Taxon: Cynodon nlemfuensis Vanderyst **Family:** Poaceae

Common Name(s): African Bermuda grass
Rhodesian star grass
robust star grass
star grass

Synonym(s): Cynodon dactylon var. sarmentosus
Cynodon lemfuensis Vanderyst
Cynodon parodii Caro & E.A.Sánchez

Assessor: Chuck Chimera **Status:** Assessor Approved **End Date:** 29 Sep 2021

WRA Score: 12.0 **Designation:** H(HPWRA) **Rating:** High Risk

Keywords: Perennial Grass, Invasive Elsewhere, Palatable, Stoloniferous, Limited Seeding

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

Qsn #	Question	Answer Option	Answer
409	Is a shade tolerant plant at some stage of its life cycle	y=1, n=0	n
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y=1, n=0	y
411	Climbing or smothering growth habit	y=1, n=0	n
412	Forms dense thickets	y=1, n=0	y
501	Aquatic	y=5, n=0	n
502	Grass	y=1, n=0	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	y=1, n=-1	y
604	Self-compatible or apomictic		
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)	y=1, n=-1	y
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant		
704	Propagules adapted to wind dispersal		
705	Propagules water dispersed	y=1, n=-1	n
706	Propagules bird dispersed	y=1, n=-1	n
707	Propagules dispersed by other animals (externally)	y=1, n=-1	y
708	Propagules survive passage through the gut		
801	Prolific seed production (>1000/m2)	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**
	't Mannetje, L. & Jones, R.M. (Eds.). (1992). Plant Resources of South-East Asia. No. 4. Forages. Pudoc Scientific Publishers, Wageningen, Netherlands	[Sterile selections would presumably have reduced ability to disperse long distances] "Improved selections of stargrass are sterile or almost sterile. It can be propagated by planting stolons or stem pieces."

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**
	't Mannetje, L. & Jones, R.M. (Eds.). (1992). Plant Resources of South-East Asia. No. 4. Forages. Pudoc Scientific Publishers, Wageningen, Netherlands	"Stargrass occurs naturally in East and Central Africa, from Ethiopia and Sudan through Zaire to Malawi and Angola. In other parts of the tropics, including South-East Asia, it has been introduced as a fodder grass."

202	**Quality of climate match data**	**High**
	Source(s)	**Notes**
	't Mannetje, L. & Jones, R.M. (Eds.). (1992). Plant Resources of South-East Asia. No. 4. Forages. Pudoc Scientific Publishers, Wageningen, Netherlands	"Stargrass occurs naturally in East and Central Africa, from Ethiopia and Sudan through Zaire to Malawi and Angola. In other parts of the tropics, including South-East Asia, it has been introduced as a fodder grass."

203	**Broad climate suitability (environmental versatility)**	**n**
	Source(s)	**Notes**

Qsn #	Question	Answer
	Cook, B.G., et al. (2020). Tropical Forages: an interactive selection tool – Digital ISBN 978958694234-8. https://www.tropicalforages.info/text/intro/index.html. [Accessed 29 Sep 2021]	"C. nlemfuensis occurs from about 15º N to 15º S, and from sea level to >2,300 m asl, representing a range in average annual temperature from about 20-27ºC. However, in Florida, USA, it is not recommended north of a line between Brooksville and Orlando. Although the average annual temperature in these cities is about 22 ºC, the very low winter temperatures beyond the line can cause winter kill. In Australia, var. nlemfuensis is naturalized in areas with average annual temperature down to 18 ºC, suggesting the limitation lies either with the variety, or the freeze factor that is experienced in the USA but not in Australia. "
	Burton, G.W. (1993). African grasses. p. 294-298. In: J. Janick and J.E. Simon (eds.), New crops. Wiley, New York	"It lacks winterhardiness and is limited to South Florida and South Texas."
	't Mannetje, L. & Jones, R.M. (Eds.). (1992). Plant Resources of South-East Asia. No. 4. Forages. Pudoc Scientific Publishers, Wageningen, Netherlands	[Broad elevation range, at least at low latitudes, but does not doe well in colder temperatures] "Productivity and persistence of stargrass are limited to lower elevations or where temperatures do not fall below -4 °C, as growth rapidly ceases with low temperatures. In its area of origin it occurs up to 2300 m altitude." ... "C. nlemfuensis much resembles C. dactylon (L.) Pers., the main difference being the absence of underground rhizomes and the lack of hardiness."

204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	**Notes**
	Herbst, D.R.& Wagner, W.L. (1999). Contributions to the flora of Hawai'i. VII. Bishop Museum Occasional Papers 58: 12-36	"Cynodon nlemfuensis was included as a note in O'Connor's treatment of the genus (1990: 1520) stating that it was an adventive at least on Moloka'i and Hawai'i. Although not common, it should be considered as naturalized in Hawai'i."
	Oppenheimer, H. L. (2003). New plant records from Maui and Hawai'i Counties. Bishop Museum Occasional Papers. 73: 3-30	"Herbst & Wagner (1999: 25–26) reassessed the status of this taxon, considering it to be naturalized instead of adventive. It had been known to occur on the islands of Moloka'i and Hawai'i. Recently it was collected on West Maui, where it appears to be at least locally naturalized."

