Taxon: Imperata cylindrica (L.) Raeusch.

Family: Poaceae

Common Name(s): alang-alang
blady grass
cogon
cogon grass
cotton-wool grass
imperata
Japanese blood grass
kunai grass
kura-kura
satintail

Synonym(s): Imperata arundinacea Cirillo
Imperata koenigii (Retz.) P. Beauv.
Lagurus cylindricus L.
Saccharum koenigii Retz.

Assessor: Chuck Chimera **Status:** Assessor Approved **End Date:** 18 Jan 2022

WRA Score: 21.0 **Designation:** H(HPWRA) **Rating:** High Risk

Keywords: Rhizomatous Grass, Noxious Weed, Flammable, Forms Monocultures, Wind-Dispersed

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

Qsn #	Question	Answer Option	Answer
403	Parasitic	y=1, n=0	y
404	Unpalatable to grazing animals	y=1, n=-1	y
405	Toxic to animals	y=1, n=0	n
406	Host for recognized pests and pathogens		
407	Causes allergies or is otherwise toxic to humans		
408	Creates a fire hazard in natural ecosystems	y=1, n=0	y
409	Is a shade tolerant plant at some stage of its life cycle	y=1, n=0	y
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	n
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	y
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	1
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y=1, n=-1	y
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant	y=1, n=-1	y
704	Propagules adapted to wind dispersal	y=1, n=-1	y
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	n
708	Propagules survive passage through the gut	y=1, n=-1	n
801	Prolific seed production (>1000/m2)		
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

Qsn #	Question	Answer Option	Answer
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	[No evidence] "I. cylindrica is seldom propagated deliberately, but spreads by rhizomes and seed. If rhizomes are cut by cultivation, they can establish from pieces with as few as 2 nodes."

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**
	't Mannetje, L. & Jones, R.M. (Eds.). (1992). Plant Resources of South-East Asia. No. 4. Forages. Pudoc Scientific Publishers, Wageningen, Netherlands	"A native of the Old World tropics that is widely distributed throughout the tropics and subtropics of South-East Asia, Africa, the Indian subcontinent and Australia. It occurs to a lesser extent in North, Central and South America. It also occurs in warm temperate areas and has been recorded at latitudes of 45° in New Zealand and Japan."

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	"A native of the Old World tropics that is widely distributed throughout the tropics and subtropics of South-East Asia, Africa, the Indian subcontinent and Australia."

203	**Broad climate suitability (environmental versatility)**	**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	[Broad elevational and distributional range] "Imperata cylindrica is often found in areas receiving more than 1000 mm rainfall, but has been recorded in sites receiving from 500—5000 mm. It can withstand waterlogging but not continuous flooding. It grows at altitudes from sea-level up to 2000 m in several countries and has been recorded at 2700 m in Indonesia. It has been estimated that it covers some 500 million ha worldwide including 200 million ha in South-East Asia."

Qsn #	Question	Answer
204	**Native or naturalized in regions with tropical or subtropical climates**	**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	"A native of the Old World tropics that is widely distributed throughout the tropics and subtropics of South-East Asia, Africa, the Indian subcontinent and Australia. It occurs to a lesser extent in North, Central and South America. It also occurs in warm temperate areas and has been recorded at latitudes of 45° in New Zealand and Japan."
	Rao, V. S. (2000). Principles of Weed Science, Second Edition. CRC Press, Boca Raton, FL	"I. cylindrica occurs widely throughout the tropics."
	Global Invasive Species Database (2022) Species profile: Imperata cylindrica. http://www.iucngisd.org/gisd/species.php?sc=16. [Accessed 12 Jan 2022]	"Native to Asia, cogon grass (Imperata cylindrica) is common in the humid tropics and has spread to the warmer temperate zones worldwide."

205	**Does the species have a history of repeated introductions outside its natural range?**	**y**
	Source(s)	**Notes**
	CABI. (2022). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"The accidental introduction of I. cylindrica into the south-eastern USA occurred in Mobile County, Alabama, in 1911 through a shipment of oranges from Japan (Tabor, 1952). I. cylindrica was then intentionally introduced from the Philippines into Florida and Mississippi between 1921 and the 1940s for forage and erosion control purposes (Tabor, 1949; Dickens and Buchanan, 1971; Dickens, 1974). I. cylindrica was reportedly introduced into Oregon through ballast in 1971 but there are no recent accounts of its establishment in the north-west USA. According to Dickens and Buchanan (1971), the eradication of I. cylindrica in the south-eastern USA was recommended as early as 1948. Collins et al. (2007) concluded that I. cylindrica was able to invade habitats in Southern USA regardless of the diversity of the flora, hence not obeying Elton's Hypothesis which proposes that diversity reduces invasibility. I. cylindrica was introduced into New Zealand in 1911 and is listed as one of the potential problem weeds in New Zealand as of 1996 (PIER, 2008). According to PIER (2008), I. cylindrica is also an invasive species in Micronesia and has been recommended for eradication."

301	**Naturalized beyond native range**	**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 12 Jan 2022]	"Naturalized Africa MACARONESIA: Cabo Verde WESTERN INDIAN OCEAN: Madagascar, Seychelles Asia-Tropical PAPUASIA: Papua New Guinea INDO-CHINA: Thailand Australasia AUSTRALIA: Australia [Lord Howe Island] NEW ZEALAND: New Zealand Northern America REGION: United States Pacific NORTH-CENTRAL PACIFIC: United States [Hawaii] NORTHWESTERN PACIFIC: Micronesia, Palau, United States [Guam, Northern Mariana Islands] SOUTHWESTERN PACIFIC: United States [American Samoa], Vanuatu Southern America CARIBBEAN: West Indies CENTRAL AMERICA: Central America WESTERN SOUTH AMERICA: Colombia SOUTHERN SOUTH AMERICA: Chile REGION: South America"
	Oahu Early Detection. (2009). Specimen Details for Imperata cylindrica (L.) Raeusch. Catalog #: 16033. National Tropical Botanical Garden, Koloa, HI	[Collection from Oahu. Not reported to be naturalized] "Locality: United States, Hawaii, OAHU: Kaimuki neighborhood, knearth 12th and Harding Avenue. UTM 2353760,0624445. Dry lowland residential area. Growing from under a water heater within a narrow area near restaurant."
	Parker, J. (2022). BIISC Early Detection Botanist. Pers. Comm. 10 Jan	[Hawaii island] "I'd like to report a naturalized population of Cogon grass in Puna. It is spread out over 300 feet in vacant lots in the Hawaiian Paradise Park subdivision. It appears to be spreading primarily via rhizomes at this point. It is showing very dense growth. The leaf blades, entirely green, extend up to 6 feet, to a sharp point without folding over. Inflorescences were collected from sections of the infestation that receive periodic mowing by a road crew. The rest of the infestation did not appear to be flowering. "
	Frohlich, D. & Lau, A. (2007). Specimen Details for Imperata cylindrica (L.) Beauv. Catalog #: 731446. Bishop Museum, Honolulu, HI	[Sterile specimen collected on Oahu. Not reported to be naturalized] " Habitat: In landscaped area in front of house, escaping into lawn. Notes: Grass~ 1 ft. tall, red tinged at tips. Sterile specimen."

