Taxon: Bothriochloa ischaemum (L.) Keng **Family:** Poaceae

Common Name(s): yellow bluestem **Synonym(s):** Amphilophis ischaemum (Linnaeus)
Andropogon ischaemum Linnaeus

Assessor: Chuck Chimera **Status:** Assessor Approved **End Date:** 7 Mar 2022

WRA Score: 19.0 **Designation:** H(HPWRA) **Rating:** High Risk

Keywords: Perennial Grass, Environmental Weed, Palatable, Monoculture, Apomictic

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

Qsn #	Question	Answer Option	Answer
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y=1, n=0	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	y=1, n=-1	y
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	y
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	2
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	y=1, n=-1	y
704	Propagules adapted to wind dispersal		
705	Propagules water dispersed		
706	Propagules bird dispersed	y=1, n=-1	n
707	Propagules dispersed by other animals (externally)	y=1, n=-1	n
708	Propagules survive passage through the gut		
801	Prolific seed production (>1000/m2)	y=1, n=-1	y
802	Evidence that a persistent propagule bank is formed (>1 yr)	y=1, n=-1	n
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**
	Quattrocchi, U. (2006). CRC World Dictionary of Grasses: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	[No evidence] "South Europe, Algeria, Asia temperate and tropical, India, China, Nepal, Central or Southern Asia. Perennial, upright to semiprostrate bunchgrass, tussocks-forming, sheaths shorter than the internodes, ligule hairy, inflorescences digitate, terminal and palmate clusters of panicles, papery paired spikelets, lower glumes nonpitted, lemmas awned, long twisted awns, weed species, cultivated and naturalized, used for pasture and hay, good pasturage native pasture species, drought-resistant, potential seed contaminant, no tolerance to flooding, found in dry stony places, slopes, field"

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

103	**Does the species have weedy races?**	
	Source(s)	**Notes**
	WRA Specialist. (2022). Personal Communication	NA

201	**Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"**	**High**
	Source(s)	**Notes**
	Quattrocchi, U. (2006). CRC World Dictionary of Grasses: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"South Europe, Algeria, Asia temperate and tropical, India, China, Nepal, Central or Southern Asia."

202	**Quality of climate match data**	**High**
	Source(s)	**Notes**
	Quattrocchi, U. (2006). CRC World Dictionary of Grasses: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"South Europe, Algeria, Asia temperate and tropical, India, China, Nepal, Central or Southern Asia."

203	**Broad climate suitability (environmental versatility)**	**y**
	Source(s)	**Notes**
	Flora of North America Editorial Committee, eds. (1993+).Flora of North America North of Mexico [Online]. 22+ vols. New York and Oxford. http://beta.floranorthamerica.org. [Accessed 4 Mar 2022]	"Bothriochloa ischaemum. grows along roadsides and in waste ground and rangeland pastures, at 50-1200 m. It is native to southern Europe and Asia."

Qsn #	Question	Answer
	Cook, B.G., et al. (2022). Tropical Forages: an interactive selection tool – Digital ISBN 978958694234-8. https://www.tropicalforages.info/text/intro/index.html. [Accessed 4 Mar 2022]	"Moisture - Annual rainfall over its natural distribution ranges from 350 to 500 mm, and it is naturalized in areas receiving up to 1,000 mm. It is drought resistant, but has no tolerance of flooding. Temperature - Occurs naturally between about 35 and 50º N in Asia and Europe, with outliers at about 24º N in Taiwan. Naturalized between about 30 and 38º N in USA at c. 300 m asl and at 10º N at 1,500–1,800 m asl in Costa Rica. This distribution suggests best adapted to areas with an average annual temperature of between 10 and 17 ºC, extending to about 20 ºC in some cases. Extremely cold winters are experienced over most of its distribution."
	Quattrocchi, U. (2006). CRC World Dictionary of Grasses: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	[Broad distribution and range of climates] "South Europe, Algeria, Asia temperate and tropical, India, China, Nepal, Central or Southern Asia."

204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	**Notes**
	Quattrocchi, U. (2006). CRC World Dictionary of Grasses: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"South Europe, Algeria, Asia temperate and tropical, India, China, Nepal, Central or Southern Asia."

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	**Notes**
	Harmoney, K. R., Stahlman, P. W., & Hickman, K. R. (2004). Herbicide effects on established yellow old world bluestem (Bothriochloa ischaemum). Weed Technology, 18(3), 545-550	"Old world bluestems (OWB) ['Yellow' -Bothriochloa ischaemum (L.) Keng; 'Caucasian' -Bothrichloa bladhii (Retz) S.T. Blake] have been widely introduced in the southern and central Great Plains of the United States as warm-season perennial grasses for soil stabilization in Conservation Reserve Program (CRP) fields, road rights-of-way, and as pasture or hay for animal consumption."

