecified or innocuous]
	Queensland Government. (2019). Weeds of Australia. Oxalis debilis Kunth var. corymbosa. http://keyserver.lucidcentral.org. [Accessed 9 Apr 2019]	"Pink shamrock (Oxalis debilis var. corymbosa) is regarded as a minor environmental weed in Queensland, and as a "sleeper weed" in other parts of Australia." [Impacts unspecified or innocuous]

305	Congeneric weed	y
	Source(s)	**Notes**
	Doust, L. L., MacKinnon, A., & Doust, J. L. (1985). Biology of Canadian weeds: 71. Oxalis stricta L., O. corniculata L., O. dillenii Jacq. ssp. dillenii and O. dillenii Jacq. ssp. filipes (Small) Eiten. Canadian Journal of Plant Science, 65(3), 691-709	"Oxalis stricta and O. dillenii spp. dillenii often occur on cultivated land. The extent of the loss from invasion of cropland by Oxalis is not known." … "Oxalis corniculata and O. dillenii ssp. filipes are specially harmful in the greenhouse as weeds (Whitcomb and Santelmann 1977)."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Weed of: Cereals, Cotton, Cutflowers, Grapevines, Nursery Production, Orchards & Plantations, Pastures, Vegetables"

Qsn #	Question	Answer
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] "Acaulescent perennial herbs from an ovoid bulb 2-2.5 cm long, covered with brownish ovate scales, maturing into masses of brown ovoid bulbils 3-6 mm in diameter in the axils of the old scales. Leaves trifoliolate, leaflets broadly obcordate, often drooping, 1.5-4.5 cm Jong, 2-6.5 cm wide, glabrous or sparsely pubescent, both surfaces covered with minute reddish tubercles, petioles slender, flexuous, ascending, 10-2 5 cm long, ± villous, stipules small, membranous, adnate to petioles."

402	**Allelopathic**	
	Source(s)	**Notes**
	Peng, Y., Hu, J., & Su, Z. (2007). Research on allelopathic effects of Oxalis corymbosa-an invasive species. Acta Prataculturae Sinica, 16(5), 90-95	[Potentially yes. Extracts demonstrate allelopathic effects in a growth chamber] "Abstract : Allelopathy plays an important role in biological invasion, but there is little research on the allelopathic influence of Oxalis corymbosa. The allelopathic effect of O. corymbosa on 9 herbaceous species studied in a growth chamber showed that aqueous leaf extracts of O. corymbosa inhibited seed germination and seedling growth of all 9 species and that the effect increased with an increase in concentration. The germination rate, germination speed, germination speed index, root length, seedling length, seedling fresh mass and dry mass were all affected. Germination speed, germination speed index and dry mass were the most sensitive measures to judge allelopathy. Sensitivity to the aqueous leaf extract of O. corymbosa differed among the 9 species with Trifolium pratense, Trifolium repens, Dichondra repens, Festuca arundinacea the most affected, while there was little effect on Medicago sativa. Abstract : Allelopathy plays an important role in biological invasion, but there is little research on the allelopathic influence of Oxalis corymbosa. The allelopathic effect of O. corymbosa on 9 herbaceous species studied in a growth chamber showed that aqueous leaf extracts of O. corymbosa inhibited seed germination and seedling growth of all 9 species and that the effect increased with an increase in concentration. The germination rate, germination speed, germination speed index, root length, seedling length, seedling fresh mass and dry mass were all affected. Germination speed, germination speed index and dry mass were the most sensitive measures to judge allelopathy. Sensitivity to the aqueous leaf extract of O. corymbosa differed among the 9 species with Trifolium pratense, Trifolium repens, Dichondra repens, Festuca arundinacea the most affected, while there was little effect on Medicago sativa."