Qsn #	Question	Answer
302	**Garden/amenity/disturbance weed**	
	Source(s)	**Notes**
	CABI. (2022). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"I. cylindrica is a serious weed not only in crops but also in natural areas, causing serious economic and environmental damage. The ability of I. cylindrica to effectively compete for water and nutrients, spread and persist through the production of seeds and rhizomes that can survive a wide range of environmental conditions, and its allelopathic effects and pyrogenic nature, allow it to exclude native plant species and other desirable plants and dominate large areas of land." [Disturbance weed not scored because yes for 3.04]

303	**Agricultural/forestry/horticultural weed**	**y**
	Source(s)	**Notes**
	Weber, E. (2017). Invasive Plant Species of the World, 2nd Edition: A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	"Cogongrass is also a serious agricultural weed in many tropical and subtropical countries (Holm et al., 1977)."
	MacDonald, G. E. (2004). Cogongrass (Imperata cylindrica)—biology, ecology, and management. Critical Reviews in Plant Sciences, 23(5), 367-380	"It is considered a primary weedy species in tea (Camillia sinesis L.), rubber (Hevea spp.), pineapple (Ananas comosus Merr.), coconut (Cocos nucifera L.), oil palm (Elaeis spp.), and other perennial plantation crops in Asia, whereas in Africa it causes the greatest damage in agronomic production (Ivens, 1980)." ... "Cogongrass is a major constraint in the establishment of plantation crops such as rubber, pineapple, tea, banana (Musa spp.), citrus (Citrus spp.), and coconut (Soerianegara, 1980; Dela Cruz, 1986; Ohta, 1990). This weedy species competes directly with the crop for light, nutrients, and water, and it has been shown to retard the growth of teak trees (Tectona grandis L.) by more than 85% in the first year of establishment (Coster, 1932, 1939). Cogongrass has also been shown to reduce rubber tree growth by 96% after five years (Soedarsan, 1980)." ... "Cogongrass is also a serious weed in slash and burn agriculture systems, particularly in Africa (Udensi et al., 1999) and southeast Asia (Friday et al., 1999). It is reported to be one of the top three weedy pests of cassava (Manihot spp.), cotton (Gossypium spp.), maize (Zea mays L.), peanut (Arachis hypogaea L.), upland rice (Oryza sativa L.), and sweet potatoes (Ipomoea batatas (L.) Poir.; Holm et al., 1977). Cogongrass is considered to be the most serious agricultural weed in Benin, Nigeria, and southern Guinea, infesting over 20 crop species (Chikoye et al., 2000). In west Africa, cogongrass has been shownto reduce cassava yields by 62 to80%and yam (Dioscorea spp.) production by 78% (Udensi et al., 1999). Chickoye et al. (2001) showed a 50% reduction in maize yield from cogongrass interference, and Akobundu et al. (2000) found that four hand weedings were needed to prevent yield reduction in maize grown in Nigeria."

Qsn #	Question	Answer
	Howard, J. L. (2005). Imperata brasiliensis, I. cylindrica. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/graminoid/imspp/all.html . [Accessed 14 Jan 2022]	"Silvicultural: Cogongrass competes with hardwood species for light, water, and nutrients. Cogongrass grows so tall and thick that it decreases growth and increases mortality of young trees [90]. Allen and others [4] describe cogon grass as particularly problematic in peninsular Florida pinewoods. Lippencott's [86] Florida study suggests that pine and oak regeneration is reduced in cogongrass swards; however, she found that median basal area of mature pines was greater on cogongrass sites compared to uninfested sites. Basal area of oaks did not differ between sites (P<0.01). She postulated that mature longleaf pine was unaffected by understory cogongrass cover once longleaf pine reached a critical size (10.4 cm dbh or 85.1 cm^2 basal area in her study), but that longleaf pine regeneration would not occur until cogongrass was controlled [86]. Because cogongrass increases fire severity, wildfires in pine plantations infested with cogongrass may kill pine seedlings that are normally fire resistant [90]. Tropical ecosystems: Cogongrass is invasive in tropical and subtropical regions worldwide. Cogongrass is a troublesome agricultural weed in Asia and Africa [2,6,10,21,22]. Repeated agricultural burning has converted millions of acres of tropical forest to cogongrasslands [15]. In a 1997 survey, Garrity and others [46] estimated that about 35 million acres (14 million ha) were dominated by cogongrass in Asia, mostly as a result of frequent fire on shifting agricultural lands. In Indonesia, for example, shifting agriculture has resulted in a type conversion of tropical forest to coarse tropical grasslands dominated by cogongrass and/or wild sugarcane (Saccharum spontaneum) [42,100]. Cogongrass coverage increased in Indonesia from 31.3 million acres (12.5 million ha) in 1996-1997 to 58 million acres (23.2 million ha) in 2000. Cogongrass coverage also increased in tropical forest understories [100]. Van der Wall [154] demonstrated that it takes about 4 or 5 slash-and-burn cycles to effect a type conversion from tropical forest to cogongrassland."

304	Environmental weed	y
	Source(s)	**Notes**
	CABI. (2022). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"I. cylindrica is a serious weed not only in crops but also in natural areas, causing serious economic and environmental damage. The ability of I. cylindrica to effectively compete for water and nutrients, spread and persist through the production of seeds and rhizomes that can survive a wide range of environmental conditions, and its allelopathic effects and pyrogenic nature, allow it to exclude native plant species and other desirable plants and dominate large areas of land."

Qsn #	Question	Answer
	MacDonald, G. E. (2004). Cogongrass (Imperata cylindrica)—biology, ecology, and management. Critical Reviews in Plant Sciences, 23(5), 367-380	"In the U.S., cogongrass poses the most serious threat to native ecosystems. There are over 500,000 hectares with some level of infestation in Florida alone. Several thousand hectares are also infested in the states of Alabama and Mississippi (Bryson and Carter, 1993; Matlack, 2002). This species can also be found as far west as Louisiana and as far north asVirginia, primarily along the coastal regions. Cogongrass generally invades areas after a disturbance, such as mining/land reclamation, forest operations including clear cutting and replanting, highway construction, and natural fire or flood. Once established, cogongrass outcompetes native vegetation, forming large monotypic expanses with extremely low species diversity and richness."
	Global Invasive Species Database (2022) Species profile: Imperata cylindrica. http://www.iucngisd.org/gisd/species.php?sc=16. [Accessed 14 Jan 2022]	"Native to Asia, cogon grass (Imperata cylindrica) is common in the humid tropics and has spread to the warmer temperate zones worldwide. Cogon grass is considered to be one of the top ten worst weeds in the world. Its extensive rhizome system, adaptation to poor soils, drought tolerance, genetic plasticity and fire adaptability make it a formidable invasive grass. Increases in cogon grass concern ecologists and conservationists because of the fact that this species displaces native plant and animal species and alters fire regimes."

