

Taxon: Cenchrus echinatus L.	Family: Poaceae
Common Name(s): sand bur bur grass common sandbur golden grass hedgehog grass Mossman River grass southern sandbur spiny sandbur	Synonym(s): Cenchrus echinatus var. brevisetus Cenchrus hillebrandianus Hitchc. Cenchrus pungens Kunth

Assessor: Chuck Chimera	Status: Assessor Approved	End Date: 5 Aug 2021
WRA Score: 20.0	Designation: H(Hawai'i)	Rating: High Risk

Keywords: Annual Grass, Disturbance-Adapted, Environmental Weed, Spiny Burrs, Externally Dispersed

Qsn #	Question	Answer Option	Answer
101	Is the species highly domesticated?	y=-3, n=0	n
102	Has the species become naturalized where grown?		
103	Does the species have weedy races?		
201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
202	Quality of climate match data	(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
203	Broad climate suitability (environmental versatility)	y=1, n=0	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	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	y
402	Allelopathic		
403	Parasitic	y=1, n=0	n
404	Unpalatable to grazing animals	y=1, n=-1	n

Qsn #	Question	Answer Option	Answer
405	Toxic to animals		
406	Host for recognized pests and pathogens		
407	Causes allergies or is otherwise toxic to humans	y=1, n=0	n
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		
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	y
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		
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	n
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	1
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y=1, n=-1	y
702	Propagules dispersed intentionally by people	y=1, n=-1	n
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	y=1, n=-1	y
706	Propagules bird dispersed		
707	Propagules dispersed by other animals (externally)	y=1, n=-1	y
708	Propagules survive passage through the gut	y=1, n=-1	n
801	Prolific seed production (>1000/m ²)		
802	Evidence that a persistent propagule bank is formed (>1 yr)	y=1, n=-1	y
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
	Parsons, W.T. & Cuthbertson, E.G. (2001). Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	[No evidence of domestication] "Mossman River grass is a native of tropical America, extending from the southern United States through the Caribbean region and Central America to Colombia, Brazil, Argentina and Chile. It has been introduced to and is now prevalent in tropical Africa, Madagascar, India, Israel and all countries bordering the western Pacific Ocean."

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

103	Does the species have weedy races?	
	Source(s)	Notes
	WRA Specialist. (2021). Personal Communication	NA

201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	High
	Source(s)	Notes
	USDA, Agricultural Research Service, National Plant Germplasm System. (2021). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/ . [Accessed 3 Aug 2021]	"Native Northern America SOUTHEASTERN U.S.A.: United States [Alabama, Florida, Georgia, Louisiana, Mississippi, South Carolina] SOUTH-CENTRAL U.S.A.: United States [Texas] SOUTHWESTERN U.S.A.: United States [California] NORTHERN MEXICO: Mexico [Chihuahua, Coahuila de Zaragoza, Durango, Nuevo León, San Luis Potosí, Sinaloa, Sonora, Tamaulipas, Zacatecas, Baja California (Norte), Baja California Sur] SOUTHERN MEXICO: Mexico [Aguascalientes, Campeche, Chiapas, Colima, Guanajuato, Guerrero, Hidalgo, Jalisco, México, Michoacán de Ocampo, Morelos, Nayarit, Oaxaca, Puebla, Querétaro, Quintana Roo, Tabasco, Tlaxcala, Veracruz de Ignacio de la Llave, Yucatán] Southern America CARIBBEAN: Hispaniola, Antigua and Barbuda, Bahamas, Cuba, Dominica, Grenada, Jamaica, United States [Puerto Rico, Virgin Islands, U.S.] CENTRAL AMERICA: Costa Rica, Guatemala, Nicaragua, Panama WESTERN SOUTH AMERICA: Bolivia, Colombia, Ecuador, Peru SOUTHERN SOUTH AMERICA: Argentina, Chile, Paraguay, Uruguay"

202	Quality of climate match data	High
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Qsn #	Question	Answer
	Source(s)	Notes
	USDA, Agricultural Research Service, National Plant Germplasm System. (2021). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/ . [Accessed 3 Aug 2021]	

203	Broad climate suitability (environmental versatility)	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.	"in Hawai'i naturalized in arid, disturbed habitats such as beach dunes, dry, rocky slopes, pastures, and along roadsides, 0-920 m"
	Zhenghao Xu & Meihua Deng. (2017). Identification and Control of Common Weeds: Volume 1. Zhejiang University Press, Hangzhou and Springer Nature, Singapore	"The species is naturalized in arid, disturbed habitats such as beach dunes; dry, rocky slopes; pastures and along roadsides. It is usually restricted to low elevations near the coast, being found on seashores and in pastures, cane and rice fields, lawns, waste places, and along roadsides."

204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	Notes
	Parsons, W.T. & Cuthbertson, E.G. (2001). Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	"Mossman River grass is a native of tropical America, extending from the southern United States through the Caribbean region and Central America to Colombia, Brazil, Argentina and Chile. It has been introduced to and is now prevalent in tropical Africa, Madagascar, India, Israel and all countries bordering the western Pacific Ocean."
	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 the Neotropics, now widely naturalized; in Hawai'i naturalized in arid, disturbed habitats such as beach dunes, dry, rocky slopes, pastures, and along roadsides, 0-920 m, on Kure and Midway atolls, Lisianski, Laysan, French Frigate Shoals, Nihoa, and all of the main islands."

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	Notes
	Parsons, W.T. & Cuthbertson, E.G. (2001). Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	"Mossman River grass is a native of tropical America, extending from the southern United States through the Caribbean region and Central America to Colombia, Brazil, Argentina and Chile. It has been introduced to and is now prevalent in tropical Africa, Madagascar, India, Israel and all countries bordering the western Pacific Ocean."