Qsn #	Question	Answer
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.	"Acaulescent perennial herbs from an ovoid bulb 2-2.5 cm long, covered with brownish ovate scales, maturing into masses of brown ovoid bulbils 3-6 mm in diameter in the axils of the old scales." [Oxalidaceae. No evidence]

404	**Unpalatable to grazing animals**	**n**
	Source(s)	**Notes**
	Suzuki, R. O., Kato, T., Maesako, Y., & Furukawa, A. (2009). Morphological and population responses to deer grazing for herbaceous species in Nara Park, western Japan. Plant Species Biology, 24(3), 145-155	[Palatable to deer] "To quantify the morphological and population responses of plants to grazing by deer, we conducted two deer-exclusion experiments in Nara Park, western Japan. The first experiment assessed the morphological differences in 10 traits of two species with erect growth (Oxalis corymbosa and Cyperus brevifolius. var. leiolepis) and two species with prostrate growth (Oxalis corniculata and Hydrocotyle maritima) between shoots inside and outside of the exclosures at the end of a growing season (late autumn). The size and weight of the leaves, stems and reproductive organs of the four perennials were significantly smaller outside the exclosures. The degree of size reduction was highest for an erect species, O. corymbosa, compared with the other three species, and was similar between the two prostrate species. The second experiment, using 11 erect species and 15 prostrate species, demonstrated that erect species exhibited greater reduction in leaf length and cover in the grazing environments compared with prostrate species, suggesting that the erect species suffered more from grazing. In conclusion, many of the plant species reduced their size under grazing pressure during the growing season, but the nature of the changes depended on the growth form of each species. It remains unclear whether the morphological reduction was an adaptive response to grazing."
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	[Palatable to humans] "leaves often eaten in curries"
	Khan, R., Khan, M. A., Sultan, S., Marwat, K. B., Khan, I., Hassan, G., & Shah, H. U. (2013). Nutritional quality of sixteen terrestrial weeds for the formulation of cost-effective animal feed. The Journal of Animal and Plant Sciences, 23, 75-79	[Palatable to livestock] "Nutritional composition of sixteen weeds was investigated to determine their nutritional potential for livestock consumption in Pakistan. Analysis of dry matter, ash, crude fiber, acid detergent fiber, nutrient detergent fiber and crude protein were conducted in Dicanthium annulatum, Cynodon dactylon, Avena fatua, Convolvulus arvensis, Sorghum halepense and Amananthus Viridis. Most of the species were rich in calcium, zinc, copper, iron, sodium and magnesium with the highest values recorded in Oxalis debilis, Rumex crispus, Medicago polymorpha, P. oleracea and A. viridis. Overall results indicated that broadleaf weeds possess higher mineral contents than grassy weeds. Results indicate that weeds can be used as a source of nutrients in livestock feeding, which will also help in promoting growth of the major corps. The grasses (A. fatua, D. annulatum and C. rotundus) could be important sources of fiber while broad leaf weeds (C. arvensis, A. viridis, and R. crispus) could be good sources of protein and minerals."

Qsn #	Question	Answer
405	**Toxic to animals**	
	Source(s)	**Notes**
	Khan, R., Khan, M. A., Sultan, S., Marwat, K. B., Khan, I., Hassan, G., & Shah, H. U. (2013). Nutritional quality of sixteen terrestrial weeds for the formulation of cost-effective animal feed. The Journal of Animal and Plant Sciences, 23, 75-79	[No evidence. Palatable to livestock] "Nutritional composition of sixteen weeds was investigated to determine their nutritional potential for livestock consumption in Pakistan. Analysis of dry matter, ash, crude fiber, acid detergent fiber, nutrient detergent fibe and crude protein were conducted in Dicanthium annulatum, Cynodon dactylon, Avena fatua, Convolvulus arvensis, Sorghum halepense and Amananthus Viridis. Most of the species were rich in calcium, zinc, copper, iron, sodium and magnesium with the highest values recorded in Oxalis debilis, Rumex crispus, Medicago polymorpha, P. oleracea and A. viridis. Overall results indicated that broadleaf weeds possess higher mineral contents than grassy weeds. Results indicate that weeds can be used as a source of nutrients in livestock feeding, which will also help in promoting growth of the major corps. The grasses (A. fatua, D. annulatum and C. rotundus) could be important sources of fiber while broad leaf weeds (C. arvensis, A. viridis, and R. crispus) could be good sources of protein and minerals."
	Burrows, G. E., & Tyrl, R. J. (2013). Toxic Plants of North America. Second Edition. Wiley-Blackwell, Hoboken, NJ	[Possibly, if consumed in large quantities] "Disease Problems—Species of Oxalis are typically rather innocuous and cause little problem in North America. In only rare instances of very large populations is there a risk of intoxication. The disease these species produce occurs worldwide in ruminants, mainly sheep. It may be acute, subacute, or chronic and occur after several days or months of grazing (Bull 1929; Smith 1951; McIntosh 1972; Rekhis and Amara 1990). The most typical effects, as reported in other areas of the world, are those of a subacute nephritis or chronic tetany, in some instances without a marked decrease in blood calcium. Experimentally, a number of changes were apparent in 6 -month-old lambs fed exclusively O. pes -caprae for 6 weeks. There was a signifi cant but not dangerous decrease in serum calcium, chloride, and albumen and an increase in phosphorus, magnesium, parathyroid hormone, and α- and γ-globulins (Manuta et al. 1985a,b). Ruminal pH decreased while urinary pH increased to 8, with increased calcium salts in urine and considerable oxalate deposition in the kidneys (Manuta and Floris 1984; Manuta and Naitana 1984). These changes for the most part were readily reversed or prevented by providing an acidogenic feed. With long -term ingestion of plants containing high levels of oxalate, the disease is one of progressive kidney injury, and clinical signs develop when the changes culminate in renal failure."

