

Taxon: <i>Euphorbia tirucalli</i> L.	Family: Euphorbiaceae
Common Name(s): African milkbush fingertree Indian tree-spurge milkhedge penchtree petroleum-plant rubber euphorbia	Synonym(s): Eurphorbia laro Drake

Assessor: Chuck Chimera	Status: Assessor Approved	End Date: 22 Jul 2022
WRA Score: 12.0	Designation: H(HPWRA)	Rating: High Risk

Keywords: Succulent Shrub, Naturalized, Unarmed, Toxic Sap, 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	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)	n
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	y
405	Toxic to animals	y=1, n=0	y

Qsn #	Question	Answer Option	Answer
406	Host for recognized pests and pathogens		
407	Causes allergies or is otherwise toxic to humans	y=1, n=0	y
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	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	n
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	y
607	Minimum generative time (years)		
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	y=1, n=-1	n
704	Propagules adapted to wind dispersal	y=1, n=-1	n
705	Propagules water dispersed	y=1, n=-1	y
706	Propagules bird dispersed	y=1, n=-1	y
707	Propagules dispersed by other animals (externally)	y=1, n=-1	n
708	Propagules survive passage through the gut	y=1, n=-1	y
801	Prolific seed production (>1000/m ²)	y=1, n=-1	n
802	Evidence that a persistent propagule bank is formed (>1 yr)		
803	Well controlled by herbicides	y=-1, n=1	y
804	Tolerates, or benefits from, mutilation, cultivation, or fire	y=1, n=-1	y
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)		

Supporting Data:

Qsn #	Question	Answer
101	Is the species highly domesticated?	n
	Source(s)	Notes
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	[No evidence] "Euphorbia tirucalli originates in eastern tropical Africa, and has long since become naturalized in other parts of Africa, including South Africa and the Indian Ocean islands. It is widely naturalized and planted as an ornamental throughout the tropics and subtropics and is grown as a pot plant in temperate regions."

102	Has the species become naturalized where grown?	
	Source(s)	Notes
	WRA Specialist. (2022). Personal Communication	NA

103	Does the species have weedy races?	
	Source(s)	Notes
	WRA Specialist. (2022). 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
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	"Euphorbia tirucalli originates in eastern tropical Africa, and has long since become naturalized in other parts of Africa, including South Africa and the Indian Ocean islands."
	USDA, Agricultural Research Service, National Plant Germplasm System. (2022). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/ . [Accessed 21 Jul 2022]	"Native Africa NORTHEAST TROPICAL AFRICA: Eritrea, Ethiopia, Sudan EAST TROPICAL AFRICA: Kenya, Tanzania, Uganda WEST-CENTRAL TROPICAL AFRICA: Rwanda SOUTH TROPICAL AFRICA: Angola, Mozambique SOUTHERN AFRICA: Eswatini, South Africa [Cape Province, KwaZulu-Natal, Transvaal] WESTERN INDIAN OCEAN: Madagascar"

202	Quality of climate match data	High
	Source(s)	Notes
	USDA, Agricultural Research Service, National Plant Germplasm System. (2022). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/ . [Accessed 21 Jul 2022]	

203	Broad climate suitability (environmental versatility)	y
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Qsn #	Question	Answer
	Source(s)	Notes
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	"Euphorbia tirucalli is very well adapted to semi-arid conditions, but also occurs in both dry and moist forest, savanna and shrub land, and withstands salt stress associated with coastal conditions, but no frost. It occurs from sea-level up to 2500 m altitude."

204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	Notes
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	"Euphorbia tirucalli originates in eastern tropical Africa, and has long since become naturalized in other parts of Africa, including South Africa and the Indian Ocean islands. It is widely naturalized and planted as an ornamental throughout the tropics and subtropics and is grown as a pot plant in temperate regions."

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	Notes
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	"Euphorbia tirucalli originates in eastern tropical Africa, and has long since become naturalized in other parts of Africa, including South Africa and the Indian Ocean islands. It is widely naturalized and planted as an ornamental throughout the tropics and subtropics and is grown as a pot plant in temperate regions."
	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	"Seemingly native to tropical Africa and evidently dispersed from there by humans along the Arab trading routes in the Indian Ocean, E. tirucalli is cultivated and naturalized in a broad band from southern and tropical Africa eastward across India to Indonesia. Today it is widely grown as a curiosity and ornamental in all tropical regions."