301	Naturalized beyond native range	y
	Source(s)	Notes

Qsn #	Question	Answer
	<p>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.</p>	<p>"Native to the Neotropics, now widely naturalized; in Hawai'i naturalized in arid, disturbed habitats such as beach dunes, dry, rocky slopes, pastures, and along roadsides, 0-920 m, on Kure and Midway atolls, Lisianski, Laysan, French Frigate Shoals, Nihoa, and all of the main islands. First recorded from O'ahu in 1867 (Hillebrand, 1888)."</p>
	<p>USDA, Agricultural Research Service, National Plant Germplasm System. (2021). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 3 Aug 2021]</p>	<p>"Naturalized Asia-Temperate WESTERN ASIA: Israel CHINA: China [Fujian Sheng, Guangdong Sheng, Yunnan Sheng, Hainan Sheng] EASTERN ASIA: Taiwan Australasia AUSTRALIA: Australia Pacific NORTHWESTERN PACIFIC: Marshall Islands"</p>
	<p>Starr, F., Martz, K., & Loope, L.L. (2001). Botanical inventory of Kure Atoll. United States Geological Survey, Biological Resources Division, Haleakala Field Station, HI</p>	<p>[Kure Atoll] "Cenchrus echinatus -- Sandbur -- (Poaceae) -- [Non-Native] Common almost anywhere on the island, especially in open areas. Lamoureux (1961) collected sandbur for the first time on Kure and reported "two plants observed, one near the living quarters, the other near the east end of the landing strip. Both had set large quantities of seed so this plant will probably spread." Cenchrus echinatus has spread in open areas and is constantly clinging to shoelaces, socks, and perhaps feathers of those that pass by. As proven by the Laysan eradication, with enough resources, it can be eradicated."</p>
	<p>Starr, F. & Martz, K. (1999). S. S. Midway Expedition. A botanical survey of Pearl & Hermes Atoll, Lisianski, Laysan, Gardner Pinnacles, and French Frigate Shoals. Trip report prepared for U. S. Fish and Wildlife Service, Honolulu, Hawai'i</p>	<p>[Laysan Island] "Cenchrus echinatus - sand bur Alien. Two plants were observed One at camp (replanted in pot for search image) and one on west coast near beginning at rock ledges." [Lisianski Island] "Cenchrus echinatus - sand bur Alien. Common near camp, in interior of the island, and along west coast. This is the most widespread alien plant on Lisianski. The successful control on Laysan could potentially be repeated on Lisianski." [North Island, Pearl and Hermes Atoll] "Cenchrus echinatus - sand bur Alien. Scattered over the north part of the island with a few large patches in the northwest part of the island." [Southeast Island, Pearl and Hermes Atoll] "Cenchrus echinatus - sand bur Alien. There is a small patch (about 300 plants) located inland on the eastern side of the island marked off by floats. It is mixed in with <i>Setaria verticillata</i> and <i>Tribulus cistoides</i>. No plants were seen on the western side of the island. Very few plants were seeding at the time. A plant was vouchered and represents a new island record for <i>C. echinatus</i> on Southeast Island, Pearl and Hermes Atoll. Collection #Starr and Martz 990614-2. The patch was controlled on June 14, 1999 by Kim Martz and Dominique Aycock who hand pulled about 300 plants. Seeds were bagged and taken back to Midway Atoll and burned. Follow up control will be necessary."</p>

Qsn #	Question	Answer
	Wood, K. R. & LeGrande, M. (2006). An annotated checklist and new island records of flowering plants from Lehua Islet, Ni'ihau, Hawai'i. Bishop Museum Occasional Papers 87:19-29	[Lehua Islet] "Cenchrus echinatus L. 'Ume'alu is a nonnative, naturalized annual species of grass with decumbent culms and burs with sharp bristles. Caum did not find this species. Currently it is occasional throughout the islet with a greater density around the western end of the outer crescent. Material examined. NI'HAU: Lehua Islet; 10 Jan 1992, Flynn et al. 4854 (PTBG, US); 20 Dec 2001, K.R. Wood et al. 9223 (BISH, PTBG)."
	Starr, F., Martz, K., & Loope, L.L. (2002). New plant records from the Hawaiian archipelago. Bishop Museum Occasional Papers. 69:16-27	[Pearl and Hermes Atoll] "Cenchrus echinatus L. New island record Cenchrus echinatus (sandbur) was previously known to be naturalized in arid, disturbed habitats on Kure and Midway Atolls, Lisianski, Laysan, French Frigate Shoals, Nihoa, and all of the main islands (Wagner et al., 1999: 1513, 1904). On Pearl and Hermes Atoll, C. echinatus was collected on both North and Southeast Islands. These collections represent a new island record for Pearl and Hermes Atoll. Material examined. PEARL AND HERMES ATOLL: North I, center of island, 14 Jun 1999, Starr & Martz 990614-3; Southeast I, center of east part of island, 14 Jun 1999, Starr & Martz 990614-2."

302	Garden/amenity/disturbance weed	Y
	Source(s)	Notes
	Zhenghao Xu & Meihua Deng. (2017). Identification and Control of Common Weeds: Volume 1. Zhejiang University Press, Hangzhou and Springer Nature, Singapore	"Cenchrus echinatus, naturalized in seashore sand dunes, roadsides, or other waste places and introduced by grain importation, often colonizes quickly and withstands repeated defoliation in lawns or pastures; in addition, its bur detaches easily from the spike and attaches to clothing or animals for further dispersion."
	Haselwood, E.L., Motter, G.G., & Hirano, R.T. (eds.). (1983) Handbook of Hawaiian Weeds. University of Hawaii Press, Honolulu, HI	"Found in dry and in moist regions. Thrives in light, sandy soils at low elevations; spreads rather rapidly in moderately moist regions. A weed in lawns, cultivated areas, waste places; rarely found in pastures." ... "Declared noxious in Regulation 2."
	Parsons, W.T. & Cuthbertson, E.G. (2001). Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	"On beaches and other recreational areas the burrs cause annoyance by injuring the feet of people using the facilities. It is an aggressive pioneer plant, favouring open sandy areas and semi-dry conditions."