301	Naturalized beyond native range	y
	Source(s)	**Notes**
	Quattrocchi, U. (2006). CRC World Dictionary of Grasses: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"cultivated and naturalized"
	Hatch, S. L., Umphres, K. C., & Ardoin, A. J. (2016). Field Guide to Common Texas Grasses. Texas A&M University Press, College Station, TX	"Introduced from Asia to King Ranch, near Kingsville, it has spread and been seeded throughout Texas. Poor to fair forage. An aggressive weed in many situations; an invasive grass."
	USDA, Agricultural Research Service, National Plant Germplasm System. (2022). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 3 Mar 2022]	"Naturalized (natzd. elsewhere)"
	Cook, B.G., et al. (2022). Tropical Forages: an interactive selection tool – Digital ISBN 978958694234-8. https://www.tropicalforages.info/text/intro/index.html. [Accessed 4 Mar 2022]	"Naturalized: Naturalized elsewhere, including North America"

Qsn #	Question	Answer
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"References: Costa Rica-I-975, Global-NZW-85, Global-W-90, United States of America-N-101, Chile-N-241, Japan-N-287, China-W-297, China-A-275, United States of America-E-80, United Kingdom-UZD-317, China-W-431, India-A-712, Mexico-N-791, Japan-N-794, Costa Rica-N-872, Mexico-I-878, Europe-A-889, India-I-914, France-N-1006, Europe-N-819, Belgium-ZD-1220, Burma-Myanmar-A-1254, Japan-N-1278, south and southeast Asia-A-1320, Global-W-1324, Global-W-1349, India-I-1389, Turkey--1412, Brazil-N-1597, Iraq-A-87, Caribbean Netherlands-N-1012, Pakistan-A-1044, Brazil-N-1733, Eastern Caribbean-N-1742, Bolivia-N-1753, Bolivia-N-1796, Colombia-N-1796, Colombia-N-1856, South Korea-A-1860, Chile-I-1872, Argentina-A-1874, Mexico-N-1881, Anguilla-W-1977, Bhutan-W-1977, Bolivia-W-1977, Bonaire-W-1977, Chile-W-1977, Costa Rica-W-1977, Japan-W-1977, Mexico-W-1977, Spain-W-1977."

302	Garden/amenity/disturbance weed	
	Source(s)	**Notes**
	CABI. (2022). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"B. ischaemum can readily escape original planting sites where it can invade native rangelands, with negative ecological and economic consequences such as the formation of monocultures and the loss of native biodiversity. This species is a particular problem in Texas where dense monocultures are displacing native grass species."
	Brown, W. V., & Emery, W. H. P. (1957). Apomixis in the Gramineae, Tribe Andropogoneae: Themeda triandra and Bothriochloa ischaemum. Botanical Gazette, 118(4), 246–253	"B. ischaemum, on the other hand, is a somewhat weedy type of grass, common in disturbed areas along roadsides, on abandoned farms, and in open semiarid lands." [A disturbance-adapted weed that impacts natural ecosystems. See 3.04]

303	Agricultural/forestry/horticultural weed	
	Source(s)	**Notes**
	CABI. (2022). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"B. ischaemum is regarded as an invasive and weedy species in many areas of North America, and control is often difficult to achieve and can be costly (Mittelhauser et al., 2011; Ruffner and Barnes, 2012)."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Weed of: Cereals, Orchards & Plantations, Pastures"
	USDA Forest Service. (2018). Field Guide for Managing Yellow and Caucasian (Old World) Bluestems in the Southwest. Southwestern Region TP-R3-16-36, Albuquerque, NM	[May impact pasture productivity] "Heavy OWB infestations in pastures or native grassland may require changes in grazing management practices. Mature patches of OWBs are typically avoided by grazing animals, which can cause accumulation of residual dead standing material that is also avoided. High levels of dry matter accumulated in these patches may be prone to wildfire."
	Brown, W. V., & Emery, W. H. P. (1957). Apomixis in the Gramineae, Tribe Andropogoneae: Themeda triandra and Bothriochloa ischaemum. Botanical Gazette, 118(4), 246–253	[Weedy grass also used in pastures] "B. ischaemum, on the other hand, is a somewhat weedy type of grass, common in disturbed areas along roadsides, on abandoned farms, and in open semiarid lands." ... "Propagated under various varietal names during the last 40 years, it is today a rather successful and well-accepted pasture grass of the southwestern United States."