Qsn #	Question	Answer
406	**Host for recognized pests and pathogens**	
	Source(s)	**Notes**
	Mamun, M. S. A., Ahmed, M., & Paul, S. K. (2014). Integrated approaches in tea pest management for sustainable tea production. Pp. 21-31 in M. Ahmed (ed.). Proceedings of the workshop on Tea Production Technology Updated. Bangladesh Tea Research Institute, Srimangal	"Ageratum conizoides, Borreria hispida, Commelina bengalensis, Pouzolzia indica and Oxalis corymbosa are alternate host of Root knot nematode. So, growth of host plants in and around tea fields should be controlled and this will help reducing the growth of pest population. Besides, improved drainage system helps minimize the pest infestations."

407	**Causes allergies or is otherwise toxic to humans**	
	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	[Edible and medicinal uses] "leaves often eaten in curries … Plant juice for stomachache, scurvy, indigestion, piles; flowers and young twigs of Ipomoea batatas along with Oxalis corymbosa eaten in curries for gastrointestinal disorders. Leaf paste in skin diseases, on boils. Leaves used in the form of a gargle to relieve pains of angina. Rhizome juice antidote."
	Guzman, C. C. de & Siemonsma, J. S. (eds.). (1999). Plant resources of South-East Asia, No.13. Spices. Backhuys Publishers, Leiden, The Netherlands	[Generic description. Possible if consumed in large quantities] "In Indonesia, the leaves of Oxalis are used in salads, in particular for their sour or slightly acid taste. They are sometimes used as a substitute for tamarind. When consumed in large quantities, they are toxic."

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.	[No evidence. Unlikely given habit and habitat] "Acaulescent perennial herbs from an ovoid bulb 2-2.5 cm long" … "in Hawai'i naturalized and sometimes locally common, usually in relatively wet, shaded sites"

409	**Is a shade tolerant plant at some stage of its life cycle**	**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 Hawai'i naturalized and sometimes locally common, usually in relatively wet, shaded sites"
	Guzman, C. C. de & Siemonsma, J. S. (eds.). (1999). Plant resources of South-East Asia, No.13. Spices. Backhuys Publishers, Leiden, The Netherlands	"Oxalis is primarily found in anthropogenic habitats: in gardens, along roads, in hedges, fields, village groves, estates, along rivers, and in grassy locations with shade." … "In weed control studies, it has been observed that 0. corymbosa grows best under heavy shade (50%); however, bulb or bulbil production is not affected by shade."
	Dave's Garden. (2019). Oxalis Species, Lilac Oxalis, Pink Wood Sorrel - Oxalis debilis subsp. corymbosa. https://davesgarden.com/guides/pf/go/60788/. [Accessed 9 Apr 2019]	"Sun Exposure: Sun to Partial Shade"