Qsn #	Question	Answer
303	Agricultural/forestry/horticultural weed	y
	Source(s)	Notes
	Parsons, W.T. & Cuthbertson, E.G. (2001). Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	"It is a serious weed of maize, sugarcane, cotton, peanuts and pastures and sometimes of orchards, vineyards, vegetable crops and soybeans. It grows rapidly in moist conditions, producing thick clumps which compete with the crop for light, moisture and nutrients, often smothering low-growing plants. Its presence in a crop causes injury and inconvenience to workers and, by impeding harvest, increases costs considerably. In pastures the burrs contaminate wool, reduce its value, make shearing difficult and, penetrating the skin, injure the animal and reduce the value of the pelt. The burrs also cause serious injury to the eyes, tongue and feet of dogs and stock, including horses."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Weed of: Bananas, Cereals, Cotton, Grapevines, Lupins, Orchards & Plantations, Pastures, Pome Fruits, Vegetables"

304	Environmental weed	y
	Source(s)	Notes
	Flint, E., & Rehkemper, C. (2002). Control and eradication of the introduced grass, <i>Cenchrus echinatus</i> , at Laysan Island, Central Pacific Ocean. Pp. 110-115 in Veitch, C.R. and Clout, M. N. (eds.). Turning the tide: the eradication of invasive species. IUCN, Gland, Switzerland and Cambridge, UK	"It seeds prolifically, forms mats, and it appeared to be displacing the native bunchgrass <i>Eragrostis variabilis</i> over large areas of the western part of the island. <i>Eragrostis</i> is a perennial bunchgrass and the dominant species on Laysan."
	Queensland Government. (2021). Weeds of Australia. <i>Cenchrus echinatus</i> . https://keyserver.lucidcentral.org . [Accessed 4 Aug 2021]	"Mossman River grass (<i>Cenchrus echinatus</i>) is mainly regarded as an environmental weed in northern Queensland, the Northern Territory and the northern parts of Western Australia. This species was also recently listed as a priority environmental weed in at least one Natural Resource Management region. It is an aggressive competitor that colonises sandy soils, particularly along the coast, and can have a significant impact on coastal sand dune communities. For example, Mossman River grass (<i>Cenchrus echinatus</i>) is listed among the top ten environmental weeds in the Kimberley and Pilbara coastal regions of Western Australia. It is also regarded as an environmental weed in the New South Wales north coast region and in south eastern Queensland, where it appears on the list of the top 200 invasive plants."

Qsn #	Question	Answer
	Wood, K. R. (2008). Notes on the Conservation Status of <i>Scaevola coriacea</i> Nutt. (Goodeniaceae). National Tropical Botanical Garden, Biological Report	"The Moku Ho`oniki, Moloka`i site has three plants. The islet is a relic tuff cone located in the Pailolo channel, east of Halawa Valley. It is 5.71 hectares in area and represents a dry coastal shrubland. Associated plants include <i>Sesuvium portulacastrum</i> , <i>Sida fallax</i> , <i>Melanthera integrifolia</i> , <i>Heliotropium curassavicum</i> , <i>Jacquemontia ovalifolia</i> subsp. <i>sandwicensis</i> , <i>Chamaesyce celastroides</i> var. <i>amplectens</i> , <i>Portulaca lutea</i> , <i>Boerhavia repens</i> , <i>Scaevola coriacea</i> , <i>Scaevola taccada</i> , <i>Fimbristylis cymosa</i> subsp. <i>umbellato-capitata</i> , <i>Panicum fauriei</i> var. <i>fauriei</i> , and <i>Panicum torridum</i> . The main threats to this ecosystem include competition with non-native plant taxa such as <i>Atriplex semibaccata</i> , <i>Chenopodium murale</i> , <i>Sonchus oleraceus</i> , <i>Lantana camara</i> , <i>Portulaca oleracea</i> , <i>Portulaca pilosa</i> , <i>Cenchrus ciliaris</i> , <i>Cenchrus echinatus</i> , <i>Cynodon dactylon</i> , <i>Dactyloctenium aegyptium</i> , <i>Digitaria ciliaris</i> , and <i>Eleusine indica</i> . Possible land slides and drought are also threat, along with the loss of reproductive vigor and health as the result of inbreeding."
	Herbst, D.R. & Wagner, W.L. (1992). Alien Plants on the Northwestern Hawaiian Islands. Pp. 189-224 in Stone et al. (eds.) Alien Plant Invasions in Native Ecosystems of Hawai'i: Management & Research. Coop. Nat. Park Res. Studies Unit, U Hawaii, Honolulu, HI	[Reported to be beneficial in some instances] "Most of the naturalized species, except for those on the three islands inhabited by humans, appear to be in balance with the rest of the flora. Some even appear to be beneficial to some of the native birds because they provide additional nesting sites and food and nesting material. Sandbur (<i>Cenchrus echinatus</i>), for example, provides additional nesting sites for wedge-tailed shearwaters (<i>Puffinus pacificus chlororhynchus</i>) and other burrowing birds. The fibrous root system binds the loose sand, allowing the birds to construct nesting burrows beneath them, while the leaves and seeds are used for nesting material and food by the Laysan finch (<i>Telespyza cantons</i>)."
	WRA Specialist. (2021). Personal Communication	Primarily a weed of disturbed habitats, and agricultural areas, but negatively impacts native coastal vegetation in some areas, including the Hawaiian Islands

305	Congeneric weed	y
	Source(s)	Notes
	Marshall, V. M., Lewis, M. M., & Ostendorf, B. (2012). Buffel grass (<i>Cenchrus ciliaris</i>) as an invader and threat to biodiversity in arid environments: a review. <i>Journal of Arid Environments</i> , 78: 1-12	"Buffel grass invasion can devastate local ecosystems by altering wildfire regimes, soil erosion rates, ground surface temperatures and supply of vital resources to surrounding life forms, compromising biodiversity (D'antonio and Vitousek, 1992). Significant invasions have been reported in arid communities throughout Australia, the USA, Mexico and South America and many species and ecosystem functions have been impacted (Table 5)."