304	Environmental weed	y

Qsn #	Question	Answer
	Source(s)	**Notes**
	Sammon, J. G., & Wilkins, K. T. (2005). Effects of an invasive grass (Bothriochloa ischaemum) on a grassland rodent community. Texas Journal of Science, 57(4), 371-382	" Abstract. -- The rodent assemblages in prairie dominated by native grasses and in prairie dominated by the exotic King Ranch bluestem (Bothriochloa ischaemum) in central Texas were compared to determine if non-native prairie supported a less species-rich rodent fauna than native prairie. Species richness was greatest in the native Muhlenbergia habitat (three species) and least in the non-native King Ranch bluestem habitat (one species). Densities of the hispid cotton rat (Sigmodon hispidus) were significantly greater in the Muhlenbergia habitat than in King Ranch bluestem. Relative abundance of S. hispidus correlated significantly with cover provided by dead material, Muhlenbergia, and by "other grasses" comprising a relatively small proportion of the prairie flora."
	CABI. (2022). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"B. ischaemum is a warm seasoned perennial grass in the Poaceae family which is native to Europe, Asia and Africa. There are two varities of B. ischaemum, var. ischaemum and B. ischaemum var. songarica, which have different native ranges and have been introduced into different countries. This species was introduced into the North American Great Plains in the 1920s to tackle soil erosion and for forage production. This species has since been planted onto millions of hectares of marginal rangeland, roadsides and Conservation Reserve Program lands (Harmoney et al., 2004). B. ischaemum can readily escape original planting sites where it can invade native rangelands, with negative ecological and economic consequences such as the formation of monocultures and the loss of native biodiversity. This species is a particular problem in Texas where dense monocultures are displacing native grass species."
	Hatch, S. L., Umphres, K. C., & Ardoin, A. J. (2016). Field Guide to Common Texas Grasses. Texas A&M University Press, College Station, TX	"Introduced from Asia to King Ranch, near Kingsville, it has spread and been seeded throughout Texas. Poor to fair forage. An aggressive weed in many situations; an invasive grass."
	USDA Forest Service. (2018). Field Guide for Managing Yellow and Caucasian (Old World) Bluestems in the Southwest. Southwestern Region TP-R3-16-36, Albuquerque, NM	"Once established, OWBs can be highly invasive and have the potential to form biodiversity-inhibiting monocultures that can transform grassland vegetation at the community and ecosystem levels of organization. OWB monocultures lack the necessary variety in structure, seasonality of growth, and nutritional availability required to sustain a diverse fauna. Floral diversity may be impacted directly by OWBs through physical displacement, competition, etc. Habitats of some Threatened and Endangered (T&E) species in particular can be threatened by OWBs. In combination with other less desirable non-native grass species such as Lehmann lovegrass (Eragrostis lehmanniana), OWBs may form a complex that can act similarly to a monoculture."
	Robertson, S., Hickman, K. R., Harmoney, K. R., & Leslie Jr, D. M. (2013). Combining glyphosate with burning or mowing improves control of yellow bluestem (Bothriochloa ischaemum). Rangeland Ecology & Management, 66(3), 376-381	"Recent research has shown that monocultures of yellow bluestem reduce diversity and abundance of native plant communities (Gabbard and Fowler 2007), grassland birds and arthropods (Hickman et al. 2007), small mammals (Sammon and Wilkins 2005), and swift fox (Vulpes velox) (Kamler et al. 2003). Undesirable effects of yellow bluestem invasion have prompted land managers to seek methods for controlling it and restoring native vegetation."

305	**Congeneric weed**	**y**

Qsn #	Question	Answer
	Source(s)	**Notes**
	CABI. (2022). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"Bothriochloa pertusa (pitted beard grass) B. pertusa is a perennial grass native to eastern and southern Asia. It has been widely introduced outside Asia, in the Americas, Australia and the Pacific, either accidentally or probably in some cases deliberately for use as a forage grass. It has established itself in many habitats where it is able to out-compete native species due to its ability to establish dense mats and shade out slower establishing species. In Australia it is now an established invasive species in both the Northern Territory and central Queensland. It is similarly regarded as invasive in Mexico, in Cuba, Puerto Rico, the Dominican Republic, Anguilla and the Cayman Islands in the Caribbean, in Mauritius, and in New Caledonia, the Marquesas Islands, Midway Atoll and Hawaii in the Pacific. In Hawaii, it is among species threatening the endangered plants Spermolepis hawaiiensis and Wilkesia hobdyi. Through its effects on native vegetation, it likewise threatens the endangered lizard Ameiva polops in the US Virgin Islands, and affects populations of ants and birds in Australia."
	Quattrocchi, U. (2006). CRC World Dictionary of Grasses: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	[B. pertusa] "vigorous weed species, sometimes difficult to eradicate, rather common in disturbed as well as undisturbed areas, in moderately damp areas, along roadsides and in rather dry areas, grassland on clay soils and open woodland, limestone, loamy soils, open disturbed roadsides, dry pastures,"

401	Produces spines, thorns or burrs	n
	Source(s)	**Notes**
	Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds.). (2006). Flora of China. Vol. 22 (Poaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[No evidence] "Perennial, tussocky from a branching rootstock. Culms slender, erect or geniculately ascending, 25–70 cm tall, 3–6 -noded, nodes glabrous or appressed bearded. Leaf sheaths keeled, congested at plant base; leaf blades linear, 5–16 × 0.2–0.3 cm, usually sparingly hairy with tubercle-based hairs, apex acuminate; ligule ca. 1 mm. Inflorescence composed of 5–15 racemes, subdigitate or inserted on a brief axis; racemes 3–7 cm, silvery-green or tinged purplish brown; rachis internodes and pedicels ciliate with long white or pinkish silky hairs. Sessile spikelet 4–5 mm; lower glume oblong-lanceolate, usually cartilaginous, sometimes herbaceous, back flat to slightly concave, 5–7-veined, silky-pilose below middle, lacking a pit, margins keeled and stiffly ciliate near apex; awn of upper lemma 1–1.5 cm. Pedicelled spikelet male or barren, subequal to sessile spikelet, glabrous."

402	Allelopathic	
	Source(s)	**Notes**
	Greer, M. J., Wilson, G. W., Hickman, K. R., & Wilson, S. M. (2014). Experimental evidence that invasive grasses use allelopathic biochemicals as a potential mechanism for invasion: chemical warfare in nature. Plant and Soil, 385 (1), 165-179	[Possibly. Demonstrated under experimental conditions] "Results Application of B. ischaemum leachate or litter significantly reduced the germination, growth, and survival of both A. gerardii and S. scoparium but had no conspecific effects, while A. gerardii treatments had no effect on any species."