301	Naturalized beyond native range	y
	Source(s)	Notes
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	"Euphorbia tirucalli originates in eastern tropical Africa, and has long since become naturalized in other parts of Africa, including South Africa and the Indian Ocean islands. It is widely naturalized and planted as an ornamental throughout the tropics and subtropics and is grown as a pot plant in temperate regions."
	Parker, J.L. & Parsons, B. (2012). New plant records from the Big Island for 2009. Bishop Museum Occasional Papers 113: 55–63	[Hawaii Island] "Previously documented as naturalized on Kaua'i (Lorence et al. 1995: 35), pencil tree is widely cultivated in Hawai'i and this specimen represents a new island record. This dense flowering population is located right off of Ali'i Dr just south of Kailua and represents a hazard to pedestrians. due to the ease of vegetative spread and poisonous nature of this plant, its use as a landscape tree should be discouraged. Material examined. HAWAII: North Kona distr. Ali'i Dr, 2168362N, 188405E. large, flowering population with trunks up to 10 in dia and 15–20 ft tall trees. Milky latex abundant, 17 Jun 2009, J. Parker & R. Parsons, J. Franklin BIED86."

Qsn #	Question	Answer
	Lorence, D.H., Flynn, T.W. & Wagner, W.L. (1995). Contributions to the flora of Hawai'i. III. New additions, range extensions, and rediscoveries of flowering plants. Bishop Museum Occasional Papers 41: 19-58	[Kauai] "Euphorbia tirucalli is indigenous to tropical Africa and Madagascar and now widely cultivated in tropical areas. Variously known as milk bush, pencil plant, pencil tree, or tirucalli, this species is occasionally cultivated as a curiosity, at least on Kauai. Collector's notes indicate that although the observed plants were sterile, the species appears to be sparingly naturalized locally as it forms dense thickets along Lawai Road where it is propagating vegetatively. Euphorbia tirucalli is easily distinguished from the Kauai endemic E. haeleleana and the introduced cultivated E. lactea Haw., the only other arborescent members of the genus in the archipelago, by the following characters: branches slender, pencil-like, smooth, green, 2-4 mm in diam.; leaves linear-oblong, 5-10 x 1-1.5 mm, soon deciduous; flowers and fruits rarely produced. Material examined. KAUAI: Koloa District, Poipu, Lawai Road, in pasture N of road from Spouting Horn to the Allerton Estate, 6 m (ca. 20 ft), 12 Oct 1988, T. Flynn 3133 (PTBG)."
	Lau, A. & Frohlich, D. (2013). New plant records for the Hawaiian Islands 2011-2012. Bishop Museum Occasional Papers 114: 5-16	[Oahu] "Euphorbia tirucalli, or Pencil tree, a curiosity plant sometimes seen in home gardens and previously collected as naturalized on the islands of Kaua'i and Hawai'i, has now been spotted on O'ahu spreading sparingly in a local botanical garden. Material examined. O'AHU: Koko Crater Botanical Garden, NW side of main crater floor, 21.288°N, 157.682°W. Sparingly naturalized in the crater, well scattered, dense thickets forming in areas where its planting status is unclear. Plant 2-3 m tall, a knocked-over tree resprouting. dry lowland Leucaena forest/shrubland, 22 Mar 2012, OED 2012032202."

302	Garden/amenity/disturbance weed	
	Source(s)	Notes
	Parker, J.L. & Parsons, B. (2012). New plant records from the Big Island for 2009. Bishop Museum Occasional Papers 113: 55-63	[A potential nuisance or hazard plant where cultivated] "This dense flowering population is located right off of Ali'i Dr just south of Kailua and represents a hazard to pedestrians."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	Listed as naturalized or a weed, but literature does not indicate control.

303	Agricultural/forestry/horticultural weed	n
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	Listed as an agricultural weed, but no evidence of impacts or control in the literature.

304	Environmental weed	
	Source(s)	Notes

Qsn #	Question	Answer
	CABI. (2022). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	[A potential environmental weed, although the cited references do not indicate that native vegetation has been displaced] "E. tirucalli grows forming dense thickets that displaces native vegetation. In many tropical areas, E. tirucalli is able to establish thick woody vegetation tending towards a forest and it may form hedge-like barriers in invaded areas. This species has the potential to outcompete native plants for water and nutrients (Orwa et al., 2009; Mwine and Damme, 2011; PIER, 2016)."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	Listed as an environmental weed, but no evidence of impact and control in the literature.