Qsn #	Question	Answer
	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 27 Sep 2021]	"Native Africa NORTHEAST TROPICAL AFRICA: Ethiopia, Sudan (s.e.) EAST TROPICAL AFRICA: Kenya, Tanzania, Uganda WEST-CENTRAL TROPICAL AFRICA: Democratic Republic of the Congo SOUTH TROPICAL AFRICA: Angola, Malawi, Zambia, Zimbabwe Naturalized Africa SOUTHERN AFRICA: South Africa Australasia AUSTRALIA: Australia [Queensland] Northern America SOUTH-CENTRAL U.S.A.: United States [Texas] REGION: Mexico Southern America CARIBBEAN: West Indies CENTRAL AMERICA: Belize, Costa Rica, Honduras, El Salvador BRAZIL: Brazil WESTERN SOUTH AMERICA: Bolivia SOUTHERN SOUTH AMERICA: Argentina"
	't Mannetje, L. & Jones, R.M. (Eds.). (1992). Plant Resources of South-East Asia. No. 4. Forages. Pudoc Scientific Publishers, Wageningen, Netherlands	"Stargrass occurs naturally in East and Central Africa, from Ethiopia and Sudan through Zaire to Malawi and Angola. In other parts of the tropics, including South-East Asia, it has been introduced as a fodder grass."

Qsn #	Question	Answer
205	**Does the species have a history of repeated introductions outside its natural range?**	**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 27 Sep 2021]	"Naturalized Africa SOUTHERN AFRICA: South Africa Australasia AUSTRALIA: Australia [Queensland] Northern America SOUTH-CENTRAL U.S.A.: United States [Texas] REGION: Mexico Southern America CARIBBEAN: West Indies CENTRAL AMERICA: Belize, Costa Rica, Honduras, El Salvador BRAZIL: Brazil WESTERN SOUTH AMERICA: Bolivia SOUTHERN SOUTH AMERICA: Argentina"
	Australian Biological Resources Study. (2005). Flora of Australia: Poaceae 3, Volume 44B. CSIRO Publishing, Melbourne	"SE Qld as far \V as the Charleville area, near-coastal N Qld between Mackay and Cairns; isolated records from better-watered areas of central Australia, and from N of Adelaide. Endemic to eastern and central Africa; introduced as a fodder grass elsewhere."
	't Mannetje, L. & Jones, R.M. (Eds.). (1992). Plant Resources of South-East Asia. No. 4. Forages. Pudoc Scientific Publishers, Wageningen, Netherlands	"Stargrass occurs naturally in East and Central Africa, from Ethiopia and Sudan through Zaire to Malawi and Angola. In other parts of the tropics, including South-East Asia, it has been introduced as a fodder grass."

301	Naturalized beyond native range	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 27 Sep 2021]	"Naturalized Africa SOUTHERN AFRICA: South Africa Australasia AUSTRALIA: Australia [Queensland] Northern America SOUTH-CENTRAL U.S.A.: United States [Texas] REGION: Mexico Southern America CARIBBEAN: West Indies CENTRAL AMERICA: Belize, Costa Rica, Honduras, El Salvador BRAZIL: Brazil WESTERN SOUTH AMERICA: Bolivia SOUTHERN SOUTH AMERICA: Argentina"

Qsn #	Question	Answer
	Herbst, D.R.& Wagner, W.L. (1999). Contributions to the flora of Hawai'i. VII. Bishop Museum Occasional Papers 58: 12-36	[Molokai and Hawaii] "Cynodon nlemfuensis Vanderyst New naturalized record Cynodon nlemfuensis was included as a note in O'Connor's treatment of the genus (1990: 1520) stating that it was an adventive at least on Moloka'i and Hawai'i. Although not common, it should be considered as naturalized in Hawai'i. Akey in Herbst & Clayton (1998: 22) can be used to assist in its identification. It is an African species. Material examined. MOLOKA'I: Kaunakakai, near beach, 20 ft, 11 Nov 1974, Herbst & Spence 5096 (BISH). HAWAI 'I: Hawai'i, 29 Jan 1963, Shipman s.n. (BISH 118468)."
	Oppenheimer, H. L. (2003). New plant records from Maui and Hawai'i Counties. Bishop Museum Occasional Papers. 73: 3-30	[West Maui] "Cynodon nlemfuensis Vanderyst New island record Herbst & Wagner (1999: 25–26) reassessed the status of this taxon, considering it to be naturalized instead of adventive. It had been known to occur on the islands of Moloka'i and Hawai'i. Recently it was collected on West Maui, where it appears to be at least locally naturalized. Material examined: MAUI: West Maui, Wailuku Dist, Wailuku, 61 m, growing in sandy soil on weedy roadside with Verbesina, Bidens, Eragrostis, Cenchrus, 16 Dec 2001, Oppenheimer H120102."