Qsn #	Question	Answer
403	**Parasitic**	**n**
	Source(s)	**Notes**
	Quattrocchi, U. (2006). CRC World Dictionary of Grasses: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"Perennial, upright to semiprostrate bunchgrass, tussocks-forming" [No evidence]

404	Unpalatable to grazing animals	n
	Source(s)	**Notes**
	Cook, B.G., et al. (2022). Tropical Forages: an interactive selection tool – Digital ISBN 978958694234-8. https://www.tropicalforages.info/text/intro/index.html. [Accessed 4 Mar 2022]	"Palatability/acceptability - Grazed fairly readily by cattle and sheep."
	Quattrocchi, U. (2006). CRC World Dictionary of Grasses: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"used for pasture and hay, good pasturage"

405	Toxic to animals	n
	Source(s)	**Notes**
	Cook, B.G., et al. (2022). Tropical Forages: an interactive selection tool – Digital ISBN 978958694234-8. https://www.tropicalforages.info/text/intro/index.html. [Accessed 4 Mar 2022]	"Toxicity - No toxicity has been reported."

406	Host for recognized pests and pathogens	y
	Source(s)	**Notes**
	Cook, B.G., et al. (2022). Tropical Forages: an interactive selection tool – Digital ISBN 978958694234-8. https://www.tropicalforages.info/text/intro/index.html. [Accessed 4 Mar 2022]	"Bothriochloa ischaemum is subject to infection by leaf rust disease caused by two different fungi, Puccinia cesatii and Puccinia pseudocesatii. Smut diseases caused by Sporisorium andropogonis (Sphacelotheca andropogonis) and Ustilago amadelpha have also been recorded. It is also a host to the red-streaked leafhopper (Balclutha rubrostriata), a vector for the phytoplasma that causes the serious Sugarcane White Leaf Disease (SCWL). The association between King Ranch Bluestem (B. ischaemum var. songarica) and the red-streaked leafhopper is of considerable concern with sugar cane producers in the southern USA."

Qsn #	Question	Answer
	Omkar & Tripathi, A. K. (2020). Sucking Pests of Sugarcane. In Sucking Pests of Crops (pp. 135-151). Springer, Singapore	"The yellow sugarcane aphid was first described as Chaitophorus flavus Forbes and later moved to Sipha flava (Forbes) (Blackman and Eastop 1984). It feeds on many plant species, which incorporate several diverse families such as Cyperaceae, Poaceae and Commelinaceae (Blackman and Eastop 1984). Economically important crops infected by this aphid include sorghum, sugarcane, wheat, barley, rye and other cereal crops, as well as many species of pasture grasses (Blackman and Eastop 1984). Worldwide many hosts for S. flava are reported including Sorghum halepense (Johnsongrass), Pennisetum clandestinum (kikuyu grass), Digitaria ciliaris (crabgrass), Cymbopogon citratus (lemongrass), species from the genera Panicum, Cynodon, Paspalum, Hordeum and Bothriochloa ischaemum, and the crops wheat, barely, maize, Avena (oats) and rice. Carex and Cyperus from the Cyperaceae, and various pasture grasses, are also hosts."

407	Causes allergies or is otherwise toxic to humans	n
	Source(s)	**Notes**
	Cook, B.G., et al. (2022). Tropical Forages: an interactive selection tool – Digital ISBN 978958694234-8. https://www.tropicalforages.info/text/intro/index.html. [Accessed 4 Mar 2022]	"No toxicity has been reported."

408	Creates a fire hazard in natural ecosystems	y
	Source(s)	**Notes**
	Zouhar, K., Smith, J.K., Sutherland, S. & Brooks, M.L.2008. Wildland fire in ecosystems: fire and nonnative invasive plants. Gen. Tech. Rep. RMRS-GTR-42-vol. 6. USDA Forest Service, Rocky Mountain Research Station, Ogden, UT	"Several nonnative perennial grasses have been introduced to increase forage value of rangelands or pastures in the Central bioregion. Among these, cogongrass, yellow bluestem (Bothriochloa ischaemum), Caucasian bluestem (fig. 7-4), guineagrass, and Johnson grass may pose some threat to southern tallgrass prairies. All of these species are at least partially adapted to fire, and most are capable of remaining in late-successional grasslands. Several of the invasive grasses found in the coastal tallgrass prairie are actually a greater threat in other formations, particularly the southern mixedgrass prairie."