Qsn #	Question	Answer
410	**Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)**	**n**
	Source(s)	**Notes**
	Guzman, C. C. de & Siemonsma, J. S. (eds.). (1999). Plant resources of South-East Asia, No.13. Spices. Backhuys Publishers, Leiden, The Netherlands	"Alfisols are preferred above Entisols, Inceptisols and Ultisols. Growth and reproduction are negatively affected at moisture conditions below field capacity. Acid soils are preferred and growth slows down with increasing pH."
	Dave's Garden. (2019). Oxalis Species, Lilac Oxalis, Pink Wood Sorrel - Oxalis debilis subsp. corymbosa. https://davesgarden.com/guides/pf/go/60788/. [Accessed 10 Apr 2019]	"Soil pH requirements: 5.6 to 6.0 (acidic) 6.1 to 6.5 (mildly acidic) 6.6 to 7.5 (neutral)"

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.	"Acaulescent perennial herbs from an ovoid bulb 2-2.5 cm long, covered with brownish ovate scales, maturing into masses of brown ovoid bulbils 3-6 mm in diameter in the axils of the old scales."

412	Forms dense thickets	
	Source(s)	**Notes**
	Flora of North America. (2019). Oxalis debilis. http://www.efloras.org. [Accessed 10 Apr 2019]	[Forms dense colonies. Ability to exclude other vegetation unclear] "The species produces numerous bulblets in a basal cluster and apparently also can spread laterally by production of bulblets at the tips of filiform roots or rhizomes; it can form large, dense colonies."

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] "in Hawai'i naturalized and sometimes locally common, usually in relatively wet, shaded sites"

502	Grass	n
	Source(s)	**Notes**
	USDA, ARS, Germplasm Resources Information Network. 2019. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 4 Apr 2019]	Family: Oxalidaceae

Qsn #	Question	Answer
503	**Nitrogen fixing woody plant**	**n**
	Source(s)	**Notes**
	USDA, ARS, Germplasm Resources Information Network. 2019. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 4 Apr 2019]	Family: Oxalidaceae

504	**Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)**	**y**
	Source(s)	**Notes**
	Orchard, A,E. (ed.). (1994). Flora of Australia. Vol. 49, Oceanic islands 1. Australian Government Publishing Service, Canberra	"Perennial, stemless herb from a brown bulb, with numerous small, striate bulbils on a swollen, fleshy, white, translucent root."

601	**Evidence of substantial reproductive failure in native habitat**	**n**
	Source(s)	**Notes**
	Orchard, A,E. (ed.). (1994). Flora of Australia. Vol. 49, Oceanic islands 1. Australian Government Publishing Service, Canberra	[No evidence] "A native of South America now widespread as a weed of disturbed ground throughout temperate and warm temperate regions."

602	**Produces viable seed**	**n**
	Source(s)	**Notes**
	Wu, Z.Y., Raven,P.H. & Hong, D.Y. (eds.). 2008. Flora of China. Vol. 11 (Oxalidaceae through Aceraceae). Science Press & Missouri Botanical Garden Press, Beijing & St. Louis	"Capsule rarely formed."
	Flora of North America. (2019). Oxalis debilis. http://www.efloras.org. [Accessed 9 Apr 2019]	"Capsules not observed." … "A. Lourteig (1980) noted that plants of this species occasionally fruit but consistently reproduce through abundant bulblets. They apparently are seed-sterile in North America."
	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.	"Fruit not seen." … "Oxalis corymbosa apparently spreads in Hawai'i, as it does elsewhere, solely by bulbils."

603	**Hybridizes naturally**	
	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.	"Fruit not seen." [Unknown. Lack of fruit and seed set in Hawaii suggests plants do not hybridize. Hybridization documented in other species within genus]

604	**Self-compatible or apomictic**	
	Source(s)	**Notes**

Qsn #	Question	Answer
	Luo, S., Zhang, D., & Renner, S. S. (2006). Oxalis debilis in China: distribution of flower morphs, sterile pollen and polyploidy. Annals of Botany, 98(2), 459-464	[Unknown] "In O. debilis, the lack of seed set we cannot be attributed to either self-incompatibility or sterile pollen because it was not possible to carry out legitimate crosses (because populations were strictly monomorphic). There was also no evidence of agamospermic seed set in netted or bagged flowers"

605	Requires specialist pollinators	
	Source(s)	**Notes**
	Luo, S., Zhang, D., & Renner, S. S. (2006). Oxalis debilis in China: distribution of flower morphs, sterile pollen and polyploidy. Annals of Botany, 98(2), 459-464	"Pollination is by nectar- and pollen-foraging bees; pollen viability is low; and seed set in natural and experimentally self- or cross-pollinated flowers is extremely low."
	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. Fruit not produced in Hawaii] "Flowers 2-12 in umbellate cymes, peduncles up to 3 5 cm Jong, usually villous, bracts several, ovate-lanceolate, 2. 5-3 mm long; sepals oblong, 3.5-5(-6) mm long; petals pinkish purple, spatulate, 11-20 mm long, apex obtuse to truncate; ovules 3-8 per cell, in 1-2 rows. Fruit not seen."