302	Garden/amenity/disturbance weed	y
	Source(s)	**Notes**
	Agyakwa, C.W. & Akobundu, I.O. (1998). A Handbook of West African Weeds. International Institute of Tropical Agriculture, Ibadan, Nigeria	"Cynodon nlemfuensis Vanderyst (giant stargrass) is a coarse variety of C. dactylon and has stouter and tough stolons. It has wide leaves but no rhizomes. It was originally introduced as a pasture grass but is now spreading as a weed. It is a noxious weed wherever it is not being used as pasture grass"
	Quattrocchi, U. (2006). CRC World Dictionary of Grasses: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"troublesome, aggressive, good ground cover, it does not tolerate long periods of flooding, used mainly for soil conservation works, useful for erosion control and for waterways, a pioneer grass on wasteland, weed of arable land and perennial crops, found in disturbed areas, weedy grassy sandy places, along roadsides, in grassland, on moist alluvium"
	Brown, K. (2015). Early Detection/Rapid Response Invasive and Non-Native Plants You Should Know. Osceola CISMA. https://www.floridainvasives.org/Osceola/. [Accessed 28 Sep 2021]	[Included in a list of early detection/rapid response species in Florida] "Habitat: Native of Africa. Establishes in disturbed areas in grassland, cattle paddocks, verges, and moist alluvium. Comments: Propagated by rooted runners. Control Methods: A combination of manual and chemical methods is recommended for large infestations of C. nlemfuensis. For smaller infestations, plants can be cut out; all stolons must be removed. Larger infestations can be controlled by mowing the foliage and the above-ground segments. Burning is not recommended because fire can stimulate growth of new plants. Re-sprouts can be sprayed with a foliar application of glyphosate"
	WRA Specialist. (2021). Personal Communication	Reported as a weed of crops, but impacts have generally not been quantified. Here designated as a general weed with the potential to impact agriculture or the natural environment

303	Agricultural/forestry/horticultural weed	

Qsn #	Question	Answer
	Source(s)	**Notes**
	Laegaard, S. & Garcia, P.P. (2004). Invasive grasses in the Galapagos Islands. Lyonia 6(2): 171-175	"Cynodon nlemfuensis is of SE African origin, it is low growing, rarely more than 50 cm high, often without flowering and confined to propagation by its very long stolons. It is growing very dense and is a very strong competitor. In the mainland of Ecuador it is recently introduced but now well established as invasive from sea level to about 2000 m in areas with dry climate. In Galápagos it has only been observed in a couple of places but it is feared that it may in future become the most severely invasive of all grass species."
	Agyakwa, C.W. & Akobundu, I.O. (1998). A Handbook of West African Weeds. International Institute of Tropical Agriculture, Ibadan, Nigeria	"Cynodon nlemfuensis Vanderyst (giant stargrass) is a coarse variety of C. dactylon and has stouter and tough stolons. It has wide leaves but no rhizomes. It was originally introduced as a pasture grass but is now spreading as a weed. It is a noxious weed wherever it is not being used as pasture grass"
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Weed of: Orchards & Plantations"
	Overholt, W. A., & Franck, A. R. (2017). The invasive legacy of forage grass introductions into Florida. Natural Areas Journal, 37(2), 254-264	[As of publication, not yet reported as invasive in Florida] "A few African grasses, not yet reported as invasive, are still promoted for use in Florida pastures, including African stargrass (Cynodon nlemfuensis Vanderyst), pangola grass (Digitaria eriantha Steud.), and Rhodesgrass (Chloris gayana Kunth) (Vendramini and Mislevy 2006; Vendramini et al. 2013, 2015)."
	Australian Biological Resources Study. (2005). Flora of Australia: Poaceae 3, Volume 44B. CSIRO Publishing, Melbourne	[Cynodon nlemfuensis var. nlemfuensis] "Introduced as a pasture grass; has become a vigorous weed in some areas."
	WRA Specialist. (2021). Personal Communication	Reported as a weed of crops, but impacts have generally not been quantified.

304	Environmental weed	
	Source(s)	**Notes**
	Agyakwa, C.W. & Akobundu, I.O. (1998). A Handbook of West African Weeds. International Institute of Tropical Agriculture, Ibadan, Nigeria	"Cynodon nlemfuensis Vanderyst (giant stargrass) is a coarse variety of C. dactylon and has stouter and tough stolons. It has wide leaves but no rhizomes. It was originally introduced as a pasture grass but is now spreading as a weed. It is a noxious weed wherever it is not being used as pasture grass"
	CABI. (2021). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	[Cynodon nlemfuensis] "C. nlemfuensis is a long-lived perennial grass widely naturalized in tropical and subtropical regions of the world. It is a fast-growing C4 grass that spreads mostly vegetatively (Smith and Valenzuela, 2002). It rapidly colonizes new areas and grows forming dense mats. As in many other African grasses, this species has the potential to alter ecosystem functions by altering fire regimes, hydrological cycles, biophysical dynamics, nutrient cycles, and community composition (D'Antonio and Vitousek, 1992). C. nlemfuensis is well-adapted to drought conditions and plants are very persistent once they are established (Smith and Valenzuela, 2002). The species has the capability to easily re-sprout from stolons and rooted runners. Plants also recover quickly after fire (Cook et al., 2005)."

Qsn #	Question	Answer
	WRA Specialist. (2021). Personal Communication	A potential environmental weed elsewhere, although impacts are generally described, and cited references do not provide direct evidence of detrimental impacts. In the Hawaiian Islands, not reported to have any detrimental ecosystem impacts to date.
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence

305	Congeneric weed	y
	Source(s)	**Notes**
	Cal-IPC. (2021). Cynodon dactylon. https://www.cal-ipc.org/plants/profile/cynodon-dactylon-profile/. [Accessed 28 Sep 2021]	"Cynodon dactylon (bermudagrass) is a creeping perennial grass (family Poaceae) commonly used in garden plantings and as a turf species. However, it can escape cultivation and out-compete native species, particularly in riparian areas."
	CABI. (2021). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	[Cynodon dactylon] "Hood and Naiman (2000) have compared the invasibility of riparian plant communities high on river banks with those on floodplain floors for four South African rivers. Analyses of abundant and significant riparian species showed that the floors have 3.1 times more exotic plants than the banks. The percentage of exotics ranges from 5 to 11% of total species richness for the banks, and from 20 to 30% for the floors. Species richness and percent exotics are negatively correlated for the banks, but not correlated for the floors. Authors claim that the most prominent exotic species are Lantana camara and C. dactylon, which are present on both banks and floors. Despite great differences in climate, species richness, and land use history, the percentages of exotic plants in three rivers in the Pacific Northwest of the USA and one river in southwestern France are similar to those in South Africa (24-30% versus 20-30%, respectively). Furthermore, the high proportions of exotic species in these riparian plant communities are comparable to those reported for vascular plant communities on islands. They so conclude that the macro-channel floor regions of the riparian zones of South African rivers are highly vulnerable to invasion by exotic vascular plants."
	Weber, E. (2017). Invasive Plant Species of the World, 2nd Edition: A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	[Cynodon dactylon] "Where invasive, the grass forms solid mats crowding out native species, especially smaller species of the ground flora. Grass individuals quickly expand by rhizomes and stolons."

401	Produces spines, thorns or burrs	n
	Source(s)	**Notes**
	Australian Biological Resources Study. (2005). Flora of Australia: Poaceae 3, Volume 44B. CSIRO Publishing, Melbourne	[No evidence] "Not rhizomatous. Culms erect, 1- 3 mm wide, herbaceous or woody; flowering culms 20-83 cm high. Leaves: basal sheaths glabrous or pilose; orifice bearded; ligule a ciliolate membrane, 0. 1- 0.3 mm long; blade flat or folded, 5- 16 cm long, 2-6 mm wide, acuminate, bright pale green or dull pale green (glaucous)."

402	Allelopathic	
	Source(s)	**Notes**

Qsn #	Question	Answer
	Cook, B.G., et al. (2020). Tropical Forages: an interactive selection tool – Digital ISBN 978958694234-8. https://www.tropicalforages.info/text/intro/index.html. [Accessed 29 Sep 2021]	[Generic description. Unknown] "Compatibility (with other species). These are very vigorous grasses that, unmanaged, can overgrow associated legumes. However, they are mostly not very shade tolerant, and can be shaded out by taller grasses and trees."
	WRA Specialist. (2021). Personal Communication	Unknown. No evidence found

403	Parasitic	n
	Source(s)	**Notes**
	Australian Biological Resources Study. (2005). Flora of Australia: Poaceae 3, Volume 44B. CSIRO Publishing, Melbourne	"Not rhizomatous. Culms erect, 1- 3 mm wide, herbaceous or woody; flowering culms 20-83 cm high." [Poaceae. No evidence]

404	Unpalatable to grazing animals	n
	Source(s)	**Notes**
	Burton, G.W. (1993). African grasses. p. 294-298. In: J. Janick and J.E. Simon (eds.), New crops. Wiley, New York	"It is softer, more palatable and has a higher digestibility than common bermudagrass. Stargrasses usually contains prussic acid glucosides but reports of livestock poisoning are rare."
	Quattrocchi, U. (2006). CRC World Dictionary of Grasses: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"native pasture species, forage, grazed by ruminants, not particularly palatable, extremely palatable when young"
	't Mannetje, L. & Jones, R.M. (Eds.). (1992). Plant Resources of South-East Asia. No. 4. Forages. Pudoc Scientific Publishers, Wageningen, Netherlands	"Stargrass should be cut for hay or silage when it is 30-40 cm tall or after every 4-6 weeks growth. It can be grazed year-round if temperatures and rainfall are favourable. Overgrazing will decrease stands. A stubble height of 15-25 cm should be maintained under grazing or cutting. Dry matter yields of improved selections vary with climate and soil fertility but are at least twice the yield of local or common types. Stargrass is best utilized by grazing. It can also be stored as hay after drying."

405	Toxic to animals	
	Source(s)	**Notes**
	Burton, G.W. (1993). African grasses. p. 294-298. In: J. Janick and J.E. Simon (eds.), New crops. Wiley, New York	"Stargrasses usually contains prussic acid glucosides but reports of livestock poisoning are rare."

Qsn #	Question	Answer
	Molossi, F. A., Ogliari, D., Morais, R. M., Wicpolt, N. S., Gheller, E., Weber, L., & Gava, A. (2019). Cyanogenic poisoning by spontaneous ingestion of star grass (Cynodon nlemfuensis var. nlemfuensis cv.'Florico') in cattle. Pesquisa Veterinária Brasileira, 39(1): 20-24	[Potentially, when cultivated in the shade] "This study reports the epidemiological data and the clinical-pathological condition of five outbreaks of cyanogenic poisoning in cattle spontaneously ingesting star grass (Cynodon nlemfuensis Vanderyst var. nlemfuensis cv. 'Florico'). In all outbreaks, the areas where the plant was previously fertilized with high concentrations of nitrogen and the properties adopted the silvipastoral system. The first clinical signs appeared between 10 and 15 minutes after the first introduction of cattle and were characterized by muscular tremors, dyspnea, moderate tympanism, staggering gait, forced breathing with open mouth, sternal recumbency followed by death after 15 to 30 minutes and/or recovery in a few hours after the signs started. In total, 43 cows have become ill and 18 died. Two necropsies were performed and no significant changes were found except for the presence of the plant near the esophageal sphincter region. No histological lesions were seen through microscopy. Green leaves of the star grass were collected from all properties where the outbreaks occurred and the test of the picro-sodium paper was performed, revealing red-brick coloration in 20 minutes after maceration of the leaves." ... "When cultivated in the shade, star grass (Cynodon nlemfuensis Vanderyst var. nlemfuensis cv.'Florico') can accumulate cyanide acid and cause cyanogenic poisoning in cattle."