305	Congeneric weed	
	Source(s)	**Notes**
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	Although several Imperata spp. (e.g. Imperata arundinacea, Imperata brasiliensis, Imperata brevifolia, Imperata conferta, Imperata contracta, Imperata exaltata and Imperata tenuis) are listed as weeds of some sort, information documenting actual impacts is generally lacking or difficult to corroborate

401	Produces spines, thorns or burrs	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	"Aggressively rhizomatous, robust perennial with white, deeply buried (up to more than 1 m), branched, fleshy, scaly rhizome, forming loose to compact tufts of leaves. Culms erect, 0.1—1.2(—3 m) tall, 1—4(—8)-noded, unbranched, solid, usually hairy at the nodes. Leaf-sheath with ciliate margins, lower ones broad and leathery, overlapping, the upper ones finally splitting into thin fibres; ligule membraneous, truncate, up to 1 mm tall; leaf-blade linear-lanceolate, 10—180 cm x 5—25 mm, flat, erect, spreading or drooping, pilose at the base, when old with hard, serrate, cutting edges and a stout whitish midrib. Inflorescence a spiciform panicle, cylindrical, 6—30 cm x 2 cm, its branches ascending close to the main axis especially at anthesis; spikelets paired, bisexual, 3—6 mm long, 1-flowered, at the base with a dense whorl of silky white hairs up to 2.5 cm long; pedicels unequal, up to 1 mm long; glumes equal, 3—9-nerved; lower floret reduced to a hyaline lemma; stamens 2, anthers orange to purple; stigmas 2, purple. Caryopsis ellipsoid, ca. 1 mm long, brown."

402	Allelopathic	

Qsn #	Question	Answer
	Source(s)	**Notes**
	MacDonald, G. E. (2004). Cogongrass (Imperata cylindrica)—biology, ecology, and management. Critical Reviews in Plant Sciences, 23(5), 367-380	"Another mechanism by which cogongrass maintains dominance is through allelopathy. Cogongrass has been reported to suppress the growth of crops (Hubbard et al., 1944; Soerjani, 1970). Eussen et al. (1976), Eussen and Soerjani (1975) and Eussen (1979) in a series of experiments showed that cogongrass suppressed the growth of tomato and cucumber and that the factor(s) involved were more active at lower pH (Eussen and Wirjahardja, 1973). Studies have also demonstrated potential allelopathy by cogongrass (Eussen, 1979; Casini et al., 1998; Koger and Bryson, 2003)." [Cannot differentiate from direct competition]
	Howard, J. L. (2005). Imperata brasiliensis, I. cylindrica. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/graminoid/imspp/all.html . [Accessed 14 Jan 2022]	"Cogongrass allelopathy has been implicated in laboratory experiments [20,26,65,76,77,117]; however, such claims are based upon research using cogongrass extracts at concentrations that do not occur under field conditions. Reputed allelopathy of cogongrass awaits reciprocal transplant experiments in the field and/or greenhouse."

403	Parasitic	y
	Source(s)	**Notes**
	Howard, J. L. (2005). Imperata brasiliensis, I. cylindrica. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/graminoid/imspp/all.html . [Accessed 13 Jan 2022]	"Cogongrass causes physical injury when its rhizome tips, which are as sharp as its leaves, penetrate the roots of other herbaceous species, sometimes forming a parasitic relationship with the injured plant [12,26,48]."

404	Unpalatable to grazing animals	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	"little forage value, very low grazing value, not palatable or palatable to few animals, palatable if cut frequently, only the young shoots eaten by stock, rhizomes eaten by pigs"
	Howard, J. L. (2005). Imperata brasiliensis, I. cylindrica. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/graminoid/imspp/all.html . [Accessed 14 Jan 2022]	"Palatability: Cogongrass is relatively unpalatable and unnutritious for livestock and North American wildlife [40,41,43,58,86]. It is lower in nitrogen and higher in fiber and silica compared to native wiregrasses (Aristida spp.) of the Southeast [24,26,86]. The leaf blades are sharp and rough at the edges, discouraging animals from grazing [26]. New spring growth and postfire sprouts are palatable to livestock for 3 to 4 weeks; however, plants become coarse and fibrous after that [160]. In a rangeland study in subtropical Australia, cogongrass cover increased in response to cattle grazing at the expense of common carpet grass (Axonopus fissifolius), which is more palatable and nutritious [60]. Stober [139] described cogongrass as unpalatable to domestic sheep in Malaysia; however, domestic sheep can learn to graze cogongrass [156]."

405	Toxic to animals	n

Qsn #	Question	Answer
	Source(s)	**Notes**
	MacDonald, G. E. (2004). Cogongrass (Imperata cylindrica)—biology, ecology, and management. Critical Reviews in Plant Sciences, 23(5), 367-380	[No evidence] "Cogongrass is occasionally used as a forage, but it can only be grazed when the plants are very young. Intensive management is needed to maintain the grass in this juvenile vegetative stage, as once the leaves mature they become virtually impalatable."
	Quattrocchi, U. (2006). CRC World Dictionary of Grasses: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	[No evidence] "fodder, little forage value, very low grazing value, not palatable or palatable to few animals, palatable if cut frequently, only the young shoots eaten by stock, rhizomes eaten by pigs"

406	Host for recognized pests and pathogens	
	Source(s)	**Notes**
	MacDonald, G. E. (2004). Cogongrass (Imperata cylindrica)—biology, ecology, and management. Critical Reviews in Plant Sciences, 23(5), 367-380	"Cogongrass has been shown to harbor locusts, and there is evidence that swards of this grass is a major breeding ground for these pests (Brook, 1989). Cogongrass is also host to several polyphagous insects in cereals and an alternative host of the rust Puccinia refipes diet (Chandrasrikul, 1962; Vayssiere, 1957)." [Potentially. [Puccinia refipes is not an economically important pest and others are polyphagous or generalists]
	Howard, J. L. (2005). Imperata brasiliensis, I. cylindrica. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/graminoid/imspp/all.html . [Accessed 14 Jan 2022]	"Cogongrass has several insects and fungal pathogens that infest it in Asia [36]. Two fungal pathogens (Bipolaria sacchari and Drechslera gigantea) have shown potential as cogongrass control agents in greenhouse trials [177,178]."