606	Reproduction by vegetative fragmentation	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.	"Oxalis corymbosa apparently spreads in Hawai'i, as it does elsewhere, solely by bulbils."
	Flora of North America. (2019). Oxalis debilis. http://www.efloras.org. [Accessed 10 Apr 2019]	"The species produces numerous bulblets in a basal cluster and apparently also can spread laterally by production of bulblets at the tips of filiform roots or rhizomes; it can form large, dense colonies. A. Lourteig (1980) noted that plants of this species occasionally fruit but consistently reproduce through abundant bulblets. They apparently are seed-sterile in North America."

607	Minimum generative time (years)	1
	Source(s)	**Notes**
	Guzman, C. C. de & Siemonsma, J. S. (eds.). (1999). Plant resources of South-East Asia, No.13. Spices. Backhuys Publishers, Leiden, The Netherlands	"Description Annual or perennial herbs or subshrubs, some stemless with rhizomes, bulbs and tuberous roots."
	Orchard, A,E. (ed.). (1994). Flora of Australia. Vol. 49, Oceanic islands 1. Australian Government Publishing Service, Canberra	"Extremely persistent because the bulbils break away very easily and even the smallest produces a new plant." [Rarely, if ever, produces seeds, but likely to reproduce vegetatively in less than one year of growth]

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	
	Source(s)	**Notes**

Qsn #	Question	Answer
	Orchard, A,E. (ed.). (1994). Flora of Australia. Vol. 49, Oceanic islands 1. Australian Government Publishing Service, Canberra	"A native of South America now widespread as a weed of disturbed ground throughout temperate and warm temperate regions." … "Extremely persistent because the bulbils break away very easily and even the smallest produces a new plant." [Unknown if bulbils can be accidentally dispersed by human activities, but occurrence in disturbed areas suggests humans facilitate movement]
	Wu, Z.Y., Raven,P.H. & Hong, D.Y. (eds.). 2008. Flora of China. Vol. 11 (Oxalidaceae through Aceraceae). Science Press & Missouri Botanical Garden Press, Beijing & St. Louis	"Cultivated and also escaped as a common weed of cultivated grounds and open habitats"

702	Propagules dispersed intentionally by people	
	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	"It rarely sets fruit; instead, each bulb proliferates numerous daughter bulbs that are hard to eradicate once established. The leaves are used as a substitute for tamarind in cooking." [May be rarely cultivated, or harvested from widespread naturalized populations]

703	Propagules likely to disperse as a produce contaminant	y
	Source(s)	**Notes**
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Major Pathway/s: Contaminant, Crop, Ornamental Dispersed by: Humans, Escapee"
	Q-bank Invasive Plants database. (2019). Oxalis debilis var. corymbose. http://www.q-bank.eu/. [Accessed 10 Apr 2019]	"Threat: The tubers can easily be spread with soil. It is regularly found in imports of bonsai plants, which is a pathway for wider spread."

704	Propagules adapted to wind dispersal	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] "Oxalis corymbosa apparently spreads in Hawai'i, as it does elsewhere, solely by bulbils."