Qsn #	Question	Answer
	<p>Weber, E. (2017). <i>Invasive Plant Species of the World</i>, 2nd Edition: A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK</p>	<p>[<i>Pennisetum setaceum</i> and other invasive <i>Pennisetum</i> species covered in this book are now placed in the the genus <i>Cenchrus</i>] "Fountain grass is a large plant forming dense swards. It grows in a wide range of habitats and adapts physiologically and morphologically to various environmental conditions. In Hawaii fountain grass is found from sea level up to 2800 m altitude (Bossard et al., 2000). Seeds are abundantly produced and dispersed by wind, water and vehicles, especially along roads and waterways (Rahlao et al., 2010). Seeds may remain viable in the soil for at least 6 years (Benton, 2005). Fountain grass is well adapted to fire and resprouts rapidly from below-ground parts after burning. However, seeds may be killed by fires (Adkins et al., 2011). The grass raises fuel loads and alters fire regimes by increasing intensity and frequency of fires (Bossard et al., 2000). In South Africa, fountain grass infestations in the arid Karoo shrubland lead to unnatural wildfires, killing woody plants and altering the species composition of this vegetation (Rahlao et al., 2009). Unnatural fires may affect ground-nesting birds and terrestrial animals as well (Bossard et al., 2000). <i>Pennisetum setaceum</i> is spreading in the Canary Islands and is a potential threat to many endemic plant species (Gonzalez-Rodriguez et al., 2010). In remnants of tropical dry forests on Hawaii fountain grass dominates the understorey and competes with native trees and shrubs for water. Thus, the native tree <i>Diospyros sandwicensis</i> shows reduced growth and water uptake in invaded sites (Cordell and Sandquist, 2008)."</p>

401	Produces spines, thorns or burrs	y
	Source(s)	Notes
	<p>Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). <i>Manual of the flowering plants of Hawaii</i>. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.</p>	<p>"burs usually dark red to purple, readily deciduous, well-spaced, broadly ovoid, 4-7 mm long and as wide or wider, bur receptacle obconical, 1-2 mm long, tomentulose, lobes of bur deeply cleft, short-tomentulose, outer series of bristles 2-3 mm long, retrorsely scabrous, inner series of bristles rather flattened, short-pilose at base, retrorsely scabrous toward apex"</p>
	<p>Quattrocchi, U. (2006). <i>CRC World Dictionary of Grasses: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology</i>. CRC Press, Boca Raton, FL</p>	<p>"spines from this plant are very irritating"</p>

402	Allelopathic	
	Source(s)	Notes

Qsn #	Question	Answer
	Nascimento, E. A., Terrones, M. G., Morais, S. A., Chang, R., Andrade, G. A., Santos, D. Q., & Pereira, B. H. (2009). Allelopathic activity of <i>Cenchrus echinatus</i> L. extracts on weeds and crops. <i>Allelopathy Journal</i> , 24(2): 363-372	[Possibly. Extracts stimulate or inhibit germination and growth depending on concentration and test species] "The allelopathic effects of methanol extracts from stems and roots of <i>Cenchrus echinatus</i> L. were evaluated in greenhouse and laboratory assays, on seed germination and root and shoot growth of <i>Panicum maximum</i> Jacq., <i>Amaranthus hypochondriacus</i> L., <i>Physalis ixocarpa</i> Brot., <i>Trifolium alexandrinum</i> L. and <i>Lolium perenne</i> L.. Both root and shoot extracts of <i>Cenchrus echinatus</i> L. inhibited or stimulated the germination and seedling growth, depending on the extracts concentrations and the test species. Stem extracts were less inhibitory on the test species than root ones. Dichloromethane and ethyl acetate:methanol (1:1) fractions obtained from the methanol root extract caused 100% inhibition in seed germination and seedling growth of <i>P. maximum</i> . Volatile constituents of the dichloromethane fraction were mainly fatty acids and their esters [viz., palmitic (33.96%), oleic (8.32%), and stearic (6.42%) acids, and methyl linolelaidate (7.26%)]. Further investigation is needed to identify all constituents of the methanol extract."

403	Parasitic	n
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). <i>Manual of the flowering plants of Hawaii</i> . Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Annuals; culms decumbent at base, 25-70 cm tall, profusely branched, compressed, usually geniculate, often reddish at nodes and lower portion, usually scabrous for 3-4 cm below panicle, otherwise glabrous." [Poaceae. No evidence]

404	Unpalatable to grazing animals	n
	Source(s)	Notes
	Quattrocchi, U. (2006). <i>CRC World Dictionary of Grasses: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology</i> . CRC Press, Boca Raton, FL	"good forage grass when young and before the burs harden"
	Parsons, W.T. & Cuthbertson, E.G. (2001). <i>Noxious Weeds of Australia</i> . Second Edition. CSIRO Publishing, Collingwood, Australia	"It provides reasonable forage when young, and heavy grazing at this stage minimises burr production."
	Hatch, S.L., Schuster, J.L. & Drawe, D.L. (1999). <i>Grasses of the Texas Gulf Prairies and Marshes</i> . Texas A&M University Press, College Station, TX	"Occasional in sand and sand-shell mixtures throughout Gulf Coast. Poor forage; poor wildlife value."