Qsn #	Question	Answer
	Reemts, C. M., Picinich, C., & Greene, T. A. (2021). Late-Summer Fire Provides Long-Term Control of the Invasive Old World Bluestem (Bothriochloa ischaemum). Southeastern Naturalist, 20(4), 589-601	[Fire may provide some control and reduce high fuel loads] "Abstract - Bothriochloa ischaemum (Old World Bluestem) is a problematic invasive grass throughout the southern United States. We measured the long-term effects (12 years) of a single growing-season fire (September 2006) in a grassland dominated by Old World Bluestem. Prescribed fire drastically reduced Old World Bluestem cover (prefire: 76 ± 4% [mean ± standard error], 2007: 8 ± 2%) and cover remained low (21 ± 6%) in 2018 with no additional management. Surprisingly, Old World Bluestem cover in unburned plots decreased 12% during the same time. After the burn, native graminoid cover peaked after 3 years (29 ± 7%) but decreased to 18 ± 5% by 2018, and native annual forb cover, almost absent before the fire, increased dramatically to 39 ± 7% in 2007, then quickly decreased to pre-burn levels. Native perennial forb cover more than doubled in 2007 and continued to increase to 58 ± 5% in 2018. A single growing-season fire greatly reduced the cover of Old World Bluestem, likely due to high fuel loads, low rainfall, and phenological timing; the fire also allowed perennial forbs to establish. Restoring dominance of native grasses after removal of this invasive species will require additional active restoratio n such as seeding or planting."
	Hickman, K. R., Goodman, L., Elmore, D., Buthod, A., Duell, E. B., & Craun, J. N. (2018). Oklahoma's dirty dozen: Unwanted invasive plants. Oklahoma Cooperative Extension Service, Stillwater, Oklahoma	[Presumably would increase fire risk in habitats where monocultures are formed] "Where established, yellow bluestem can form monocultures." ... "Fire alone is not recommended as a control measure because yellow bluestem has a similar fire-tolerance as native warm-season species found in the Great Plains."

409	Is a shade tolerant plant at some stage of its life cycle	n
	Source(s)	**Notes**
	USDA Forest Service. (2018). Field Guide for Managing Yellow and Caucasian (Old World) Bluestems in the Southwest. Southwestern Region TP-R3-16-36, Albuquerque, NM	"Are warm-season, perennial bunchgrasses that are relatively shade-intolerant"
	Gabbard, B. L. (2003). The population dynamics and distribution of the exotic grass, Bothriochloa ischaemum. PhD Dissertation. The University of Texas at Austin	"The only habitat in which B. ischaemum was never found was under the canopies of woody plants."
	Hilty, J. (2022). Grasses, Sedges, and Non-Flowering Plants of Illinois. Old World Bluestem - Bothriochloa ischaemum. https://www.illinoiswildflowers.info/. [Accessed 4 Mar 2022]	"The preference is full sun, mesic to dry conditions, and relatively barren soil containing some sand, gravel, or clay."

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
	Source(s)	**Notes**
	Cook, B.G., et al. (2022). Tropical Forages: an interactive selection tool – Digital ISBN 978958694234-8. https://www.tropicalforages.info/text/intro/index.html. [Accessed 4 Mar 2022]	"Adapted to well-drained sandy soils (not deep sands), loams and clays. Prefers fine-textured, calcareous soils, and has some tolerance to low available iron. Has some salt tolerance, growing naturally onto saline solonetz soils. In Texas, said to prefer disturbed mesic, upland soils."

Qsn #	Question	Answer
	Skerman, P.J. & Riveros, F. (1990). Tropical Grasses. FAO, Rome	"Soil requirements. ' Plains Blue-stem' is adapted to a wide range of soils from well-drained good sandy soils to loam and clay loam soils, but not to deep sands. It has some tolerance to soils which produce iron chlorosis. It prefers limestone soils."

411	Climbing or smothering growth habit	n
	Source(s)	**Notes**
	Quattrocchi, U. (2006). CRC World Dictionary of Grasses: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"Perennial, upright to semiprostrate bunchgrass, tussocks-forming"

412	Forms dense thickets	y
	Source(s)	**Notes**
	CABI. (2022). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"B. ischaemum can form dense monocultures which may outcompete native plant species and decrease habitats occupied by native wildlife (Afflerbach, 2013). This reduction can potentially threaten endangered species and cause a loss to native species (George et al., 2013; Greer, 2013). "
	City of Austin. (2013). Invasive Species Management Plan. Field Resources. http://www.austintexas.gov. [Accessed 4 Mar 2022]	"In open areas, non-native grasses can form large monocultures that hamper and outcompete native plants."
	Dee, J. R., Thomas, S. M., Thompson, S. D., & Palmer, M. W. (2016). Long-term late season mowing maintains diversity in southern US tallgrass prairie invaded by Bothriochloa ischaemum. Applied Vegetation Science, 19 (3), 442-453	"The exotic invasive, B. ischaemum, was present in dense stands in some parts of the site." ... "Evident in this study is the negative correlation between BOIS cover and species richness. In a previous study BOIS was found to have strong plant diversity reducing effects, especially in study plots where BOIS dominated to form dense monoculture-like stands (Gabbard & Fowler 2007)."
	Hickman, K. R., Goodman, L., Elmore, D., Buthod, A., Duell, E. B., & Craun, J. N. (2018). Oklahoma's dirty dozen: Unwanted invasive plants. Oklahoma Cooperative Extension Service, Stillwater, Oklahoma	"Where established, yellow bluestem can form monocultures. Monocultures fail to provide the variety in structure, seasonality of growth and food plant availability required by diverse wildlife species. Pastures invaded by yellow bluestem attract fewer insects, a vital part of the food chain, compared to native pastures because they lack forbs. Forbs attract more insects than wind-pollinated grasses. This ultimately leads to lower songbird diversity due to the lack of available food. This reduction in forbs can also affect native pollinators like bees and butterflies."