305	Congeneric weed	y
	Source(s)	Notes
	Weber, E. (2017). Invasive Plant Species of the World, 2nd Edition: A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	[<i>Euphorbia esula</i>] "Leafy spurge has become one of the worst invaders in northern America causing both ecological and economic damage."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	Numerous <i>Euphorbia</i> species have become invasive weeds

401	Produces spines, thorns or burrs	n
	Source(s)	Notes
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	[No evidence] :Succulent, much-branched, monoecious or more often dioecious shrub to 4 m tall or small tree up to 10(-15) m tall; branchlets rounded, c. 7 mm in diameter, often produced in whorls, brittle, green with longitudinal fine stripes and very small leaf scars, the extreme tips of young leafy branchlets sparsely short-hairy, with copious white to yellowish latex. Leaves arranged spirally, present only at the tips of young branchlets and quickly falling, simple and entire, almost sessile; stipules minute, glandular, dark brown; blade linear-lanceolate, c. 15 mm × 2 mm, fleshy. Inflorescence a terminal umbel-like cyme, 2–6 together at the apex of branchlets, each forking 2–4 times, composed of dense clusters of flowers, each cluster called a 'cyathium', developing only male flowers (sometimes with a few female flowers), or only female flowers; bracts c. 2 mm long, rounded; cyathia almost sessile, c. 3 mm × 4 mm, involucre cup-shaped, glands 5, up to 1.5 mm × 2 mm, bright yellow, lobes triangular, c. 0.5 mm long. Flowers unisexual; male flowers with linear bracteoles, plumose at apex, stamen c. 4.5 mm long; female flowers with small bracteoles, pedicel up to 10 mm long in fruit, hairy, perianth distinctly 3-lobed, lobes c. 0.5 mm long, ovary superior, 3-celled, styles c. 2 mm long, fused at base, with thickened deeply bifid recurved stigma. Fruit a nearly globose capsule c. 8 mm × 8.5 mm, almost glabrous, 3-seeded. Seeds ovoid, c. 3.5 mm × 3 mm, smooth, speckled with brown and with a dark brown ventral line; caruncle 1 mm across.:
	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	No spines, thorns or burrs.

Qsn #	Question	Answer
402	Allelopathic	
	Source(s)	Notes
	Begum, K., Shammi, M., Hasan, N., Asaduzzaman, M., Appiah, K. S., & Fujii, Y. (2019). Potential allelopathic candidates for land use and possible sustainable weed management in south Asian ecosystem. <i>Sustainability</i> , 11 (9), 2649	[Potentially. Extracts demonstrate allelopathic effects] "Abstract: Weed management is one of the significant challenges of field crops since weeds pose a remarkable threat to crop productivity in South Asian countries, including Bangladesh. Allelopathy, a phenomenon whereby secondary metabolites produced and released by one plant species influence the growth and development of other species can be exploited in sustainable management. The focus of this study was to evaluate potential allelopathic plant species which can be further explored as alternatives to synthetic herbicides or incorporated as part of integrated weed management in sustainable agriculture. Two hundred fifty-two plant samples from 70 families were collected from Bangladesh and evaluated with the sandwich bioassay. Thirty-one percent of the samples showed significant allelopathic potential on lettuce radicle elongation. Among the species that showed substantial inhibition, more than 7% of the samples showed higher inhibition (HI) and 25% showed moderate inhibition (MI) on lettuce radicle. Fruit pulps of <i>Couroupita guianensis</i> (95.4%), fruits of <i>Phyllanthus emblica</i> (95.4%), and <i>Acacia concinna</i> (95.4%) showed the highest inhibition on lettuce radicle elongation. In contrast, the leaf of <i>Bombax insigne</i> had growth promoting activity by stimulating radicle (23%) and hypocotyl (80%) elongation of lettuce seedlings. This result suggested that the species with significant plant growth inhibitory potential may play a vital role as an alternative to the increasing use of synthetic herbicides for sustainable weed management in agricultural land."

403	Parasitic	n
	Source(s)	Notes
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). <i>Plant Resources of Tropical Africa</i> 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	"Succulent, much-branched, monoecious or more often dioecious shrub to 4 m tall or small tree up to 10(-15) m tall" [No evidence]
	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	Not parasitic.