405	Toxic to animals	
	Source(s)	Notes
	Parsons, W.T. & Cuthbertson, E.G. (2001). <i>Noxious Weeds of Australia</i> . Second Edition. CSIRO Publishing, Collingwood, Australia	"It is an aggressive pioneer plant, favouring open sandy areas and semi-dry conditions. It provides reasonable forage when young, and heavy grazing at this stage minimises burr production."
	HerbiGuide. (2021). Mossman River grass - <i>Cenchrus echinatus</i> . http://www.herbiguide.com.au/Descriptions/hg_Mossman_River_Grass.htm . [Accessed 4 Aug 2021]	"Toxicity: Not recorded as toxic."

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 toxic properties reported] "Anti-malarial use (with leaves of <i>Persea americana</i> or leaves of <i>Lippia schomburgkiana</i>), tea for kidney problems, an infusion is drunk as a febrifuge in the West Indies. Spines from this plant are very irritating."
	HorseDVM. (2021). Southern Sandbur <i>Cenchrus echinatus</i> . http://www.horsedvm.com/poisonous/sandburs/ . [Accessed 4 Aug 2021]	[Possibly, if consumed by horses in large quantities] "C. echinatus is an oxalate accumulating plant. Ingestion of this plant over an extended period of time can cause chronic kidney disease in horses. Acute toxicity can also occur if large amounts of the plant are consumed in a short amount of time. C. echinatus often contaminates haybales, which diminishes the quality and reduces the palatability for the horse."

406	Host for recognized pests and pathogens	
	Source(s)	Notes
	CABI. (2021). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	[Importance of this grass as a host of maize streak monogeminivirus and sugarcane streak monogeminivirus relative to other non-native grasses unknown] "C. echinatus also has some relevance as an alternative host for maize streak monogeminivirus and sugarcane streak monogeminivirus (Brunt et al., 1996)."

407	Causes allergies or is otherwise toxic to humans	n
	Source(s)	Notes
	Parsons, W.T. & Cuthbertson, E.G. (2001). Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	"On beaches and other recreational areas the burrs cause annoyance by injuring the feet of people using the facilities."
	HerbiGuide. (2021). Mossman River grass - <i>Cenchrus echinatus</i> . http://www.herbiguide.com.au/Descriptions/hg_Mossman_River_Grass.htm . [Accessed 4 Aug 2021]	"Toxicity: Not recorded as toxic."
	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. Mechanical harm reported from burrs] "Anti-malarial use (with leaves of <i>Persea americana</i> or leaves of <i>Lippia schomburgkiana</i>), tea for kidney problems, an infusion is drunk as a febrifuge in the West Indies. Spines from this plant are very irritating."

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	Notes
	Western Australian Herbarium (1998–2021). FloraBase—the Western Australian Flora. Department of Parks and Wildlife. https://florabase.dpaw.wa.gov.au/ . [Accessed 4 Aug 2021]	"Fire response. Stimulates germination of soil-stored seed."
	Parsons, W.T. & Cuthbertson, E.G. (2001). Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	[No evidence] "Burrs are formed between January and May, most plants dying-off during winter, except in the milder moist tropics where the tussocks may continue to grow throughout the year."
	CABI. (2021). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	No evidence

Qsn #	Question	Answer
409	Is a shade tolerant plant at some stage of its life cycle	
	Source(s)	Notes
	Learn 2 Grow. (2021). <i>Cenchrus echinatus</i> . http://www.learn2grow.com/plants/cenchrus-echinatus/ . [Accessed 4 Aug 2021]	"Sun Exposure - Full Sun, Partial Sun"
	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 high light environments] "in Hawai'i naturalized in arid, disturbed habitats such as beach dunes, dry, rocky slopes, pastures, and along roadsides"
	Quattrocchi, U. (2006). CRC World Dictionary of Grasses: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	[Unlikely. Occurs in open, high light environments] "common on waste ground, near running fresh water, coastal, coastal dunes, near the ocean, open areas, sandy or limestone soils, open ground and waste places, edge of cultivated fields, roadsides, ruderal areas, in turf, on disturbed ground and road verges, road ditch, river sands, poor soils, in vine thickets, on beaches and riverbanks, recently fallow land"

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	n
	Source(s)	Notes
	Parsons, W.T. & Cuthbertson, E.G. (2001). Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	"Humid and subhumid tropical lowlands, growing on sandy or other light soils."
	Queensland Government. (2021). Weeds of Australia. <i>Cenchrus echinatus</i> . https://keyserver.lucidcentral.org . [Accessed 5 Aug 2021]	"It is an aggressive competitor that colonises sandy soils, particularly along the coast, and can have a significant impact on coastal sand dune communities."
	Zhenghao Xu & Meihua Deng. (2017). Identification and Control of Common Weeds: Volume 1. Zhejiang University Press, Hangzhou and Springer Nature, Singapore	"Seashore sand dunes, roadsides, and waste places. Common in disturbed places, particularly near the ocean, on beaches, and on limestone soils. Often associated with low moisture and with sandy or light, well-drained soils of the lowland tropics, the plant can spread rapidly in moderately moist regions."
	HerbiGuide. (2021). Mossman River grass - <i>Cenchrus echinatus</i> . http://www.herbiguide.com.au/Descriptions/hg_Mossman_River_Grass.htm . [Accessed 5 Aug 2021]	"Soil: Prefers sandy or light soils."