501	Aquatic	n
	Source(s)	**Notes**
	Quattrocchi, U. (2006). CRC World Dictionary of Grasses: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	[Terrestrial] "found in dry stony places, slopes, field"

502	Grass	y
	Source(s)	**Notes**

Qsn #	Question	Answer
	USDA, Agricultural Research Service, National Plant Germplasm System. (2022). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 3 Mar 2022]	Family: Poaceae (alt. Gramineae) Subfamily: Panicoideae Tribe: Andropogoneae Subtribe: Anthristiriinae

503	Nitrogen fixing woody plant	n
	Source(s)	**Notes**
	USDA, Agricultural Research Service, National Plant Germplasm System. (2022). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 3 Mar 2022]	"Family: Poaceae (alt. Gramineae) Subfamily: Panicoideae Tribe: Andropogoneae Subtribe: Anthristiriinae"

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	**Notes**
	Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds.). (2006). Flora of China. Vol. 22 (Poaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Perennial, tussocky from a branching rootstock."

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	**Notes**
	Quattrocchi, U. (2006). CRC World Dictionary of Grasses: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"South Europe, Algeria, Asia temperate and tropical, India, China, Nepal, Central or Southern Asia." [No evidence. Widely distributed and naturalized]

602	Produces viable seed	y
	Source(s)	**Notes**
	Skerman, P.J. & Riveros, F. (1990). Tropical Grasses. FAO, Rome	"Ability to spread naturally. It volunteers readily from seed."
	CABI. (2022). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"It produces an abundant seed bank (20-40kg of seed per hectare) which can survive a long time"
	USDA Forest Service. (2018). Field Guide for Managing Yellow and Caucasian (Old World) Bluestems in the Southwest. Southwestern Region TP-R3-16-36, Albuquerque, NM	"Readily germinate from seed and establish reproducing populations within one growing season; such features are highly desirable for hay production. Both OWB species are prolific seed producers, and extensive seed banks can develop in soil."

Qsn #	Question	Answer
603	**Hybridizes naturally**	**y**
	Source(s)	**Notes**
	Harlan, J. R. (1963). Natural Introgression between Bothriochloa ischaemum and B. intermedia in West Pakistan. Botanical Gazette, 124(4), 294–300	"Morphologically, taxonomically, and cytogenetically, Bothriochloa ischaemum (L.) Keng is a "good" species over nearly the whole of its natural range, but in the foothills of northern West Pakistan the distinctions between it and B. intermedia (R. Br.) A. Camus break down almost completely as a result of extensive introgressive hybridization induced by human disturbance of the natural habitat."

604	**Self-compatible or apomictic**	**y**
	Source(s)	**Notes**
	Connor, H. E. (1979). Breeding systems in the grasses: a survey. New Zealand Journal of Botany, 17(4): 547-574	"In Bothriochloa, which with Dichanthium is considered as one agamic complex, there are three diploid species and the hexaploid B. ambigua which reproduce sexually. The other species, B. insculpata, B. ischaemum, and B. pertusa, are obligately aposporous, pseudogamous apomicts (Harlan et al. 1964)."

605	**Requires specialist pollinators**	**n**
	Source(s)	**Notes**
	Connor, H. E. (1979). Breeding systems in the grasses: a survey. New Zealand Journal of Botany, 17(4): 547-574	"B. insculpata, B. ischaemum, and B. pertusa, are obligately aposporous, pseudogamous apomicts (Harlan et al. 1964)."
	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."
	Hilty, J. (2022). Grasses, Sedges, and Non-Flowering Plants of Illinois. Old World Bluestem - Bothriochloa ischaemum. https://www.illinoiswildflowers.info/. [Accessed 4 Mar 2022]	"The blooming period occurs from late summer into the fall, lasting about 2 weeks. The florets are cross-pollinated by the wind. Fertile perfect florets are replaced by grains (about 3.0 mm. in length) that are narrowly ellipsoid and somewhat flattened in shape; the grain exteriors are usually covered with short fine hairs."

606	**Reproduction by vegetative fragmentation**	**y**
	Source(s)	**Notes**
	AggieTurf. (2014). King Ranch Bluestem. https://aggieturf.tamu.edu/turfgrass-weeds/king-ranch-bluestem/. [Accessed 7 Mar 2022]	"Description: Plants can begin as a bunch-type growth habit, but then spreading by rhizomes and/or stolons, especially in mowed turf."
	Hatch, S. L., Umphres, K. C., & Ardoin, A. J. (2016). Field Guide to Common Texas Grasses. Texas A&M University Press, College Station, TX	[May spread vegetatively when stoloniferous] "Tufted, rarely stoloniferous perennials. Culms to 80 cm long, erect or decumbent or prostrate, slender, becoming stoloniferous under close grazing or cutting; nodes bearded."
	Cook, B.G., et al. (2022). Tropical Forages: an interactive selection tool – Digital ISBN 978958694234-8. https://www.tropicalforages.info/text/intro/index.html. [Accessed 7 Mar 2022]	[Possibly under certain conditions] "Plants usually caespitose (matted or tufted), occasionally stoloniferous or almost rhizomatous under close grazing or cutting."