406	Host for recognized pests and pathogens	
	Source(s)	**Notes**
	't Mannetje, L. & Jones, R.M. (Eds.). (1992). Plant Resources of South-East Asia. No. 4. Forages. Pudoc Scientific Publishers, Wageningen, Netherlands	"Rust and Helminthosporium leaf-spot are the major diseases of common stargrass. Foliar blight (Rhizoctonia solani) has been observed on some of the selected cultivars. Armyworm (Spodoptera frugiperda) and spittlebug (Prosapia bicinata) are the major insect pests. Adequate fertilization and defoliation that allows less than 15 cm growth to accumulate will help control pests. Burning dead top growth if grass is frosted or after a dormant stage will help control spittlebug and the diseases."
	Smith, J. & Valenzuela, H. (2002). Stargrass. Sustainable Agriculture Cover Crops Aug. 2002, SA-CC-5. College of Tropical Agriculture and Human Resources, Honolulu, HI. www.ctahr.hawaii.edu	"The major diseases of common stargrass are rust and Helminthosporium leaf-spot. Stargrass has been found to be susceptible to late blight (Rhizoctonia solani) in Florida, but attacks have been sporadic, and it has not become a disease of economic importance for stargrass there. The fall armyworm (Spodoptera frugiperda) and spittlebug (Prosapia bicinata) are the major insects attacking stargrass. The strip grass looper caterpillar (Mocis latipes) is also a problem in Florida. Because several nematodes attack stargrass, vegetable and ornamental farmers need to be careful that important nematode pests do not build up in soil under stargrass if the field will subsequently be used for vegetable or ornamental crops susceptible to nematodes. Nematodes found to attack stargrass in Florida included the stubby root (Trichodorus), spiral (Helicotylenchus), stealth (Hemicycliophora), ring (Hemicriconemoides), stunt (Tylenchorhynchus), awl (Dolichodorus), and lance (Hoplalaimus) nematodes."

407	Causes allergies or is otherwise toxic to humans	n

Qsn #	Question	Answer
	Source(s)	**Notes**
	Quattrocchi, U. (2012). CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	[No evidence] "Vermifuge, wound healing, antirheumatic, for intestinal parasitism, swellings, wounds, sprains. Veterinary medicine, insecticide, external parasitism."
	Burton, G.W. (1993). African grasses. p. 294-298. In: J. Janick and J.E. Simon (eds.), New crops. Wiley, New York	[Only an issue if consumed by livestock] "Stargrasses usually contains prussic acid glucosides but reports of livestock poisoning are rare."

408	Creates a fire hazard in natural ecosystems	
	Source(s)	**Notes**
	Cook, B.G., et al. (2020). Tropical Forages: an interactive selection tool – Digital ISBN 978958694234-8. https://www.tropicalforages.info/text/intro/index.html. [Accessed 29 Sep 2021]	[Generic description. May contribute to fuel load and increase fire risk] "Plants recover quickly after fire, and can even benefit through spittlebug and disease control by fire."
	CABI. (2021). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	[Potentially yes] "Burning is not recommended because fire can stimulate growth of new plants."

409	Is a shade tolerant plant at some stage of its life cycle	n
	Source(s)	**Notes**
	Cook, B.G., et al. (2020). Tropical Forages: an interactive selection tool – Digital ISBN 978958694234-8. https://www.tropicalforages.info/text/intro/index.html. [Accessed 27 Sep 2021]	"All grow best in full sun or light shade, although some types, at least, seem adapted to moderate shade providing fertility is adequate." [Dense shade may inhibit spread]
	Smith, J. & Valenzuela, H. (2002). Stargrass. Sustainable Agriculture Cover Crops Aug. 2002, SA-CC-5. College of Tropical Agriculture and Human Resources, Honolulu, HI. www.ctahr.hawaii.edu	"Its shade tolerance is poor." ... "Stargrass is not suitable for shaded conditions."

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
	Source(s)	**Notes**
	't Mannetje, L. & Jones, R.M. (Eds.). (1992). Plant Resources of South-East Asia. No. 4. Forages. Pudoc Scientific Publishers, Wageningen, Netherlands	"It grows on many soil types but does best on moist, well-drained soils. It will tolerate a broad soil pH range but best growth is made on soils with a pH above 5.5."
	Skerman, P.J. & Riveros, F. (1990). Tropical Grasses. FAO, Rome	"It has a wide range of soil fertility and can mobilize and recycle subsoil nutrients, especially calcium, 10 offset the increasing acidity from high levels of sulphate of ammonia application (Mohamed Saleem, Chheda & Crowder. 1975)."

411	Climbing or smothering growth habit	n
	Source(s)	**Notes**
	Australian Biological Resources Study. (2005). Flora of Australia: Poaceae 3, Volume 44B. CSIRO Publishing, Melbourne	"Not rhizomatous. Culms erect, 1- 3 mm wide, herbaceous or woody; flowering culms 20-83 cm high."