404	Unpalatable to grazing animals	y
	Source(s)	Notes
	CAB International. (2005). <i>Forestry Compendium</i> . CAB International, Wallingford, UK	"E. tirucalli is widely used in windbreaks, live hedges, as fuelwood and for erosion control plantings. In dry areas, it plays a major role as fodder for camels and goats." ... "The latex is poisonous to humans and animals, although these toxic effects are low in cattle (Tokarnia et al., 1996). In an experiment to select inexpensive replants to reduce browsing by goats on newly-planted trees, Carlowitz and Wolf (1991) established that an extract from E. tirucalli was not effective."

Qsn #	Question	Answer
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	[Palatability may depend on stage of growth] "Goats and sheep browse the green parts of the plant. The toxicity of the latex is considered seasonal or reduced in young plant parts, and young branches are even roasted and chewed. Euphorbia tirucalli is widely planted as an ornamental in gardens and as a pot plant, and a golden-stemmed cultivar exists. It is widely cultivated as a hedge and around cattle enclosures, as it is considered impenetrable, due to the poisonous latex and dense growth"
	Hines, D.A. & Eckman, K. (1993). Indigenous Multipurpose Trees of Tanzania: Uses and Economic Benefits for People. Food and Agriculture Organization (FAO), Rome	Tree is fairly resistant to cattle. It is planted as a live fence.

405	Toxic to animals	y
	Source(s)	Notes
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	"The latex is poisonous to humans and animals, although these toxic effects are low in cattle (Tokarnia et al., 1996)."
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	[Potentially toxic to some animals] "Goats and sheep browse the green parts of the plant. The toxicity of the latex is considered seasonal or reduced in young plant parts, and young branches are even roasted and chewed. Euphorbia tirucalli is widely planted as an ornamental in gardens and as a pot plant, and a golden-stemmed cultivar exists. It is widely cultivated as a hedge and around cattle enclosures, as it is considered impenetrable, due to the poisonous latex and dense growth; it is also planted as a firebreak and boundary marker. The plants are used to control soil erosion, to stabilize sand dunes, and, in some parts of Africa, as grave-markers. In agriculture Euphorbia tirucalli is used for mulch and as pesticide. It is unsuitable for intercropping as the plants suppress undergrowth, including crops. In South Africa it is reported to keep moles away. "

406	Host for recognized pests and pathogens	
	Source(s)	Notes
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	"Diseases and pests. In India several diseases occur including stem rot caused by Phoma sorghina and necrotic spots by Alternaria sp.; Nectria euphorbiana was found on dead stem material. In Pakistan Euphorbia tirucalli is a host of Botryodiplodia theobromae and also of Cuscuta spp. Euphorbia tirucalli can be severely affected by nematodes, including Meloidogyne spp. Aphids, mealy bugs and grasshoppers feed on the plants, whereas mites occur on leaves and young growth, especially in greenhouses."
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	"Pests recorded Fungus diseases: Mycosphaerella holci (glume blight)"
	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 succulent euphorbias have very few insect or disease problems."

407	Causes allergies or is otherwise toxic to humans	y
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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	"Pruning is a hazardous activity because the sap is both highly poisonous and corrosive, causing blisters upon contact with the skin. Despite this, plants are often grown around homes and schools, and rooted cuttings are regularly sold at swap meets and garage sales. Because it so is so toxic, cultivation of pencil tree is not encouraged."
	Voigt, W. & Porter, H. (2007). <i>Euphorbia tirucalli</i> . PlantZAfrica. SANBI. http://pza.sanbi.org/euphorbia-tirucalli . [Accessed 21 Jul 2022]	"The latex, as in other euphorbias, is very toxic and may cause blindness, blisters on the skin, and even prove fatal if enough of it is swallowed. There is at least one recorded case of it causing death from gastro-intestinal haemorrhage."
	Schmidt, E., Lötter, M. & McClelland, W. (2002). Trees and shrubs of Mpumalanga and Kruger National Park. Jacana Media, Johannesburg, South Africa	"The poisonous latex serves as a deterrent to would-be intruders. Widely grown for this purpose and therefore often difficult to establish its original range. Latex causes burning and blistering of the skin, and a drop in the eye can cause blindness. Human fatalities reported when taken orally. Fruit, however, reported to be eaten by birds."

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	Notes
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	"it is also planted as a firebreak and boundary marker."
	Hines, D.A. & Eckman, K. (1993). Indigenous Multipurpose Trees of Tanzania: Uses and Economic Benefits for People. Food and Agriculture Organization (FAO), Rome	Tree is not resistant to fire.