407	Causes allergies or is otherwise toxic to humans	
	Source(s)	**Notes**

Qsn #	Question	Answer
	Kumar, L., Sridhara, S., Singh, B. P., & Gangal, S. V. (1998). Characterization of cogon grass (Imperata cylindrica) pollen extract and preliminary analysis of grass group 1, 4 and 5 homologues using monoclonal antibodies to Phleum pratense. International Archives of Allergy and Immunology, 117(3), 174-179	"Background: Previous studies have established the role of Imperata cylindrica (Ic) pollen in type I allergic disorders. However, no systematic information is available on the allergen composition of Ic pollen extract. Objectives: To characterize the IgE–binding proteins of Ic pollen extract and to detect the presence of grass group 1, 4 and 5 allergen homologues, if any. Methods: Pollen extract of Ic was analyzed by in vivo and in vitro procedures such as intradermal tests (ID), enzyme–linked immunosorbent assay (ELISA), ELISA–inhibition, thin–layer isoelectric focusing (TLIEF), sodium dodecylsulfate polyacrylamide gel electrophoresis (SDS–PAGE) and immunoblotting. Dot blot assay was carried out to check the presence of well–known group 1, 4, and 5 allergen homologues in Ic pollen extract. Results: Out of 303 respiratory allergies patients skin–tested, 27 showed sensitivity to Ic pollen extract. Specific IgE levels were elevated in all 15 serum samples tested. The extract prepared for this study was found to be highly potent since it required only 400 ng of homologous proteins for 50% inhibition of binding in ELISA inhibition assays. TLIEF of Ic pollen extract showed 44 silver–stained bands (pI 3.5–7.0) while SDS–PAGE resolved it into 24 Coomassie–Brilliant–Blue–stained bands (MW 100–10 kD). Immunoblotting with individual patient sera recognized 7 major IgE–binding bands (MW 85, 62, 57, 43, 40, 28 and 16 kD) in Ic pollen extract. A panel of monoclonal antibodies, specific to group 1, 4 and 5 allergens from Phleum pratense pollen extract identified group 5 and group 4 homologues in Ic pollen extract. Conclusion: Ic pollen extract was characterized for the protein profile by TLIEF and SDS–PAGE. IgE reactivity was determined by ELISA and immunoblot. Monoclonal antibodies to group 5 and group 4 allergens reacted weakly showing that this pollen contains group 5 and group 4 homologous allergens."
	Koh, D., Goh, C. L., Tan, H. T. W., Nge, S. K., & Wong, W. K. (1997). Allergic contact dermatitis from grasses. Contact Dermatitis, 37(1), 32-34	"This study attempts to demonstrate the existence of allergic contact dermatitis from grass, and to develop a patch test series to screen patients with grass intolerance. 6 common grass species from lawns and military training areas were collected. Solvent extracts of polar. non-polar and volatile fractions were prepared and used for patch testing in 20 control subjects and 46 patients with a history of grass intolerance. The 20 control had negative responses to patch testing. 5 out of 46 patients had positive patch tests to Axonopus compressus (carpet grass). Ischaenmum muticum (sea-shore centipede grass). Imperata evlindrica (lalang). Panicum maximum (Guinea grass) and Pennisetum purpureum (elephant grass). Reactions to the non-polar fraction for all 5 species were noted. This study demonstrates the existence of allergic contact dermatitis from various common species of grass. In our series, this is seen in 11% of those with a history of grass intolerance."
	MacDonald, G. E. (2004). Cogongrass (Imperata cylindrica)—biology, ecology, and management. Critical Reviews in Plant Sciences, 23(5), 367-380	"Verma et al. (2000) reported the isolation of a 67-kD cross-reactive allergen from cogongrass pollen containing at least three allergen determinants."
	WRA Specialist. (2022). Personal Communication	Potential allergen or cause of dermatitis to susceptible individuals

408	**Creates a fire hazard in natural ecosystems**	**y**

Qsn #	Question	Answer
	Source(s)	**Notes**
	Howard, J. L. (2005). Imperata brasiliensis, I. cylindrica. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/graminoid/imspp/all.html . [Accessed 14 Jan 2022]	"Cogongrass invasion changes fuel properties in pinelands of the southeastern United States. As a tall, rhizomatous grass on sites historically dominated by bunchgrasses, cogongrass produces more standing biomass and litter than native bunchgrasses. Thus, it increases fuel loads and horizontal and vertical continuity of fuels [87]. Fuel load estimates are needed for cogongrass-dominated sites in the United States. Fuel load measurements in native cogongrasslands may serve as a first step for estimating fuel loads in the southeastern United States. Pickford and others [111] conducted fuel sampling in burned and unburned forest-mangrove (Acacia mangium)/cogongrass stands in Java. They noted a "significant quantity" of dead, cured fuels that were created by and remained after burning, even in areas where cogongrass was green before the fire. They provide fuel loading and fire behavior estimates (based upon the BEHAVE fire behavior prediction system) for that community. Wibowo and others [162] provide fire behavior and severity information for a forest-mangrove/cogongrass community in West Java, Indonesia. Fine fuels are the most important factor in ignition and spread of fire in Florida longleaf pine ecosystems [159], and cogongrass contributes a large fine fuel load. Observational [111] and anecdotal [110] accounts from Indonesia indicate that live cogongrass plants ignite and burn easily while still relatively green, and researchers in Indonesia note that cogongrass becomes very dry and flammable during the dry season [100]. Cogongrass's fuel properties and abundant litter may alter fire behavior on invaded sites in Florida [86,87]. Cogongrass is high in silica content, so the litter decays relatively slowly. In an Australian study, cogongrass had the slowest decay rate of 3 grass species studied. Its half-life rate of decay exceeded the study period of 24 weeks [59]. On Florida sandhill longleaf pine savannas, Lippincott [86,87] compared fine fuel loads, fire behavior, and fire effects on uninvaded and cogongrass-invaded sites. Cogongrass produced significantly more persistent, standing dead biomass compared to sites with native understory vegetation ($P<0.05$), resulting in a greater fuel load on invaded sites. Fire mortality of young longleaf pines was greater on cogongrass sites, and postfire fuel accumulations were also greater on cogongrass sites. Average fire temperatures were higher on cogongrass sites and reached a maximum of 856 °F (458 °C) compared to a maximum of 604 °F (318 °C) on uninvaded sites [86]. Such fires are severe enough to kill longleaf pine seedlings and saplings [71]. See the Fire Case Study for additional details. Even in frequently burned communities, cogongrass may alter fire characteristics by increasing fine fuel loads. Platt and Gottschalk [113] investigated the effects of cogongrass and silkreed (Neyraudia reynaudiana), another nonnative tropical grass, on fine fuel loads in south Florida slash pine savanna in Everglades National Park. The historical fire regime of the area is surface fires at 5- to 10-year intervals. Fuels are almost all fine: woody debris is rarely present except after hurricanes. Firegrass (Andropogon cabanisii) and other bunchgrasses native to the area tend to produce greatest biomass the first year following a fire; they also mass flower at that time. Productivity of native bunchgrasses decreases with time since fire. In contrast, cogon grass produces prodigious biomass nearly every year