607	**Minimum generative time (years)**	**2**

Qsn #	Question	Answer
	Source(s)	**Notes**
	Skerman, P.J. & Riveros, F. (1990). Tropical Grasses. FAO, Rome	"It is a warm-season perennial bunch grass, sometimes forming a sod. It grows to 0.3-0.5 m with creeping root-stock, erect culms, simple or sparingly branched above, glabrous or pubescent at nodes. Leaves glaucous, hairy at base." [Conservatively estimating maturity is reached between one and two years of growth, but maturity may be reached earlier]

701	**Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)**	**y**
	Source(s)	**Notes**
	Gabbard, B. L. (2003). The population dynamics and distribution of the exotic grass, Bothriochloa ischaemum. PhD Dissertation. The University of Texas at Austin	"B. ischaemum was more often, although not exclusively, found in plots near roads, probably because roads facilitate seed dispersal."
	CABI. (2022). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"Seeds can be accidentally transported on vehicles, clothing, including footwear and in contaminated seed of forage grass"

702	**Propagules dispersed intentionally by people**	**y**
	Source(s)	**Notes**
	CABI. (2022). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"B. ischaemum is primarily spread by humans as it is intentionally introduced into new areas as a possible source of forage for cattle and for soil stabilization as a component of roadside vegetation."

703	**Propagules likely to disperse as a produce contaminant**	**y**
	Source(s)	**Notes**
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Major Pathway/s: Contaminant, Crop, Herbal, Ornamental, Pasture"
	CABI. (2022). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"Seeds can be accidentally transported on vehicles, clothing, including footwear and in contaminated seed of forage grass"

704	**Propagules adapted to wind dispersal**	
	Source(s)	**Notes**
	Hilty, J. (2022). Grasses, Sedges, and Non-Flowering Plants of Illinois. Old World Bluestem - Bothriochloa ischaemum. https://www.illinoiswildflowers.info/. [Accessed 4 Mar 2022]	"Because the grains are very light, they can be blown about by the wind in open areas."
	Gabbard, B. L. (2003). The population dynamics and distribution of the exotic grass, Bothriochloa ischaemum. PhD Dissertation. The University of Texas at Austin	"This species has no apparent adaptations for animal or wind dispersal and does not have a seed bank; pers. obs." [Not adapted for wind dispersal, but small size may enable seeds to be dispersed by wind]

705	**Propagules water dispersed**	
	Source(s)	**Notes**

Qsn #	Question	Answer
	CABI. (2022). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"Natural dispersal of B. ischaemum typically occurs via the translocation of seeds by winds and water movement"
	Gabbard, B. L. (2003). The population dynamics and distribution of the exotic grass, Bothriochloa ischaemum. PhD Dissertation. The University of Texas at Austin	(This species has no apparent adaptations for animal or wind dispersal and does not have a seed bank; pers. obs.). [Although may be dispersed by water if growing near riparian areas]

706	Propagules bird dispersed	n
	Source(s)	**Notes**
	Gabbard, B. L. (2003). The population dynamics and distribution of the exotic grass, Bothriochloa ischaemum. PhD Dissertation. The University of Texas at Austin	"This species has no apparent adaptations for animal or wind dispersal and does not have a seed bank; pers. obs."

707	Propagules dispersed by other animals (externally)	n
	Source(s)	**Notes**
	Gabbard, B. L. (2003). The population dynamics and distribution of the exotic grass, Bothriochloa ischaemum. PhD Dissertation. The University of Texas at Austin	"This species has no apparent adaptations for animal or wind dispersal and does not have a seed bank; pers. obs." [Small size may allow for some attachment, but attachment to animals is presumably not an important way seeds are dispersed]

708	Propagules survive passage through the gut	
	Source(s)	**Notes**
	WRA Specialist. (2022). Personal Communication	Unknown if viable seeds survive consumption by livestock

801	Prolific seed production (>1000/m2)	y
	Source(s)	**Notes**
	Gabbard, B. L. (2003). The population dynamics and distribution of the exotic grass, Bothriochloa ischaemum. PhD Dissertation. The University of Texas at Austin	"In the control plots, plants set about 8691 seeds/m2 in 1998 and 1470 seeds/m2 in 1999."
	Yu, W. J., Jiao, J. Y., Wang, D. L., Wang, N., Wang, Z. J., & Zhao, H. K. (2016). Seed population dynamics on abandoned slopes in the hill and gully Loess Plateau region of China. Ecological Engineering, 94, 427-436	"Table 4 Relationships between total seed bank and seed output" [Bothriochloa ischaemum (Linn.) Keng - Total seed bank density (seeds m−2) = 1799]

802	Evidence that a persistent propagule bank is formed (>1 yr)	n
	Source(s)	**Notes**
	Gabbard, B. L. (2003). The population dynamics and distribution of the exotic grass, Bothriochloa ischaemum. PhD Dissertation. The University of Texas at Austin	"This species does not have a seed bank (B. Gabbard unpublished data), so the seeds set during the growing season of a given year were the only source of new recruits to the population for that year.'