409	Is a shade tolerant plant at some stage of its life cycle	n
	Source(s)	Notes
	Voigt, W. & Porter, H. (2007). <i>Euphorbia tirucalli</i> . PlantZAfrica. SANBI. http://pza.sanbi.org/euphorbia-tirucalli . [Accessed 21 Jul 2022]	"Aspect: Full Sun, Morning Sun (Semi Shade), Afternoon Sun (Semi Shade)" ... "These beautiful trees are best positioned in open, full-sun positions on rocky sites such as rock gardens, embankments or gravelly slopes"
	Missouri Botanical Garden. (2022). <i>Euphorbia tirucalli</i> . https://www.missouribotanicalgarden.org . [Accessed 21 Jul 2022]	"Sun: Full sun"

Qsn #	Question	Answer
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
	Source(s)	Notes
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	"It grows well on a wide variety of light-textured, neutral to acidic soils." ... "Euphorbia tirucalli is sometimes propagated by seed, but usually by stem or root cuttings, and establishes quickly on almost any soil."
	Orwa C, et al. (2009). Agroforestry Database: a tree reference and selection guide version 4.0. http://www.worldagroforestry.org . [Accessed 21 Jul 2022]	"Soil type: Appears to grow on almost any soil type."

411	Climbing or smothering growth habit	n
	Source(s)	Notes
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	"Succulent, much-branched, monoecious or more often dioecious shrub to 4 m tall or small tree up to 10(-15) m tall"
	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	Shrub or tree 6-20' tall.

412	Forms dense thickets	y
	Source(s)	Notes
	Voigt, W. & Porter, H. (2007). <i>Euphorbia tirucalli</i> . PlantZAfrica. SANBI. http://pza.sanbi.org/euphorbia-tirucalli . [Accessed 21 Jul 2022]	"Dense thickets are associated with this species, and the plant itself may form hedge-like barriers in the veld."
	Lorence, D.H., Flynn, T.W. & Wagner, W.L. (1995). Contributions to the flora of Hawai'i. III. New additions, range extensions, and rediscoveries of flowering plants. Bishop Museum Occasional Papers 41: 19-58	"Collector's notes indicate that although the observed plants were sterile, the species appears to be sparingly naturalized locally as it forms dense thickets along Lawai Road where it is propagating vegetatively."
	Lau, A. & Frohlich, D. (2013). New plant records for the Hawaiian Islands 2011-2012. Bishop Museum Occasional Papers 114: 5-16	"Koko Crater Botanical Garden, NW side of main crater floor, 21.288°N, 157.682°W. Sparingly naturalized in the crater, well scattered, dense thickets forming in areas where its planting status is unclear."

501	Aquatic	n
	Source(s)	Notes
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	[Terrestrial] "Euphorbia tirucalli is very well adapted to semi-arid conditions, but also occurs in both dry and moist forest, savanna and shrub land, and withstands salt stress associated with coastal conditions, but no frost. It occurs from sea-level up to 2500 m altitude."

502	Grass	n
	Source(s)	Notes

Qsn #	Question	Answer
	USDA, Agricultural Research Service, National Plant Germplasm System. (2022). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/ . [Accessed 21 Jul 2022]	Family: Euphorbiaceae Subfamily: Euphorbioideae Tribe: Euphorbieae Subtribe: Euphorbiinae

503	Nitrogen fixing woody plant	n
	Source(s)	Notes
	USDA, Agricultural Research Service, National Plant Germplasm System. (2022). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/ . [Accessed 21 Jul 2022]	Family: Euphorbiaceae Subfamily: Euphorbioideae Tribe: Euphorbieae Subtribe: Euphorbiinae

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	Tree or shrub.

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	Notes
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	[No evidence] "Euphorbia tirucalli originates in eastern tropical Africa, and has long since become naturalized in other parts of Africa, including South Africa and the Indian Ocean islands. It is widely naturalized and planted as an ornamental throughout the tropics and subtropics and is grown as a pot plant in temperate regions."

602	Produces viable seed	y
	Source(s)	Notes
	Voigt, W. & Porter, H. (2007). Euphorbia tirucalli. PlantZAfrica. SANBI. http://pza.sanbi.org/euphorbia-tirucalli . [Accessed 21 Jul 2022]	"Euphorbia tirucalli grows moderately fast and thrives in moderate to warm climates. It does not seem to cope with extreme cold. Plants can easily be cultivated by means of seeds, cuttings or truncheons. A coarse sandy medium is ideal for sowing the seeds. Fresh seeds must be sown in late summer from February to March and kept in a warm, moist area. Plants prefer to have their 'feet' dry, especially in winter. Young plants grow relatively fast and will benefit from a liquid fertiliser and well-composted, well-drained soil."
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	"Euphorbia tirucalli is sometimes propagated by seed, but usually by stem or root cuttings, and establishes quickly on almost any soil."