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.	"Annuals; culms decumbent at base, 25-70 cm tall, profusely branched"

412	Forms dense thickets	
	Source(s)	Notes

Qsn #	Question	Answer
	Zhenghao Xu & Meihua Deng. (2017). Identification and Control of Common Weeds: Volume 1. Zhejiang University Press, Hangzhou and Springer Nature, Singapore	"It often forms slightly large clumps or predominant or monodominant populations in places where it appears."
	Parsons, W.T. & Cuthbertson, E.G. (2001). Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	"Mossman River grass does not, however, establish readily in dense pastures. Thus, with management practices designed to maintain a dense cover in spring and summer, it is possible to limit the entry of Mossman River grass into pasture."
	DiTomaso, J. (2007). Weeds of California and Other Western States, Volume 2. UCANR Publications, Oakland, CA	"Sandburs compete poorly with dense vegetation and rarely become established in well-managed pastures. Disturbances that bury burs and remove existing vegetation stimulate germination and enhance seedling establishment."
	WRA Specialist. (2021). Personal Communication	Generally a weed of disturbed, open areas, but may form dominant cover under certain conditions

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 in arid, disturbed habitats such as beach dunes, dry, rocky slopes, pastures, and along roadsides, 0-920 m"

502	Grass	y
	Source(s)	Notes
	USDA, Agricultural Research Service, National Plant Germplasm System. (2021). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/ . [Accessed 3 Aug 2021]	Family: Poaceae (alt. Gramineae) Subfamily: Panicoideae Tribe: Paniceae Subtribe: Cenchrinae

503	Nitrogen fixing woody plant	n
	Source(s)	Notes
	USDA, Agricultural Research Service, National Plant Germplasm System. (2021). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/ . [Accessed 3 Aug 2021]	Family: Poaceae (alt. Gramineae) Subfamily: Panicoideae Tribe: Paniceae Subtribe: Cenchrinae

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.	"Annuals; culms decumbent at base, 25-70 cm tall, profusely branched, compressed, usually geniculate, often reddish at nodes and lower portion, usually scabrous for 3-4 cm below panicle, otherwise glabrous."

Qsn #	Question	Answer
601	Evidence of substantial reproductive failure in native habitat	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] "Native to the Neotropics, now widely naturalized;"
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. Burs, in which seeds develop, detach readily at maturity and stick to hairs and clothing."
603	Hybridizes naturally	
	Source(s)	Notes
	Goel, S., Singh, H. D., & Raina, S. N. (2011). <i>Cenchrus</i> . In Wild crop relatives: genomic and breeding resources (pp. 31-52). Springer, Berlin, Heidelberg	[Hybridization documented within genus, but not reported for <i>Cenchrus echinatus</i>] "Another study with chloroplast <i>ndhF</i> marker shows closer relationship of <i>C. echinatus</i> with <i>C. calycalatus</i> , <i>C. myosuroids</i> , and <i>C. pilosus</i> group and also reconfirms the close relationship between <i>C. ciliaris</i> and <i>C. setiger</i> (Kellogg et al. 2009). The close relationship among these three species, <i>C. ciliaris</i> , <i>C. setiger</i> and <i>C. pennisetiformis</i> , may be because of chance hybridization among the three species (Doust et al. 2007)."
	Doust, A., Penly, A., Jacobs, S., & Kellogg, E. (2007). Congruence, Conflict, and Polyploidization Shown by Nuclear and Chloroplast Markers in the Monophyletic "Bristle Clade" (Paniceae, Panicoideae, Poaceae). <i>Systematic Botany</i> , 32(3), 531-544	[Unknown] " <i>Cenchrus ciliaris</i> , <i>C. setigerus</i> , and <i>C. echinatus</i> together form a well-supported clade, but within the clade the species are not reciprocally monophyletic. This could indicate incomplete lineage sorting, hybridization, allopolyploidy or some combination of the three."
604	Self-compatible or apomictic	
	Source(s)	Notes
	Kumar, S., & Saxena, S. (2016). Sequence characterized amplified regions linked with apomictic mode of reproduction in four different apomictic <i>Cenchrus</i> species. <i>Molecular Plant Breeding</i> , 7(8): 1-14	[<i>C. echinatus</i> is a reproduces sexually, but ability to be self-pollinated not addressed in this publication] "Based on progeny analysis, phenotypic markers or auxin-induced parthenocarpy tests, apomixis in <i>C. ciliaris</i> , <i>C. setigerus</i> (Fisher et al., 1954) and <i>C. glaucus</i> (Shanthamma, 1981) and sexual reproduction in <i>C. echinatus</i> , <i>C. prieurii</i> (Gupta et al., 2001) and <i>C. myosuroides</i> (Brown and Emery, 1958) has been reported earlier."
605	Requires specialist pollinators	n
	Source(s)	Notes
	Zomlefer, W.B. (1994). Guide to Flowering Plant Families. The University of North Carolina Press, Chapel Hill & London	"The reduced flowers are anemophilous" [Wind-pollinated. Poaceae family description]

Qsn #	Question	Answer
606	Reproduction by vegetative fragmentation	n
	Source(s)	Notes
	Western Australian Herbarium (1998–2021). FloraBase—the Western Australian Flora. Department of Parks and Wildlife. https://florabase.dpaw.wa.gov.au/ . [Accessed 5 Aug 2021]	"General Biology. Growth form. Grass. Life form. Annual, caespitose. Reproduction. Seed"
	Parsons, W.T. & Cuthbertson, E.G. (2001). Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	[May be able to spread locally by vegetative means, but seeds are the primary mode of reproduction] "Seeds germinate and seedlings establish at almost any time of the year provided the area is free from frosts and moisture is available. Most seeds, however, germinate in the hot humid period of late spring and early summer. Vegetative growth at this time is rapid. The young plants form dense clumps; the lower parts of the stem take root at the nodes and then produce bunches of erect flowering stems."

607	Minimum generative time (years)	1
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R. & Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Annuals; culms decumbent at base, 25-70 cm tall, profusely branched, compressed, usually geniculate, often reddish at nodes and lower portion, usually scabrous for 3-4 cm below panicle, otherwise glabrous."
	Parsons, W.T. & Cuthbertson, E.G. (2001). Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	"Seeds germinate and seedlings establish at almost any time of the year provided the area is free from frosts and moisture is available. Most seeds, however, germinate in the hot humid period of late spring and early summer. Vegetative growth at this time is rapid. The young plants form dense clumps; the lower parts of the stem take root at the nodes and then produce bunches of erect flowering stems. Burrs are formed between January and May, most plants dying-off during winter, except in the milder moist tropics where the tussocks may continue to grow throughout the year."