		Study plots were on prescribed underburn rotations of 10 years or less. Study design compared plots with a native ground cover of firegrass with areas that contained 1 of the 2 nonnative grasses. Total plant biomass (measured as g/484 cm²) on plots with cogongrass was 1.7 times greater than on plots without cogongrass: a significant difference (P=0.03). Litter biomass was also significantly greater on plots with cogongrass (P=0.05) and was almost twice that on plots without cogongrass. Biomass of native plants was not different among plots with and without cogongrass [113]."
	Weber, E. (2017). Invasive Plant Species of the World, 2nd Edition: A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	"The dry plant material is highly flammable and I. cylindrica alters fire regimes by causing more frequent and intense fires that exacerbate the negative impacts of cogongrass on the plant communities. Fires do little damage to the underground rhizomes of I. cylindrica (Johnson and Shilling, 2005)."

409	**Is a shade tolerant plant at some stage of its life cycle**	**y**
	Source(s)	**Notes**
	Howard, J. L. (2005). Imperata brasiliensis, I. cylindrica. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/graminoid/impspp/all.html . [Accessed 14 Jan 2022]	"Cogongrass cannot tolerate deep shade [15,100], but can survive in the moderate shade of savannas [63,64]."
	MacDonald, G. E. (2004). Cogongrass (Imperata cylindrica)—biology, ecology, and management. Critical Reviews in Plant Sciences, 23(5), 367-380	"Cogongrass is a C4 grass species (Paul and Elmore, 1984), and while it is best adapted to full sun, cogongrass can also thrive under the moderate shade of savannahs (Hubbard et al., 1944). Studies conducted by Patterson (1980) suggest cogongrass can adapt to changes in light levels through changes in specific leaf area and leaf area ratio and could tolerate a 50% reduction in sunlight. Further studies by Gaffney (1996) and Ramsey et al. (2003) showed that cogongrass has a light compensation point of 32 to 35 μ mol · m−2 · s −1, indicating the ability to survive as an understory species. This would explain its ability to rapidly invade deforested areas and persist in plantation crops."
	Evans, C.W., D.J. Moorhead, C.T. Bargeron, and G.K. Douce (2006). Invasive Plant Responses to Silvicultural Practices in the South. The University of Georgia Bugwood Network, Tifton GA	"Full sun and deep shade tolerant"
	't Mannetje, L. & Jones, R.M. (Eds.). (1992). Plant Resources of South-East Asia. No. 4. Forages. Pudoc Scientific Publishers, Wageningen, Netherlands	"It is regarded as a light-loving plant and will not persist under heavy shade in plantations."

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	"Although it grows in a wide range of soil types with widely differing fertility levels, it grows most vigorously in wet soil of reasonable fertility. It has been reported to grow on soils with pH ranging form 4.0—7.5. It can even tolerate very hot, steamy and sulphurous conditions near an active volcanic fumarole or vent."

Qsn #	Question	Answer
	MacDonald, G. E. (2004). Cogongrass (Imperata cylindrica)—biology, ecology, and management. Critical Reviews in Plant Sciences, 23(5), 367-380	"Cogongrass tolerates a wide range of soil conditions but appears to grow best in soils with acidic pH, low fertility and low organic matter. Consequently, cogongrass habitats are quite diverse, ranging from the course sands of shorelines, the fine sands or sandy loam soils of swamps and river margins, to the >80% clay soils of reclaimed phosphate settling ponds. Saxena and Ramakrishnan (1983) report cogongrass to be extremely efficient in nutrient uptake. Brook (1989) also reports an association with mycorrhiza, which may help explain its competitiveness on unfertile soils. Brewer and Cralle (2003) also suggested that cogongrass is a better competitor for phosphorus than native pine-savanna species in the southern U.S., citing that legume species are frequently displaced through this competitive mechanism."

411	Climbing or smothering growth habit	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	"Aggressively rhizomatous, robust perennial with white, deeply buried (up to more than 1 m), branched, fleshy, scaly rhizome, forming loose to compact tufts of leaves."

412	Forms dense thickets	y
	Source(s)	**Notes**
	Weber, E. (2017). Invasive Plant Species of the World, 2nd Edition: A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	"Cogongrass is a major invader of pine woodland in Florida where it forms dense mats excluding almost all other species (Yager et al., 2010)."
	Howard, J. L. (2005). Imperata brasiliensis, I. cylindrica. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/graminoid/imspp/all.html . [Accessed 14 Jan 2022]	"In Southeast Asia, rhizomes typically occur 4 to 20 inches (10-40 cm) below ground and form dense, extensive layers. Some rhizomes grow as deep as 3 feet (1 m) [8,100]. Cogongrass's growth habit is loose to clumped, compacted aerial stems arising from the dense rhizome mat [35,43]. Dense stands may form monocultures [43,87]."

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] "It is found in a wide range of habitats including dry sand dunes of seashores and deserts, as well as swamps and river valleys."

502	Grass	y
	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 14 Jan 2022]	Family: Poaceae (alt. Gramineae) Subfamily: Panicoideae Tribe: Andropogoneae

Qsn #	Question	Answer
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 14 Jan 2022]	Family: Poaceae (alt. Gramineae) Subfamily: Panicoideae Tribe: Andropogoneae

504	**Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)**	**n**
	Source(s)	**Notes**
	Howard, J. L. (2005). Imperata brasiliensis, I. cylindrica. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/graminoid/imspp/all.html . [Accessed 14 Jan 2022]	"The root system is fibrous. Cogongrass rhizomes are "tough and scaly," with short internodes forming a dense underground mat. Cogongrass rhizomes develop in 2 stages: primary seedling rhizomes, and secondary rhizomes that sprout from seedling rhizomes [43]."

601	**Evidence of substantial reproductive failure in native habitat**	**n**
	Source(s)	**Notes**
	Rao, V. S. (2000). Principles of Weed Science, Second Edition. CRC Press, Boca Raton, FL	"I. cylindrica occurs widely throughout the tropics."
	Howard, J. L. (2005). Imperata brasiliensis, I. cylindrica. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/graminoid/imspp/all.html . [Accessed]	"Imperata cylindrica var. major shows considerable diversity in reproductive morphology and physiology in Asia ([14] and references therein),[124,146]."