603	Hybridizes naturally	

Qsn #	Question	Answer
	Source(s)	Notes
	WRA Specialist. (2022). Personal Communication	Unknown. No evidence found

604	Self-compatible or apomictic	n
	Source(s)	Notes
	Duke, J. A. (1983). <i>Euphorbia tirucalli</i> . Handbook of Energy Crops. https://hort.purdue.edu/newcrop/duke_energy/Euphorbia_tirucalli.html . [Accessed 22 Jul 2022]	"Dioecious, succulent, cactus-like milky tree, devoid of spines, to 10 m tall, the branches often arranged in pseudowhorls."
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	"Succulent, much-branched, monoecious or more often dioecious shrub to 4 m tall or small tree up to 10(-15) m tall;"

605	Requires specialist pollinators	n
	Source(s)	Notes
	Orwa C, et al. (2009). Agroforestry Database: a tree reference and selection guide version 4.0. http://www.worldagroforestry.org . [Accessed 22 Jul 2022]	" <i>E. tirucalli</i> flowers in October and fruits from November-December and is pollinated by insects."
	Voigt, W. & Porter, H. (2007). <i>Euphorbia tirucalli</i> . PlantZAfrica. SANBI. http://pza.sanbi.org/euphorbia-tirucalli . [Accessed 22 Jul 2022]	" <i>Euphorbia tirucalli</i> produces yellowish flowers that attract butterflies, bees and other insects. These are primarily responsible for pollination as the flowers also produces minute quantities of nectar."
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	"Pollination is by insects."

Qsn #	Question	Answer
606	Reproduction by vegetative fragmentation	y
	Source(s)	Notes
	Lorence, D.H., Flynn, T.W. & Wagner, W.L. (1995). Contributions to the flora of Hawai'i. III. New additions, range extensions, and rediscoveries of flowering plants. Bishop Museum Occasional Papers 41: 19-58	"Collector's notes indicate that although the observed plants were sterile, the species appears to be sparingly naturalized locally as it forms dense thickets along Lawai Road where it is propagating vegetatively."
	Parker, J.L. & Parsons, B. (2012). New plant records from the Big Island for 2009. Bishop Museum Occasional Papers 113: 55-63	"Due to the ease of vegetative spread and poisonous nature of this plant, its use as a landscape tree should be discouraged."
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	"Euphorbia tirucalli is sometimes propagated by seed, but usually by stem or root cuttings, and establishes quickly on almost any soil. Cuttings should be at least 10 cm long and should be left to dry for at least 24 hours before planting. For ornamental purposes, cuttings of 35-40 cm long are usually taken and for hedges cuttings of up to 1 m long."
	Lau, A. & Frohlich, D. (2013). New plant records for the Hawaiian Islands 2011-2012. Bishop Museum Occasional Papers 114: 5-16	"Plant 2-3 m tall, a knocked-over tree resprouting."
	Voigt, W. & Porter, H. (2007). Euphorbia tirucalli. PlantZAfrica. SANBI. http://pza.sanbi.org/euphorbia-tirucalli . [Accessed 21 Jul 2022]	"Plants can easily be cultivated by means of seeds, cuttings or truncheons."

607	Minimum generative time (years)	
	Source(s)	Notes
	Voigt, W. & Porter, H. (2007). Euphorbia tirucalli. PlantZAfrica. SANBI. http://pza.sanbi.org/euphorbia-tirucalli . [Accessed 22 Jul 2022]	"Euphorbia tirucalli grows moderately fast and thrives in moderate to warm climates."
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	"Euphorbia tirucalli grows vigorously once established. Leaves are only present during the rainy season and flowering starts at the end of the dry season before new leaves are formed." [Time to maturity unspecified]
	Hines, D.A. & Eckman, K. (1993). Indigenous Multipurpose Trees of Tanzania: Uses and Economic Benefits for People. Food and Agriculture Organization (FAO), Rome	Medium to fast growing.