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y
	Source(s)	Notes
	Parsons, W.T. & Cuthbertson, E.G. (2001). Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	"Mossman River grass is well adapted to spread by seed because of its spiny burrs which fall from the plant when mature and, not only float on water, but adhere to wool, fur, clothing, bags, tyres and any fibrous material. Spread by water is particularly important in the irrigation districts of central Queensland and Western Australia. Some spread also occurs in agricultural produce and on farm machinery."
	Haselwood, E.L., Motter, G.G., & Hirano, R.T. (eds.). (1983) Handbook of Hawaiian Weeds. University of Hawaii Press, Honolulu, HI	"Propagation: By seed. Burs, in which seeds develop, detach readily at maturity and stick to hairs and clothing."

702	Propagules dispersed intentionally by people	n
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Qsn #	Question	Answer
	Source(s)	Notes
	Parsons, W.T. & Cuthbertson, E.G. (2001). Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	[Unintentionally or passively dispersed] "Mossman River grass is well adapted to spread by seed because of its spiny burrs which fall from the plant when mature and, not only float on water, but adhere to wool, fur, clothing, bags, tyres and any fibrous material. Spread by water is particularly important in the irrigation districts of central Queensland and Western Australia. Some spread also occurs in agricultural produce and on farm machinery."

703	Propagules likely to disperse as a produce contaminant	y
	Source(s)	Notes
	Parsons, W.T. & Cuthbertson, E.G. (2001). Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	"In pastures the burrs contaminate wool, reduce its value, make shearing difficult and, penetrating the skin, injure the animal and reduce the value of the pelt." ... "Some spread also occurs in agricultural produce and on farm machinery."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Major Pathway/s: Contaminant, Crop, Herbal, Ornamental, Pasture Dispersed by: Humans, Animals, Livestock, Sheep, Water, Escapee"

704	Propagules adapted to wind dispersal	n
	Source(s)	Notes
	Parsons, W.T. & Cuthbertson, E.G. (2001). Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	"Mossman River grass is well adapted to spread by seed because of its spiny burrs which fall from the plant when mature and, not only float on water, but adhere to wool, fur, clothing, bags, tyres and any fibrous material. Spread by water is particularly important in the irrigation districts of central Queensland and Western Australia. Some spread also occurs in agricultural produce and on farm machinery."

705	Propagules water dispersed	y
	Source(s)	Notes
	Parsons, W.T. & Cuthbertson, E.G. (2001). Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	"Mossman River grass is well adapted to spread by seed because of its spiny burrs which fall from the plant when mature and, not only float on water, but adhere to wool, fur, clothing, bags, tyres and any fibrous material. Spread by water is particularly important in the irrigation districts of central Queensland and Western Australia."

706	Propagules bird dispersed	
	Source(s)	Notes
	Flint, E., & Rehkemper, C. (2002). Control and eradication of the introduced grass, <i>Cenchrus echinatus</i> , at Laysan Island, Central Pacific Ocean. Pp. 110-115 in Veitch, C.R. and Clout, M. N. (eds.). Turning the tide: the eradication of invasive species. IUCN, Gland, Switzerland and Cambridge, UK	"A very efficient ally in the depletion of the seed bank was the Laysan finch (<i>Telespiza cantans</i>). These granivorous birds actively searched the soil for seeds and destroyed them as they consumed them." [Birds that consume seeds act as seed predators. Seeds may adhere to bird feathers, but there is no evidence that viable seeds are dispersed internally by birds]

Qsn #	Question	Answer
	Aoyama, Y., Kawakami, K., & Chiba, S. (2012). Seabirds as adhesive seed dispersers of alien and native plants in the oceanic Ogasawara Islands, Japan. <i>Biodiversity and Conservation</i> , 21(11), 2787-2801	[Dispersed externally by birds] "In total, 41 black-footed albatrosses, 45 Bulwer's petrels, 45 wedge-tailed shearwaters, and 29 brown boobies were captured (Table 1). Seeds of nine plant species (<i>C. echinatus</i> , <i>C. barbata</i> , <i>B. diffusa</i> , <i>O. corniculata</i> , <i>S. nigrum</i> , <i>C. didymus</i> , <i>Youngia japonica</i> , <i>Digitaria pruriens</i> , and <i>Sporobolus diander</i>) were collected from the birds. The three most common species (<i>C. echinatus</i> , <i>C. barbata</i> , and <i>B. diffusa</i>) and <i>C. didymus</i> are alien species. Seeds were attached to 16–32 % of birds for each species (Fig. 2). All seeds were found on feathers, and none on the feet."

707	Propagules dispersed by other animals (externally)	y
	Source(s)	Notes
	Parsons, W.T. & Cuthbertson, E.G. (2001). <i>Noxious Weeds of Australia</i> . Second Edition. CSIRO Publishing, Collingwood, Australia	"Mossman River grass is well adapted to spread by seed because of its spiny burrs which fall from the plant when mature and, not only float on water, but adhere to wool, fur, clothing, bags, tyres and any fibrous material. Spread by water is particularly important in the irrigation districts of central Queensland and Western Australia. Some spread also occurs in agricultural produce and on farm machinery."
	Haselwood, E.L., Motter, G.G., & Hirano, R.T. (eds.). (1983) <i>Handbook of Hawaiian Weeds</i> . University of Hawaii Press, Honolulu, HI	"Propagation: By seed. Burs, in which seeds develop, detach readily at maturity and stick to hairs and clothing."