705	Propagules water dispersed	
	Source(s)	**Notes**
	Orchard, A,E. (ed.). (1994). Flora of Australia. Vol. 49, Oceanic islands 1. Australian Government Publishing Service, Canberra	"Extremely persistent because the bulbils break away very easily and even the smallest produces a new plant." [Possibly. Bulbils might be moved by water if plants occur near riparian habitats]

706	Propagules bird 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.	"Oxalis corymbosa apparently spreads in Hawai'i, as it does elsewhere, solely by bulbils." [No evidence, and unlikely in Hawaiian Islands]

Qsn #	Question	Answer
707	**Propagules dispersed by other animals (externally)**	
	Source(s)	**Notes**
	Orchard, A,E. (ed.). (1994). Flora of Australia. Vol. 49, Oceanic islands 1. Australian Government Publishing Service, Canberra	"Extremely persistent because the bulbils break away very easily and even the smallest produces a new plant." [Unknown. Bulbils could possibly adhere to animals in soil]

708	**Propagules survive passage through the gut**	
	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.	"Oxalis corymbosa apparently spreads in Hawai'i, as it does elsewhere, solely by bulbils." [Sometimes consumed by animals. Unknown if bulbils are consumed or if they survive gut passage]

801	**Prolific seed production (>1000/m2)**	
	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 seeds. Bulbil density unknown] "Oxalis corymbosa apparently spreads in Hawai'i, as it does elsewhere, solely by bulbils."

802	**Evidence that a persistent propagule bank is formed (>1 yr)**	
	Source(s)	**Notes**
	Orchard, A,E. (ed.). (1994). Flora of Australia. Vol. 49, Oceanic islands 1. Australian Government Publishing Service, Canberra	"Extremely persistent because the bulbils break away very easily and even the smallest produces a new plant." [Longevity of bulbils in soil unknown]
	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	"It rarely sets fruit; instead, each bulb proliferates numerous daughter bulbs that are hard to eradicate once established." [Longevity of bulbils unknown]

803	**Well controlled by herbicides**	**y**
	Source(s)	**Notes**
	Huang, B., Luo, J., Wang, X., Zhou, X., & Zhang, Y. (2000). Studies on chemical control of pink woodsorrel (Oxalis corymbosa DC.) in a city. Journal of South China Agricultural University, 21(1), 47-50	"Abstract : The bioactivities of 9 herbicides and 7 admixtures against pink woodsorrel (Oxalis corymbosa) in a city lawn were determined. Metribuzin, atrazine, caoping-2, caoping-3 [compositions not specified] and glyphosate had high levels of control against O. corymbosa. Control values of 88.66-99.10% were achieved at the 20th day after treatment. The LC50 of caoping-1 was 106.67 mg/litre on the 7th day after treatment and caoping-1 was safe for lawn grass. Glyphosate achieved a greater level of control, but the growth of lawn grass was inhibited to varying degrees."
	Q-bank Invasive Plants database. (2019). Oxalis debilis var. corymbose. http://www.q-bank.eu/. [Accessed 10 Apr 2019]	"Control: Large-Flowered Pink-Sorrel can be controlled with ordinary herbicides, but there is a risk of spread and establishment of tubers."

804	**Tolerates, or benefits from, mutilation, cultivation, or fire**	**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	"It rarely sets fruit; instead, each bulb proliferates numerous daughter bulbs that are hard to eradicate once established."

805	**Effective natural enemies present locally (e.g. introduced biocontrol agents)**	**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.	[Wide distribution suggests no limiting factors exist in Hawaiian Islands] "Native to South America; in Hawai'i naturalized and sometimes locally common, usually in relatively wet, shaded sites, 10-850 m, on all of the main islands except Ni'ihau and Kaho'olawe. First collected on O'ahu in 1864-1865 (Mann & Brigham 37, BISH)."

Summary of Risk Traits:

High Risk / Undesirable Traits
• Grows in warm temperate to tropical climates
• Naturalized on all the main Hawaiian Islands except Ni'ihau and Kaho'olawe; widely naturalized elsewhere
• Garden and disturbance adapted weed
• Potential crop and environmental weed (impacts generally innocuous)
• Other Oxalis species are invasive
• Potentially allelopathic
• May be toxic to animals and people if consumed in large quantities due to high levels of oxalate
• Shade tolerant
• Persists from bulbs and spreads vegetatively from bulbils
• Bulbils spread in soil, as a pot contaminant, and potentially by people

Low Risk Traits
• Despite widespread naturalization and weediness, generally not regarded as a significant problem in agricultural or natural areas
• Unarmed (no spines, thorns, or burrs)
• Provides fodder for livestock (palatable despite potential toxicity)
• Limited or no seed production in Hawaiian Islands, and other locations outside native range
• Herbicides may provide effective control