Qsn #	Question	Answer
412	**Forms dense thickets**	**y**
	Source(s)	**Notes**
	Laegaard, S. & Garcia, P.P. (2004). Invasive grasses in the Galapagos Islands. Lyonia 6(2): 171-175	"Cynodon nlemfuensis is of SE African origin, it is low growing, rarely more than 50 cm high, often without flowering and confined to propagation by its very long stolons. It is growing very dense and is a very strong competitor."
	Australian Biological Resources Study. (2005). Flora of Australia: Poaceae 3, Volume 44B. CSIRO Publishing, Melbourne	"Found on sandy to black alluvial soils in disturbed areas; vigorous, forming dense swards."
	CABI. (2021). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	[Cynodon nlemfuensis] "It rapidly colonizes new areas and grows forming dense mats."

501	Aquatic	n
	Source(s)	**Notes**
	't Mannetje, L. & Jones, R.M. (Eds.). (1992). Plant Resources of South-East Asia. No. 4. Forages. Pudoc Scientific Publishers, Wageningen, Netherlands	[Terrestrial] "Productivity and persistence of stargrass are limited to lower elevations or where temperatures do not fall below -4 °C, as growth rapidly ceases with low temperatures. In its area of origin it occurs up to 2300 m altitude."

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 27 Sep 2021]	Family: Poaceae (alt. Gramineae) Subfamily: Chloridoideae Tribe: Cynodonteae Subtribe: Eleusininae

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 27 Sep 2021]	"Family: Poaceae (alt. Gramineae)"

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	**Notes**
	't Mannetje, L. & Jones, R.M. (Eds.). (1992). Plant Resources of South-East Asia. No. 4. Forages. Pudoc Scientific Publishers, Wageningen, Netherlands	"A stoloniferous sward-forming perennial without rhizomes; stolons stout, woody, lying flat on the ground"

601	Evidence of substantial reproductive failure in native habitat	n

Qsn #	Question	Answer
	Source(s)	**Notes**
	't Mannetje, L. & Jones, R.M. (Eds.). (1992). Plant Resources of South-East Asia. No. 4. Forages. Pudoc Scientific Publishers, Wageningen, Netherlands	"Stargrass occurs naturally in East and Central Africa, from Ethiopia and Sudan through Zaire to Malawi and Angola. In other parts of the tropics, including South-East Asia, it has been introduced as a fodder grass."

602	Produces viable seed	y
	Source(s)	**Notes**
	Cook, B.G., et al. (2020). Tropical Forages: an interactive selection tool – Digital ISBN 978958694234-8. https://www.tropicalforages.info/text/intro/index.html. [Accessed 27 Sep 2021]	"C. nlemfuensis genotypes produce little or no seed, whereas, generally speaking, C. aethiopicus and C. plectostachyus produce reasonable amounts of seed."
	Burton, G.W. (1993). African grasses. p. 294-298. In: J. Janick and J.E. Simon (eds.), New crops. Wiley, New York	"Stargrass is highly variable, spreads by seed and stolons but lacks rhizomes."

603	Hybridizes naturally	y
	Source(s)	**Notes**
	't Mannetje, L. & Jones, R.M. (Eds.). (1992). Plant Resources of South-East Asia. No. 4. Forages. Pudoc Scientific Publishers, Wageningen, Netherlands	"Much opportunity still exists for genetic improvement in yield and quality. Hybrids need to be produced and evaluated. Proper fertilization and management and wider use of current improved cultivars could have major impact on improving animal nutrition and for soil conservation purposes."
	Harlan, J. R., De Wet, J. M. J., & Richardson, W. L. (1969). Hybridization studies with species of Cynodon from East Africa and Malagasy. American Journal of Botany, 56(8), 944-950	[Cynodon nlemfuensis and Bermudagrass hybridize readily, though seed set in the F1 hybrids is poor] "A collection of 198 accessions of Cynodon from East Africa and Malagasy was grown in uniform nurseries at Stillwater, Okla., and classified morphologically, studied cytologically, and tested for crossabiiity in hybridization studies. The following taxa were recognized: C. arcuatus, C. plectostachyus, C. aethiopicus, C. nlemfuensis var. nlemfuensis, C. nlemfuensis var. robustus, C. dactylon var. aridus, C. dactylon var. coursii, and C. dactylon var. dactylon. The magnitude of barriers to gene flow was estimated by ease of hybridization and by sterility of the hybrids obtained. C. arcuatus and C. plectostachyus are well isolated from all other species in the genus. The others are sufficiently related that they may be intercrossed. The barriers to gene flow vary demonstrably in strength between different combinations of taxa. The magnitude of a barrier required to establish species limits is, perhaps, more a matter of subjective opinion than a scientific conclusion. It was concluded that no completely sati;:factory cla.ssification of the genus is possible. The system adopted was a compromise between classical morphological concepts of species, the biological concept of species, and pragmatic utility."

Qsn #	Question	Answer
604	**Self-compatible or apomictic**	
	Source(s)	**Notes**
	Cook, B.G., et al. (2020). Tropical Forages: an interactive selection tool – Digital ISBN 978958694234-8. https://www.tropicalforages.info/text/intro/index.html. [Accessed 29 Sep 2021]	"Evidence suggests that some types, at least of C. aethiopicus, are apomictic, while C. nlemfuensis may be outcrossing."