708	Propagules survive passage through the gut	n
	Source(s)	Notes
	Flint, E., & Rehkemper, C. (2002). Control and eradication of the introduced grass, <i>Cenchrus echinatus</i> , at Laysan Island, Central Pacific Ocean. Pp. 110-115 in Veitch, C.R. and Clout, M. N. (eds.). <i>Turning the tide: the eradication of invasive species</i> . IUCN, Gland, Switzerland and Cambridge, UK	"A very efficient ally in the depletion of the seed bank was the Laysan finch (<i>Telespiza cantans</i>). These granivorous birds actively searched the soil for seeds and destroyed them as they consumed them." [Birds that consume seeds act as seed predators. Seeds may adhere to bird feathers, but there is no evidence that viable seeds are dispersed internally by birds]
	Parsons, W.T. & Cuthbertson, E.G. (2001). <i>Noxious Weeds of Australia</i> . Second Edition. CSIRO Publishing, Collingwood, Australia	[Grazed to suppress seeding, but no evidence that viable seeds are consumed and dispersed internally by grazing animals] "Where it is present, affected areas should be grazed as heavily as possible during summer to minimise seeding."

Qsn #	Question	Answer
801	Prolific seed production (>1000/m²)	
	Source(s)	Notes
	Uasuf, A., Tigabu, M., & Odén, P. C. (2009). Soil Seed Banks and Regeneration of Neotropical Dry Deciduous and Gallery Forests in Nicaragua. Bois et Forêts des Tropiques, 299(1): 50-62	"Table 1. Density (seeds/m ²), frequency and viability of seeds recovered from soil samples." [Cenchrus echinatus recorded at densities of 22 seeds/m ² in both Dry deciduous forest and Gallery forest]
	Flint, E., & Rehkemper, C. (2002). Control and eradication of the introduced grass, Cenchrus echinatus, at Laysan Island, Central Pacific Ocean. Pp. 110-115 in Veitch, C.R. and Clout, M. N. (eds.). Turning the tide: the eradication of invasive species. IUCN, Gland, Switzerland and Cambridge, UK	[Seed density data unspecified] "It seeds prolifically, forms mats, and it appeared to be displacing the native bunchgrass Eragrostis variabilis over large areas of the western part of the island."

802	Evidence that a persistent propagule bank is formed (>1 yr)	y
	Source(s)	Notes
	Royal Botanic Gardens Kew. (2021) Seed Information Database (SID). Version 7.1. http://data.kew.org/sid/ . [Accessed 5 Aug 2021]	"Storage Behaviour: Orthodox"
	Western Australian Herbarium (1998–2021). FloraBase—the Western Australian Flora. Department of Parks and Wildlife. https://florabase.dpaw.wa.gov.au/ . [Accessed 5 Aug 2021]	[Cenchrus echinatus] "Seedbank persistence. Medium, 1-5 years."

803	Well controlled by herbicides	y
	Source(s)	Notes
	Parsons, W.T. & Cuthbertson, E.G. (2001). Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	"Where chemical control is required several herbicides give good control. In most situations best results are obtained by spraying with paraquat plus an appropriate non-ionic surfactant. Apply the spray to actively growing plants before the seed head appears, wetting the plants thoroughly but avoiding excess run-off. Paraquat is inactivated on contact with soil and has the same disadvantages as mentioned for mechanical methods of control. Mossman River grass is also susceptible to a number of selective residual herbicides which can be used in various crops. Atrazine is effective in maize, benfluralin and trifluralin in peanuts, and trifluralin, diuron + dinitramine mixtures and fluometuron in cotton . Overseas the newer herbicides chlorazifop, fluazifop butyl, oryzolin and sethoxydim have given good control in soybeans."

804	Tolerates, or benefits from, mutilation, cultivation, or fire	y
	Source(s)	Notes
	Parsons, W.T. & Cuthbertson, E.G. (2001). Noxious Weeds of Australia. Second Edition. CSIRO Publishing, Collingwood, Australia	"As Mossman River grass is an annual, it is essential to prevent seeding. This can be achieved before burrs appear by hand pulling single plants, cutting below ground level, burning with a flame-thrower, cultivating or spraying with herbicides. The main problem with all these methods is that they only kill plants already present, necessitating repeated treatments as new germinations occur."

Qsn #	Question	Answer
	DiTomaso, J. (2007). Weeds of California and Other Western States, Volume 2. UCANR Publications, Oakland, CA	"Disturbances that bury burs and remove existing vegetation stimulate germination and enhance seedling establishment. However, repeated cultivation before burs develop reduces the seedbank and can eventually eliminate a problematic population. Under mowing regimes, plants grow low to the ground and can still produce burs."

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.	[Given distribution on all Hawaiian Islands, presumably no natural enemies act as limiting factors] "in Hawai'i naturalized in arid, disturbed habitats such as beach dunes, dry, rocky slopes, pastures, and along roadsides, 0-920 m, on Kure and Midway atolls, Lisianski, Laysan, French Frigate Shoals, Nihoa, and all of the main islands."

Summary of Risk Traits:

High Risk / Undesirable Traits

- Thrives, and spreads, in regions with tropical climates
- Naturalized on Kure and Midway atolls, Lisianski, Laysan, French Frigate Shoals, Nihoa, and all the main islands; naturalized elsewhere
- A disturbance-adapted grass that impacts lawns and several crops
- An environmental weed impacting native coastal vegetation and seabird habitat
- Other *Cenchrus* species are invasive weeds
- Possesses spiny burrs that contaminate wool, and can injure the eyes, tongue and feet of dogs and stock, including horses; also harmful and a nuisance to humans
- May be allelopathic
- Reproduces by prolific seed production
- An annual grass reaching maturity in <1 year
- Seeds easily dispersed by adhering to clothing, hair, and feathers, as well as footwear and machinery, and also dispersed by water
- Seeds may form a seed bank persisting for 1-5 years
- Tolerates mowing and grazing

Low Risk Traits

- Palatable to, and grazed by livestock, especially when young
- Occurs primarily in sandy soils
- Thrives in high light environments (dense shade may prevent establishment and spread)
- Vegetative spread may be minimal and very localized
- Herbicides provide effective control