602	**Produces viable seed**	**y**
	Source(s)	**Notes**
	Howard, J. L. (2005). Imperata brasiliensis, I. cylindrica. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/graminoid/imspp/all.html . [Accessed 14 Jan 2022]	"Cogon grass reproduces from seed, rhizome expansion, and rhizome fragments [43,86]. Both seed and rhizome regeneration are important in its spread. Seed reproduction allows for long-distance dispersal and colonization, whereas rhizome spread is the primary means of population expansion [56,64]. Transported rhizome fragments also contribute to its long-distance dispersal and colonization [86]."
	MacDonald, G. E. (2004). Cogongrass (Imperata cylindrica)—biology, ecology, and management. Critical Reviews in Plant Sciences, 23(5), 367-380	"Cogongrass is also a prolific seed producer, with over 3000 seeds per plant."

603	**Hybridizes naturally**	**y**
	Source(s)	**Notes**

Qsn #	Question	Answer
	Howard, J. L. (2005). Imperata brasiliensis, I. cylindrica. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/graminoid/impspp/all.html . [Accessed 14 Jan 2022]	"Brazilian satintail and cogongrass are morphologically and genetically very similar, and their hybrids produce fertile offspring [57,133,165]. Hybridization, introgression, and overlapping morphological characters often cause taxonomic confusion between the 2 species, especially in North America. Some systematists consider the 2 species synonymous [25,57]. Hall [57] suggests that Brazilian satintail be classified as an infrataxon within I. cylindrica. Gabel [9,43] separates the taxa as 2 distinct species based upon continents of origin and morphological, cytological, and genetic attributes. This review treats Brazilian satintail and cogongrass as 2 distinct species. "
	CABI. (2022). Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"I. cylindrica is also known to hybridize with other species, with Gabel (1982) providing evidence of hybridization between I. cylindrica and I. brasiliensis. Intergeneric hybrids have been obtained with Saccharum (Watson and Dallwitz, 1992)."

604	Self-compatible or apomictic	n
	Source(s)	**Notes**
	Howard, J. L. (2005). Imperata brasiliensis, I. cylindrica. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/graminoid/impspp/all.html . [Accessed 14 Jan 2022]	"Breeding system: Cogongrass is outcrossing [43,50,125,133]. Clonal populations show low or no fertility [94]."
	MacDonald, G. E. (2004). Cogongrass (Imperata cylindrica)—biology, ecology, and management. Critical Reviews in Plant Sciences, 23(5), 367-380	"Seed production from populations in Florida was shown to be self-incompatible; only cross-pollination from geographically isolated, heterogenous populations produced viable seeds."

605	Requires specialist pollinators	n
	Source(s)	**Notes**
	Howard, J. L. (2005). Imperata brasiliensis, I. cylindrica. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/graminoid/impspp/all.html . [Accessed 14 Jan 2022]	"Pollination: Cogongrass is pollinated by wind [94,133]."

Qsn #	Question	Answer
606	**Reproduction by vegetative fragmentation**	**y**
	Source(s)	**Notes**
	Howard, J. L. (2005). Imperata brasiliensis, I. cylindrica. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/graminoid/impspp/all.html . [Accessed 14 Jan 2022]	"Cogongrass reproduces from seed, rhizome expansion, and rhizome fragments [43,86]. Both seed and rhizome regeneration are important in its spread. Seed reproduction allows for long-distance dispersal and colonization, whereas rhizome spread is the primary means of population expansion [56,64]. Transported rhizome fragments also contribute to its long-distance dispersal and colonization [86]."
	't Mannetje, L. & Jones, R.M. (Eds.). (1992). Plant Resources of South-East Asia. No. 4. Forages. Pudoc Scientific Publishers, Wageningen, Netherlands	"Imperata cylindrica is seldom propagated deliberately, but spreads by rhizomes and seed. If rhizomes are cut by cultivation, they can establish from pieces with as few as 2 nodes."

607	**Minimum generative time (years)**	**1**
	Source(s)	**Notes**
	Howard, J. L. (2005). Imperata brasiliensis, I. cylindrica. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/graminoid/impspp/all.html . [Accessed 14 Jan 2022]	"Flower production: Cogon grass flower production is highly variable. Some researchers report cogon grass as highly productive [43], but flowering is often sporadic, ranging from none to frequent flowering within and among populations [33,43,106,170]. In a common garden study using Malaysian collections, some cogon grass populations frequently produced flowers; others never produced flowers (but spread vegetatively); while most produced flowers only after mowing disturbance [125]. Disturbances including nitrogen amendment, slashing, burning, defoliation, and grazing may trigger cogon grass flowering [43,63]. However, Shilling and others [133] found consistent flowering in 11 Florida cogon grass populations, none of which were disturbed. Field and greenhouse studies suggest that cogon grass flowering is not photoperiod dependent [133]."
	Evans, C.W., D.J. Moorhead, C.T. Bargeron, and G.K. Douce (2006). Invasive Plant Responses to Silvicultural Practices in the South. The University of Georgia Bugwood Network, Tifton GA	"Matures in less than one year"

701	**Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)**	**y**
	Source(s)	**Notes**
	MacDonald, G. E. (2004). Cogongrass (Imperata cylindrica)—biology, ecology, and management. Critical Reviews in Plant Sciences, 23(5), 367-380	"Although seed production has been reported to be prolific, seed as a major form of spread is questionable, particularly in the U.S. Willard et al. (1990) reported the primary spread in Florida was from rhizome pieces, either through contaminated fill dirt used in construction or intentional plantings for forage."
	Howard, J. L. (2005). Imperata brasiliensis, I. cylindrica. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/graminoid/impspp/all.html . [Accessed 18 Jan 2022]	"Roads and road construction are important corridors for cogongrass dispersal [17,169]. Rhizomes are transported by machinery and fill dirt during construction [43,107]. Most long-distance dispersal of cogongrass is probably from inadvertent human transport of rhizomes and seeds [86]. Willard and others [169,170] speculated that cogongrass spread in Florida was mostly from transporting soil contaminated with cogongrass propagules."

Qsn #	Question	Answer
702	**Propagules dispersed intentionally by people**	**y**
	Source(s)	**Notes**
	MacDonald, G. E. (2004). Cogongrass (Imperata cylindrica)—biology, ecology, and management. Critical Reviews in Plant Sciences, 23(5), 367-380	"Another important aspect in the area of prevention is the concern over the sale of cogongrass var. Rubra, or var. koenigii. This variant is widely promoted as an ornamental grass under the names Rubra, Red Baron, and Japanese Blood Grass. These varieties have been reported as nonaggressive, but research by Greenlee (1992) and Bryson (personal communication) suggested plants revert to the green, invasive form."