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	
	Source(s)	Notes
	Hines, D.A. & Eckman, K. (1993). Indigenous Multipurpose Trees of Tanzania: Uses and Economic Benefits for People. Food and Agriculture Organization (FAO), Rome	Planted as a low, live boma hedge and windbreak in dry areas and livestock rearing areas. It is used mainly along boundaries, enclosing dwellings, fields and swamps, along tracks, roads, and waterways. [Possibly. Grown in heavily trafficked areas, but seeds lack means of external attachment]

702	Propagules dispersed intentionally by people	y
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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	"Seemingly native to tropical Africa and evidently dispersed from there by humans along the Arab trading routes in the Indian Ocean, <i>E. tirucalli</i> is cultivated and naturalized in a broad band from southern and tropical Africa eastward across India to Indonesia. Today it is widely grown as a curiosity and ornamental in all tropical regions."
	Hines, D.A. & Eckman, K. (1993). Indigenous Multipurpose Trees of Tanzania: Uses and Economic Benefits for People. Food and Agriculture Organization (FAO), Rome	Succulent shrub common in the livestock rearing areas of Arusha, Dodoma, Mwanza, and Singida where it is planted as a boma and live fence. <i>E. tirucalli</i> is widely distributed, and adaptable to a range of sites, including marginal, drought prone zones

703	Propagules likely to disperse as a produce contaminant	n
	Source(s)	Notes
	Hines, D.A. & Eckman, K. (1993). Indigenous Multipurpose Trees of Tanzania: Uses and Economic Benefits for People. Food and Agriculture Organization (FAO), Rome	Grown as living fences, but not with produce.
	CABI. (2022). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	No evidence.

704	Propagules adapted to wind dispersal	n
	Source(s)	Notes
	Wigrup, I. (2005). The Role of Indigenous Knowledge in Forest Management. Graduate thesis in Forest Management. Swedish University of Agricultural Sciences, Umea, Sweden	In the Sook and Masol Division, West Pokot District, Kenya, <i>Euphorbia tirucalli</i> is said to disperse by birds and flood water. [no adaptation for wind dispersal]

705	Propagules water dispersed	y
	Source(s)	Notes
	Wigrup, I. (2005). The Role of Indigenous Knowledge in Forest Management. Graduate thesis in Forest Management. Swedish University of Agricultural Sciences, Umea, Sweden	In the Sook and Masol Division, West Pokot District, Kenya, <i>Euphorbia tirucalli</i> is said to disperse with flood waters.

706	Propagules bird dispersed	y
	Source(s)	Notes
	Voigt, W. & Porter, H. (2007). <i>Euphorbia tirucalli</i> . PlantZAfrica. SANBI. http://pza.sanbi.org/euphorbia-tirucalli . [Accessed 22 Jul 2022]	"The seeds are also eaten by various birds. The plant itself has very bushy branches which are used for nesting and roosting, and the spineless branches are an added advantage to the birds."
	Wigrup, I. (2005). The Role of Indigenous Knowledge in Forest Management. Graduate thesis in Forest Management. Swedish University of Agricultural Sciences, Umea, Sweden	In the Sook and Masol Division, West Pokot District, Kenya, <i>Euphorbia tirucalli</i> is said to disperse by birds.

Qsn #	Question	Answer
707	Propagules dispersed by other animals (externally)	n
	Source(s)	Notes
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	"Fruit a nearly globose capsule c. 8 mm × 8.5 mm, almost glabrous, 3-seeded. Seeds ovoid, c. 3.5 mm × 3 mm, smooth, speckled with brown and with a dark brown ventral line; caruncle 1 mm across." [No means of external attachment]
	Wigrup, I. (2005). The Role of Indigenous Knowledge in Forest Management. Graduate thesis in Forest Management. Swedish University of Agricultural Sciences, Umea, Sweden	In the Sook and Masol Division, West Pokot District, Kenya, <i>Euphorbia tirucalli</i> is said to disperse by birds and flood water. [no external means of attachment]

708	Propagules survive passage through the gut	y
	Source(s)	Notes
	Voigt, W. & Porter, H. (2007). <i>Euphorbia tirucalli</i> . PlantZAfrica. SANBI. http://pza.sanbi.org/euphorbia-tirucalli . [Accessed 22 Jul 2022]	"The seeds are also eaten by various birds." [Presumably yes]
	Wigrup, I. (2005). The Role of Indigenous Knowledge in Forest Management. Graduate thesis in Forest Management. Swedish University of Agricultural Sciences, Umea, Sweden	Presumably yes. Bird dispersed.