803	Well controlled by herbicides	y
	Source(s)	**Notes**

Qsn #	Question	Answer
	Harmoney, K. R., Stahlman, P. W., & Hickman, K. R. (2004). Herbicide effects on established yellow old world bluestem (Bothriochloa ischaemum). Weed Technology, 18(3), 545-550	"Abstract: Nine herbicides were tested in a field trial during 2001 and 2002 for the ability to suppress growth of established plants of yellow old world bluestem (OWB) that had invaded native vegetation in central Kansas. Herbicide treatments were applied to OWB at the V 4 stage of growth using the Nebraska staging method. At 9 wk after treatment (WAT), plots treated with imazapyr at 1 .40 kg ail ha had much lower OWB plant frequency than the untreated plots, and plots sprayed with imazapyr and bromacil at 7 .84 kg ai/ha had much lower OWB tiller densities than the control plots. Imazapyr and glyphosate at 3.36 kg ai/ha provided greater OWB control than other herbicides. At the first frost after treatment application, imazapyr and bromacil treatments continued to have lower OWB frequency and tiller density than the control plots. Visible herbicide control was closely related to end-of-season yield (R = -0.97). Imazapic at 0.16 kg ai/ha, glyphosate, sulfometuron at 0.21 kg ail ha, bromacil, and imazapyr controlled OWB from 54 to 94%. Split applications, altered timing of herbicide application, or varied rates of herbicides that exhibited suppressive potential may further improve efficacy of these herbicides."
	Robertson, S., Hickman, K. R., Harmoney, K. R., & Leslie Jr, D. M. (2013). Combining glyphosate with burning or mowing improves control of yellow bluestem (Bothriochloa ischaemum). Rangeland Ecology & Management, 66(3), 376-381	"The invasive yellow bluestem (Bothriochloa ischaemum [L.] Keng) threatens native biodiversity, and its control is of interest to land managers involved in restoration of invaded grasslands. We used single, double, and triple applications of glyphosate (2.125 kg ai ha -1 application -1) over the course of one growing season in combinations at different timings (early, middle, late season) with and without a mechanical treatment of mowing or burning to determine the most effective control method. One year after treatment, burning and mowing prior to a mid-season single or double early, middle, and/or late season herbicide application resulted in a similar level of control of yellow bluestem relative to a triple herbicide application, all of which had greater control relative to herbicide treatment alone. Reproductive tiller density and visual obstruction increased 2 yr after treatment with two herbicide treatments applied either early and middle season or early and late season, but it was prevented with burning and mowing prior to herbicide application. With the exception of three herbicide applications, combining burning or mowing with herbicide applications provided more effective control of yellow bluestem than any individual herbicide applications. Burning or mowing likely improves glyphosate effectiveness by altering the invasive grass structure so that plants are clear of standing dead and have shorter, active regrowth to enhance herbicide effectiveness. During restoration projects requiring control of invasive yellow bluestem, an effective management option is a combination of mechanical and chemical control."

804	Tolerates, or benefits from, mutilation, cultivation, or fire	y
	Source(s)	**Notes**

Qsn #	Question	Answer
	USDA Forest Service. (2018). Field Guide for Managing Yellow and Caucasian (Old World) Bluestems in the Southwest. Southwestern Region TP-R3-16-36, Albuquerque, NM	"Both OWB species are quickly established, produce large numbers of seed, and can tolerate severe drought, heavy grazing, fire, and a limited amount of winter freezing." ... "OWBs rapidly recover after fire and may return at greater densities than before. Thus, burning is not recommended as a single or stand-alone control method. As compared to mowing, burning is better able to reduce OWB cover. Prescribed fire applied past the boot stage but prior to full seed production has shown the greatest potential for reducing OWB cover."
	Hilty, J. (2022). Grasses, Sedges, and Non-Flowering Plants of Illinois. Old World Bluestem - Bothriochloa ischaemum. https://www.illinoiswildflowers.info/. [Accessed 4 Mar 2022]	"This grass tolerates grazing and fire."
	Cook, B.G., et al. (2022). Tropical Forages: an interactive selection tool – Digital ISBN 978958694234-8. https://www.tropicalforages.info/text/intro/index.html. [Accessed 4 Mar 2022]	"Tolerant of fire."

805	**Effective natural enemies present locally (e.g. introduced biocontrol agents)**	
	Source(s)	**Notes**
	WRA Specialist. (2022). Personal Communication	Unknown

Summary of Risk Traits:

High Risk / Undesirable Traits
• Broad climate suitability (temperate to tropical)
• Naturalized elsewhere
• A weedy, disturbance-adapted grass thay impacts native biodiversity where invasive
• May also negatively impact pasture productivity
• Other Bothriochloa species are invasive
• Potentially allelopathic
• Host of crop pests and pathogens
• May increase fire risk where invasive
• Tolerates many soil types
• Can form monocultures, inhibiting growth or establishment of other species
• Reproduces by seeds and vegetatively by stolons or rhizomes
• Hybridizes with other species
• Apomictic
• Seeds disperse along roads, possibly by wind and water, and intentionally cultivated
• Prolfic seed production
• Tolerates heavy grazing, mowing and fire

Low Risk Traits
• Unarmed (no spines, thorns, or burrs)
• Valued as a palatable pasture species (grazed by cattle and sheep)
• Non-toxic
• Shade-intolerant (dense shade may inhibit spread)
• Not reported to form a persistent seed bank
• Herbicides may provide effective control