703	**Propagules likely to disperse as a produce contaminant**	**y**
	Source(s)	**Notes**
	MacDonald, G. E. (2004). Cogongrass (Imperata cylindrica)—biology, ecology, and management. Critical Reviews in Plant Sciences, 23(5), 367-380	"Cogongrass invades and persists in moist tropical areas because of extensive deforestation and fire-based land utilization systems (Holm, 1969, Islam et al., 2001). It is considered a primary weedy species in tea (Camillia sinesis L.), rubber (Hevea spp.), pineapple (Ananas comosus Merr.), coconut (Cocos nucifera L.), oil palm (Elaeis spp.), and other perennial plantation crops in Asia, whereas in Africa it causes the greatest damage in agronomic production (Ivens, 1980). In other areas, cogongrass infests natural habitats, destroying many native plant ecosystems in the southeastern U.S."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Major Pathway/s: Contaminant, Crop, Herbal, Ornamental, Pasture Dispersed by: Humans, Wind, Escapee"

704	**Propagules adapted to wind dispersal**	**y**
	Source(s)	**Notes**
	Howard, J. L. (2005). Imperata brasiliensis, I. cylindrica. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/graminoid/imspp/all.html . [Accessed 18 Jan 2022]	"Seed/rhizome dispersal: Cogongrass seed is spread by wind. The seeds are small and light weight, with long, hairy plumes aiding wind carriage [43,94,133,164]. Cogongrass seeds may drift 15 miles (20 km) in open country [64]. Shilling and others [133] showed that wind can disperse cogongrass spikelets up to 360 feet (110 m) from the parent plant. Cogongrass spread in Alabama from 1973 to 1985 was apparently due to northeasterly prevailing winds from the Gulf of Mexico blowing seeds up Interstate 65 [164,165]. "
	MacDonald, G. E. (2004). Cogongrass (Imperata cylindrica)—biology, ecology, and management. Critical Reviews in Plant Sciences, 23(5), 367-380	"The brownish colored seed (grain) is a caryopsis and single in each spikelet. The caryopsis possesses a plume of long hairs that effects wind dispersal."

Qsn #	Question	Answer
705	**Propagules water dispersed**	**n**
	Source(s)	**Notes**
	Howard, J. L. (2005). Imperata brasiliensis, I. cylindrica. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/graminoid/impspp/all.html . [Accessed 18 Jan 2022]	[No evidence. Unlikely given low tolerance to inundation] "It grows up to the edges of standing water in Florida [70], but does not invade continually flooded sites [28]. In a greenhouse experiment, cogongrass germinants were intolerant of soil inundation and became increasingly tolerant of saturated soils as the plants matured. The authors concluded that soil inundation in early spring could limit cogongrass seedling establishment [74]."

706	**Propagules bird dispersed**	**n**
	Source(s)	**Notes**
	Howard, J. L. (2005). Imperata brasiliensis, I. cylindrica. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/graminoid/impspp/all.html . [Accessed 18 Jan 2022]	"Both seed and rhizome regeneration are important in its spread. Seed reproduction allows for long-distance dispersal and colonization, whereas rhizome spread is the primary means of population expansion [56,64]. Transported rhizome fragments also contribute to its long-distance dispersal and colonization [86]."

707	**Propagules dispersed by other animals (externally)**	**n**
	Source(s)	**Notes**
	Howard, J. L. (2005). Imperata brasiliensis, I. cylindrica. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/graminoid/impspp/all.html . [Accessed 18 Jan 2022]	"Cogongrass reproduces from seed, rhizome expansion, and rhizome fragments [43,86]. Both seed and rhizome regeneration are important in its spread. Seed reproduction allows for long-distance dispersal and colonization, whereas rhizome spread is the primary means of population expansion [56,64]. Transported rhizome fragments also contribute to its long-distance dispersal and colonization [86]."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Major Pathway/s: Contaminant, Crop, Herbal, Ornamental, Pasture Dispersed by: Humans, Wind, Escapee"

708	**Propagules survive passage through the gut**	**n**
	Source(s)	**Notes**
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Dispersed by: Humans, Wind, Escapee"
	Dinerstein, E. (1989). The Foliage-as-Fruit Hypothesis and the Feeding Behavior of South Asian Ungulates. Biotropica, 21(3), 214–218	"During the dry season, the common grass I. cylindrica flowers and fruits immediately after the fires, and is dispersed by wind. After dispersal the grass send up new shoots at which time it is heavily grazed by rhinoceros and other ungulates, the direct opposite of the FAF strategy." [Author argues that Imperata cylindrica seeds are not dispersed by animals, but this is not evidence that seeds would or would not survive passage through gut. Grass was rated as not palatable (4.04) so consumption of mature inflorescences by grazers is not a reasonable expectation]

801	**Prolific seed production (>1000/m2)**	

Qsn #	Question	Answer
	Source(s)	**Notes**
	MacDonald, G. E. (2004). Cogongrass (Imperata cylindrica)—biology, ecology, and management. Critical Reviews in Plant Sciences, 23(5), 367-380	"Cogongrass is also a prolific seed producer, with over 3000 seeds per plant." ... "Seed production from populations in Florida was shown to be self-incompatible; only cross-pollination from geographically isolated, heterogenous populations produced viable seeds (McDonald et al., 1995, 1996)."
	Holm, L.G., Doll, J., Holm, E., Pancho, J.V. & Herberger, J.P. (1997). World Weeds: Natural Histories and Distribution. John Wiley and Sons, Inc., New York, NY	"Seed production in early spring with up to 3000 seed per seedhead, most of which are viable."
	Howard, J. L. (2005). Imperata brasiliensis, I. cylindrica. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/graminoid/imspp/all.html . [Accessed 18 Jan 2022]	[May be dependent on genetic variability of populations] "Cogongrass is outcrossing [43,50,125,133]. Clonal populations show low or no fertility [94]. Imperata cylindrica var. major shows considerable diversity in reproductive morphology and physiology in Asia ([15] and references therein),[124,146]. Studies in central and northern Florida suggested a high degree of genetic variability among cogongrass populations. Populations with low genetic diversity tended to have low seed viability, while populations with high genetic diversity had high seed viability. It is not known whether low seed viability was due to inability to outcross, poor environmental conditions, or other factors. The authors concluded that successful outcrossing was low in most cogongrass populations, but higher rates of genetic diversity and fecundity could be expected as southeastern populations expand and outcross [133]."

802	**Evidence that a persistent propagule bank is formed (>1 yr)**	**n**
	Source(s)	**Notes**
	Howard, J. L. (2005). Imperata brasiliensis, I. cylindrica. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/graminoid/imspp/all.html . [Accessed 18 Jan 2022]	"Seed banking: Cogongrass seed is short lived, generally remaining viable in the soil for about 1 year [50]. Viability of seeds stored in a laboratory steadily decreased over 13 months [34]. Field studies in Asia show a maximum seed life of 16 months [124,125]."
	Shilling, D. G., Bewick, T. A., Gaffney, J. F., McDonald, S. K., Chase, C.A., and Johnson, E. R. R. L. (1997). Ecology, Physiology, and Management of Cogongrass (Imperata cylindrica). Final Report. Florida Institute of Phosphate Research. Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL	"Seedling emergence from soil samples collected in naturally infested sites lasted only 3 mo following flowering. A high proportion (>90%) of seeds stored in cool, dry conditions remained viable for up to 3 mo, after which seeds quickly lost viability, dropping to 50% by 7 mo and to 0 by 11 mo."