801	Prolific seed production (>1000/m2)	n
	Source(s)	Notes
	Lorence, D.H., Flynn, T.W. & Wagner, W.L. (1995). Contributions to the flora of Hawai'i. III. New additions, range extensions, and rediscoveries of flowering plants. Bishop Museum Occasional Papers 41: 19-58	"flowers and fruits rarely produced."
	Whistler, W.A. (2000). Tropical Ornamentals: A Guide. Timber Press, Portland, OR	"Fruit a three-lobed schizocarp, infrequently formed in cultivation."
	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	"rooted cuttings are regularly sold at swap meets and garage sales." [Primarily cultivated vegetatively in the Hawaiian Islands, presumably due to ease of propagation and limited seed set]

802	Evidence that a persistent propagule bank is formed (>1 yr)	
	Source(s)	Notes
	Whistler, W.A. (2000). Tropical Ornamentals: A Guide. Timber Press, Portland, OR	"Fruit a three-lobed schizocarp, infrequently formed in cultivation." [Unknown, but may be irrelevant in Hawaiian Islands if seeds are rarely produced]

803	Well controlled by herbicides	y
	Source(s)	Notes

Qsn #	Question	Answer
	Allonsy, A. (2022). How to Kill & Remove Euphorbia Tirucalli. https://homeguides.sfgate.com/kill-remove-euphorbia-tirucalli-66580.html . [Accessed 22 Jul 2022]	"Spray the exposed trunk cut with a non-selective herbicide, such as a product containing approximately 25 percent glyphosate herbicide. Allow at least one week for the herbicide to travel to the roots and kill the entire root system." [One of seven steps recommended to control this plant. Presumably effective]
	Bureau of Invasive Plant Management. (2004). Upland Invasive Exotic Plant Management Program Fiscal Year 2003-2004 Annual Report. Florida Department of Environmental Protection	A basal treatment of Garlon 4 was used to control Euphorbia tirucalli on USFW lands in the Florida keys. Control efficacy was not mentioned.

804	Tolerates, or benefits from, mutilation, cultivation, or fire	y
	Source(s)	Notes
	Schmelzer, G.H. & Gurib-Fakim, A. (Eds.). (2008). Plant Resources of Tropical Africa 11(1). Medicinal Plants 1. PROTA Foundation, Wageningen, Netherlands	"Euphorbia tirucalli may be coppiced, trimmed and top-pruned to establish a living fence or hedge."
	Allonsy, A. (2022). How to Kill & Remove Euphorbia Tirucalli. https://homeguides.sfgate.com/kill-remove-euphorbia-tirucalli-66580.html . [Accessed 22 Jul 2022]	"Euphorbia tirucalli, commonly called pencil cactus, might be difficult to kill and remove because, like other succulents, it tolerates extreme neglect and roots easily from a small cutting. Pencil cactus grows in U.S. Department of Agriculture plant hardiness zones 10 through 11, but dies back to the ground at first frost in colder climates."
	Lau, A. & Frohlich, D. (2013). New plant records for the Hawaiian Islands 2011–2012. Bishop Museum Occasional Papers 114: 5–16	"Plant 2–3 m tall, a knocked-over tree resprouting."

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	Notes
	Whistler, W.A. (2000). Tropical Ornamentals: A Guide. Timber Press, Portland, OR	"Fruit a three-lobed schizocarp, infrequently formed in cultivation." [Unknown. Limited fruit and seed set, rather than natural enemies, may be the limiting factor in the Hawaiian Islands]

Summary of Risk Traits:

High Risk / Undesirable Traits

- Broad climate suitability and elevation range
- Naturalized on Kauai, Hawaii, and possibly Oahu (Hawaiian Islands) and widely naturalized elsewhere
- A potential landscaping or environmental weed due to toxic sap and ability to form dense thickets
- Other Euphorbia species are invasive weeds
- Sap poisonous to animals and people
- Tolerates many soil types
- Forms dense thickets that may impede movement or exclude other vegetation
- Reproduces by seeds (at least within native range) and vegetatively by rooting stems and fragments
- Seeds, if produced, reportedly spread by birds, water and intentional cultivation
- Coppices and resprouts after cutting or physical damage

Low Risk Traits

- Unarmed (no spines, thorns, or burrs)
- Palatable to goats and sheep at younger stages of growth (despite toxic sap)
- Grows best in high light environments (dense shade may inhibit spread)
- Dioecious (although some plants may be monoecious)
- Limited fruit and seed production in cultivation limits risk of long distance or accidental dispersal
- Herbicides may provide effective control