605	**Requires specialist pollinators**	**n**
	Source(s)	**Notes**
	Kellogg, E. A. (2015). The Families and Genera of Vascular Plants. Volume XIII. Flowering Plants. Monocots: Poaceae. Springer International Publishing, Switzerland	"Most grasses are wind-pollinated."

606	**Reproduction by vegetative fragmentation**	**y**
	Source(s)	**Notes**
	Skerman, P.J. & Riveros, F. (1990). Tropical Grasses. FAO, Rome	"It is propagated by rooted runners."
	't Mannetje, L. & Jones, R.M. (Eds.). (1992). Plant Resources of South-East Asia. No. 4. Forages. Pudoc Scientific Publishers, Wageningen, Netherlands	"Stargrass grows vigorously and roots at nodes as it spreads. Some genotypes have a bunch-habit type of growth, even though they spread by stolons."

607	**Minimum generative time (years)**	
	Source(s)	**Notes**
	CABI. (2021). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"C. nlemfuensis is a perennial fast-growing grass (Barkworth et al., 2003). In South Africa, it has been recorded flowering from January to March, but in tropical America it can flower all year long (Más and Garcia-Molinari, 2006)."
	Cook, B.G., et al. (2020). Tropical Forages: an interactive selection tool – Digital ISBN 978958694234-8. https://www.tropicalforages.info/text/intro/index.html. [Accessed 29 Sep 2021]	[A perennial. Reproductive maturity may be irrelevant if little seed production occurs. May spread vegetatively at an early stage of growth] "C. nlemfuensis genotypes produce little or no seed,"

701	**Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)**	**y**
	Source(s)	**Notes**
	CABI. (2021). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"C. nlemfuensis spreads by seeds and vegetatively by stolons and root runners. However, seed production is very poor. When produced, seeds are wind-dispersed, but they can also be dispersed attached to animals and vehicles. Seeds may also be spread as a contaminant in agricultural produce (i.e., fodder, hay, and silage). Stolons and root runners may be broken off and dispersed to new locations by humans, wild animals, livestock and vehicles (Cook et al., 2005; FAO, 2013)."

702	**Propagules dispersed intentionally by people**	**y**

Qsn #	Question	Answer
	Source(s)	**Notes**
	Smith, J. & Valenzuela, H. (2002). Stargrass. Sustainable Agriculture Cover Crops Aug. 2002, SA-CC-5. College of Tropical Agriculture and Human Resources, Honolulu, HI. www.ctahr.hawaii.edu	[Intentionally cultivated in Hawaii and elsewhere] "Use in plantation and orchard cropping systems (macadamia, coffee)"

703	Propagules likely to disperse as a produce contaminant	
	Source(s)	**Notes**
	CABI. (2021). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	[Rarely seeds] "C. nlemfuensis spreads by seeds and vegetatively by stolons and root runners. However, seed production is very poor. When produced, seeds are wind-dispersed, but they can also be dispersed attached to animals and vehicles. Seeds may also be spread as a contaminant in agricultural produce (i.e., fodder, hay, and silage). Stolons and root runners may be broken off and dispersed to new locations by humans, wild animals, livestock and vehicles (Cook et al., 2005; FAO, 2013)."

704	Propagules adapted to wind dispersal	
	Source(s)	**Notes**
	CABI. (2021). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	[Yes, if seeds are produced, but rarely produces seed] "C. nlemfuensis spreads by seeds and vegetatively by stolons and root runners. However, seed production is very poor. When produced, seeds are wind-dispersed, but they can also be dispersed attached to animals and vehicles. Seeds may also be spread as a contaminant in agricultural produce (i.e., fodder, hay, and silage). Stolons and root runners may be broken off and dispersed to new locations by humans, wild animals, livestock and vehicles (Cook et al., 2005; FAO, 2013)."

705	Propagules water dispersed	n
	Source(s)	**Notes**
	CABI. (2021). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"C. nlemfuensis spreads by seeds and vegetatively by stolons and root runners. However, seed production is very poor. When produced, seeds are wind-dispersed, but they can also be dispersed attached to animals and vehicles. Seeds may also be spread as a contaminant in agricultural produce (i.e., fodder, hay, and silage). Stolons and root runners may be broken off and dispersed to new locations by humans, wild animals, livestock and vehicles"

Qsn #	Question	Answer
706	**Propagules bird dispersed**	**n**
	Source(s)	**Notes**
	CABI. (2021). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"C. nlemfuensis spreads by seeds and vegetatively by stolons and root runners. However, seed production is very poor. When produced, seeds are wind-dispersed, but they can also be dispersed attached to animals and vehicles. Seeds may also be spread as a contaminant in agricultural produce (i.e., fodder, hay, and silage). Stolons and root runners may be broken off and dispersed to new locations by humans, wild animals, livestock and vehicles"

707	Propagules dispersed by other animals (externally)	y
	Source(s)	**Notes**
	CABI. (2021). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"C. nlemfuensis spreads by seeds and vegetatively by stolons and root runners. However, seed production is very poor. When produced, seeds are wind-dispersed, but they can also be dispersed attached to animals and vehicles. Seeds may also be spread as a contaminant in agricultural produce (i.e., fodder, hay, and silage). Stolons and root runners may be broken off and dispersed to new locations by humans, wild animals, livestock and vehicles"