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

Qsn #	Question	Answer
	Howard, J. L. (2005). Imperata brasiliensis, I. cylindrica. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/graminoid/imspp/all.html . [Accessed 18 Jan 2022]	"Chemical: Herbicides may provide initial control of a new invasion or a severe infestation, but used alone, they are rarely a complete or long-term solution to invasive species management [18]. Herbicides are most effective on large infestations when incorporated into long-term management plans that include replacement of weeds with desirable species, careful land use management, and prevention of new infestations. Control with herbicides is temporary, as it does not change the conditions that allowed the invasion to occur (e.g. [179]). See The Nature Conservancy's Weed Control Methods Handbook for considerations on the use of herbicides in Natural Areas and detailed information on specific chemicals. Imazapyr and glyphosate help control cogongrass [43,70,146,148,165,167]. Imazapyr is nonselective and has some soil residual activity. Glyphosate is also nonselective but is less residual, offering more flexibility in timing and species selection for posttreatment revegetation [44]. Rhizomes must be killed for effective, long-lasting control [70,88,96]. Depending upon rhizome reserves, multiple herbicide applications and follow-up spot treatments are usually needed for complete rhizome kill and long-term control [26,96]. Fall applications are usually recommended because cogongrass transports carbohydrates and herbicides down into its rhizomes and roots at that time of year [70,88,96]. Shilling and others [133] found autumn applications of glyphosate or imazapyr provided better control than spring or summer applications. Winter applications can be effective if plants are still green. Analysis of rhizome total nonstructural carbohydrates (TNC) can show when carbohydrate allocation is directed toward rhizomes and therefore, when herbicide applications are likely to be most effective. In Florida, TNC content showed a small peak in December and January, and showed greatest gains in February and May. Rhizome TNC content was lowest in November [133]. Twelve and sixteen months after Florida field trials, Gaffney [44] found December application was twice as effective as either September or January application. Imazapyr gave better control than glyphosate. Follow-up herbicide applications in spring, prior to flowering, can suppress cogongrass seed production [96]. Young plants can often be controlled using fewer applications and/or lower doses of herbicide than plants with well-developed rhizomes [35]. Demers and Long [31] provide standard application rate recommendations for cogongrass. High concentrations of herbicides do not necessarily translate into higher rate of cogongrass kill compared to recommended rates of application. In a loblolly pine plantation study in Florida, Ramsey and others [118] report high rates of glyphosate or imazapyr actually inhibit translocation of the herbicide to rhizomes. They recommend half-dose applications, sprayed twice a year, to ensure good rhizome kill. Terry and others [146] found glyphosate application to newly burned cogongrasslands was not effective. Glyphosate is usually a foliar-applied and foliar-absorbed herbicide, and top-killed cogongrass lacked sufficient aboveground surface area to carry the herbicide to rhizomes [146]. Carefully timed herbicide treatments may control cogongrass for as long as 1 or 2 years, but without establishment of desirable native species, cogongrass can eventually reinfest treated areas [118,133]"

Qsn #	Question	Answer
	MacDonald, G. E. (2004). Cogongrass (Imperata cylindrica)—biology, ecology, and management. Critical Reviews in Plant Sciences, 23(5), 367-380	"Over the last 30 years, several herbicides have been evaluated for cogongrass control with few successes (Dickens and Buchanan, 1975; Sandanam and Jayasinghe, 1977). Single applications of soil sterilants have been shown to provide acceptable but expensive control (Dickens and Buchanan, 1975; Barnett et al., 2000). Dalapon was shown to have activity on cogongrass, but this material is no longer manufactured (Dickens and Buchanan, 1975; Willard et al., 1996). Glufosinate provides good initial control, but regrowth occurs within 6 months (Gaffney, 1996; Barnett et al., 2000). Fluazifopbutyl, clethodim, sethoxydim, quizalofop, fenoxaprop, diclofop, and imazapic provided limited activity in field and greenhouse studies but never satisfactory control (Gaffney, 1996; Mask et al., 2000, 2001). However, Avav (2000) demonstrated good control of cogongrass in soybean production in the savanna zone of Nigeria with fluazifop-butyl. To date, the most effective herbicides for cogongrass management are glyphosate and imazapyr (Willard et al., 1997; Dozier et al., 1998; Udensi et al., 1999; Barnett et al., 2001; MacDonald et al., 2002). These materials are broad-spectrum, systemic herbicides that have been shown to provide good control of cogongrass for one year after application (Miller, 2000). Applications in the fall in the southeastern U.S. have resulted in greater efficacy for both herbicides (Johnson et al., 1999). This has been attributed to the basipetal flow of photosynthates that occurs at this time of year (Gaffney, 1996; Tanner et al., 1992). Generally, imazapyr provides control for a longer period of time due to soil activity, but off-target effects limits its use in certain areas (MacDonald et al., 2002)."

804	**Tolerates, or benefits from, mutilation, cultivation, or fire**	**y**
	Source(s)	**Notes**
	Howard, J. L. (2005). Imperata brasiliensis, I. cylindrica. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/graminoid/imspp/all.html . [Accessed 18 Jan 2022]	"Rhizomes sprout readily after mowing, grazing, or burning removes top-growth [8]. A low root:rhizome ratio aids in rapid regrowth after fire or mowing [124]. In a growth chamber study, Ayeni and Duke [8] found old, large rhizome segments showed best stem sprouting and biomass gain compared to small, younger rhizome segments. "

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

Summary of Risk Traits:

High Risk / Undesirable Traits
• Broad climate suitability and elevation range
• Thrives and spreads in regions with tropical climates
• Naturalized or naturalizing on Hawaii Island, widely naturalized elsewhere
• A Hawaii state noxious weed
• A serious agricultural and environmental weed
• Potentially allelopathic
• Roots can penetrate and parasitize other plants
• All but the young shoots unpalatable to grazing animals
• Increases fire risk and fuel load
• Moderate shade tolerance
• Tolerates many soil types
• Forms dense monocultures that exclude other vegetation
• Reproduces by seeds and vegetatively by rhizomes
• Hybridizes with other Imperata species
• Reaches maturity in one year
• Seeds dispersed by wind and as a possible crop or soil contaminant
• Rhizomes dispersed by machinery and as a soil contaminant
• Intentionally cultivated
• Prolific seed producer (depending on genetic variability in populations)
• Tolerates grazing, mowing and fire

Low Risk Traits
• Non-toxic to animals (who generally do not graze on grass)
• Self-incompatible populations may limit seed production and potential for wind, or long-distance seed dispersal
• Short-lived seeds lose viability in <1 year
• Herbicides may provide effective control