708	Propagules survive passage through the gut	
	Source(s)	**Notes**
	Cook, B.G., et al. (2020). Tropical Forages: an interactive selection tool – Digital ISBN 978958694234-8. https://www.tropicalforages.info/text/intro/index.html. [Accessed 29 Sep 2021]	"Most workers agree that C. nlemfuensis prduces very low amounts of seed."
	CABI. (2021). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	[Unknown if viable seeds, when produced, are passed internally through grazing livestock] "C. nlemfuensis spreads by seeds and vegetatively by stolons and root runners. However, seed production is very poor. When produced, seeds are wind-dispersed, but they can also be dispersed attached to animals and vehicles. Seeds may also be spread as a contaminant in agricultural produce (i.e., fodder, hay, and silage). Stolons and root runners may be broken off and dispersed to new locations by humans, wild animals, livestock and vehicles"

801	Prolific seed production (>1000/m2)	n
	Source(s)	**Notes**
	Cook, B.G., et al. (2020). Tropical Forages: an interactive selection tool – Digital ISBN 978958694234-8. https://www.tropicalforages.info/text/intro/index.html. [Accessed 27 Sep 2021]	"C. nlemfuensis genotypes produce little or no seed, whereas, generally speaking, C. aethiopicus and C. plectostachyus produce reasonable amounts of seed."
	Skerman, P.J. & Riveros, F. (1990). Tropical Grasses. FAO, Rome	"Strickland (1976-77) could only obtain a 1rac.e of seed from three accessions tested at Samford, Queensland, in 1976-77."

802	Evidence that a persistent propagule bank is formed (>1 yr)	

Qsn #	Question	Answer
	Source(s)	**Notes**
	Cook, B.G., et al. (2020). Tropical Forages: an interactive selection tool – Digital ISBN 978958694234-8. https://www.tropicalforages.info/text/intro/index.html. [Accessed 29 Sep 2021]	"C. nlemfuensis genotypes produce little or no seed" [Longevity of seeds, when produced, unknown]

803	Well controlled by herbicides	y
	Source(s)	**Notes**
	CABI. (2021). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"A combination of manual and chemical methods is recommended for the management of large infestations of C. nlemfuensis. In the case of smaller infestations, plants can be cut out and all stolons must be removed. Larger infestations can be controlled by mowing the foliage and the aboveground segments of the grass. Burning is not recommended because fire can stimulate growth of new plants. Long-term control of treated areas is recommended. Re-sprouts can be sprayed with a foliar application of glyphosate (Goldstein, 2003)."
	Brighenti, A. M., Souza Sobrinho, F., & Benites, F. R. G. (2020). Differential tolerance and selectivity of herbicides in forages of the genus Cynodon. Grassland Science, 66(2), 88-94	"Among the two species of Cynodon, Tifton 85, in general, was more tolerant to the applied herbicides than was the African star grass and consequently with less probability to occur forage yield losses. The most phytotoxic herbicides for both forages were fluroxypyr + aminopyralid (160.0 + 80.0 g ae/ha [grams of acid equivalent per hectare]), fluroxypyr + triclopyr (320.0 + 960.0 g ae/ha) and glyphosate (180 g ae/ha). The most selective herbicides were bentazon (720.0 g ai/ha [grams of active ingredient per hectare]), imazapyr (25.0 g ai/ha) and MSMA (1,440.0 g ai/ha), which have potential for use in fields of Tifton 85 and African star grass."

804	Tolerates, or benefits from, mutilation, cultivation, or fire	y
	Source(s)	**Notes**
	Cook, B.G., et al. (2020). Tropical Forages: an interactive selection tool – Digital ISBN 978958694234-8. https://www.tropicalforages.info/text/intro/index.html. [Accessed 29 Sep 2021]	"Plants recover quickly after fire, and can even benefit through spittlebug and disease control by fire."
	't Mannetje, L. & Jones, R.M. (Eds.). (1992). Plant Resources of South-East Asia. No. 4. Forages. Pudoc Scientific Publishers, Wageningen, Netherlands	[Tolerates grazing, but can be reduced by overgrazing] "It can be grazed year-round if temperatures and rainfall are favourable. Overgrazing will decrease stands."

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	**Notes**
	WRA Specialist. (2021). Personal Communication	Unknown

Summary of Risk Traits:

High Risk / Undesirable Traits
• Grows and spreads in regions with tropical climates
• Naturalized on Molokai, Maui, and Hawaii (Hawaiian Islands) and widely naturalized elsewhere
• Identified as a weedy grass of disturbed areas, sandy places, along roadsides, arable land, and perennial crops
• A potential environmental weed
• Other Cynodon species have become invasive
• When cultivated in the shade, can accumulate cyanide acid, and cause cyanogenic poisoning in cattle (rarely)
• Tolerates many soil types
• Forms dense swards that could inhibit other vegetation
• Reproduces by seeds (rarely) and vegetatively by stolons
• Hybridizes with Bermudagrass
• Seeds, when produced, may be dispersed by wind, attached to animals and vehicles, as a contaminant in agricultural produce and intentionally by people
• Stolon pieces may be dispersed by humans, wild animals, livestock, and vehicles
• Tolerates grazing and fire

Low Risk Traits
• Despite reports of weediness elsewhere, negative impacts have not been reported in the Hawaiian Islands
• Unarmed (no spines, thorns, or burrs)
• Valued as forage grass for livestock
• Relatively shade-intolerant (dense shade or cover may inhibit spread)
• Limited or absent seed production may limit long-distance dispersal
• Herbicides may provide effective control