

Taxon: Cymbopogon winterianus Jowitt

Family: Poaceae

Common Name(s): Burma citronella
Java citronella
maha pangiri grass
Winter's grass

Synonym(s):

Assessor: Chuck Chimera

Status: Assessor Approved

End Date: 1 Mar 2018

WRA Score: -5.0

Designation: L

Rating: Low Risk

Keywords: Cultivated Grass, Aromatic, Clumping, Essential Oil, Rarely Seeds

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

Qsn #	Question	Answer Option	Answer
409	Is a shade tolerant plant at some stage of its life cycle	y=1, n=0	n
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y=1, n=0	n
411	Climbing or smothering growth habit	y=1, n=0	n
412	Forms dense thickets	y=1, n=0	n
501	Aquatic	y=5, n=0	n
502	Grass	y=1, n=0	y
503	Nitrogen fixing woody plant	y=1, n=0	n
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y=1, n=0	n
601	Evidence of substantial reproductive failure in native habitat	y=1, n=0	n
602	Produces viable seed	y=1, n=-1	y
603	Hybridizes naturally	y=1, n=-1	y
604	Self-compatible or apomictic		
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	n
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	1
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y=1, n=-1	n
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant	y=1, n=-1	n
704	Propagules adapted to wind dispersal		
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/m ²)	y=1, n=-1	n
802	Evidence that a persistent propagule bank is formed (>1 yr)		
803	Well controlled by herbicides		
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?	y
	Source(s)	Notes
	Oyen, L.P.A & Dung, N. X. (eds.). (1999). Plant Resource. s of South-East Asia 19, Essential-oil Plants. Prosea Foundation, Bogor, Indonesia	"C. winterianus is only known from cultivation and most probably originated in southern India or Sri Lanka. C. winterianus was brought to Java at an early date and was taken into cultivation before 1900. Large-scale production and the use of improved selections and distillation equipment in Java started around 1900. At present C. winterianus is cultivated throughout the tropics. In South-East Asia it is important in Indonesia and Vietnam and elsewhere in Brazil, China, Ghana, Guatemala, Haiti, Honduras and India."

102	Has the species become naturalized where grown?	n
	Source(s)	Notes
	Oyen, L.P.A & Dung, N. X. (eds.). (1999). Plant Resource. s of South-East Asia 19, Essential-oil Plants. Prosea Foundation, Bogor, Indonesia	"C. winterianus is only known from cultivation and most probably originated in southern India or Sri Lanka."
	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	"This species, known only from cultivation, produces citronella oil of a higher quality than that from <i>Cymbopogon nardus</i> ."

103	Does the species have weedy races?	n
	Source(s)	Notes
	Oyen, L.P.A & Dung, N. X. (eds.). (1999). Plant Resource. s of South-East Asia 19, Essential-oil Plants. Prosea Foundation, Bogor, Indonesia	[Sterile cultivars may be less likely to spread, but no evidence that weedy races exist] "C. winterianus is only known from cultivation and most probably originated in southern India or Sri Lanka." ... "Many cultivars of C. winterianus, if allowed to flower, do not produce viable seed."

Qsn #	Question	Answer
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
	Oyen, L.P.A & Dung, N. X. (eds.). (1999). Plant Resource. s of South-East Asia 19, Essential-oil Plants. Prosea Foundation, Bogor, Indonesia	"C. winterianus is grown throughout the tropics and warm subtropics, provided moisture is amply available."
	USDA, ARS, Germplasm Resources Information Network. 2018. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 28 Feb 2018]	"Cultivated Africa West Tropical Africa: Ghana Asia-Temperate China: China Asia-Tropical Indian Subcontinent: India Indo-China: Vietnam Malesia: Indonesia Southern America Brazil: Brazil Central America: Guatemala ; Honduras"

202	Quality of climate match data	High
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2018. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 28 Feb 2018]	

203	Broad climate suitability (environmental versatility)	n
	Source(s)	Notes
	Oyen, L.P.A & Dung, N. X. (eds.). (1999). Plant Resource. s of South-East Asia 19, Essential-oil Plants. Prosea Foundation, Bogor, Indonesia	"C. winterianus is grown throughout the tropics and warm subtropics, provided moisture is amply available. A total annual rainfall of 2000-2500 mm evenly distributed over the year is needed for good, sustained yields. Where there is a pronounced dry season, irrigation is required if C. winterianus is to persist." ... "Generally, C. winterianus is found below 500 m altitude. However, in India, cultivars adapted to higher altitudes have been selected that yield well up to at least 1200 m, e.g. in tea-growing areas in Assam. Average daytime temperatures of 22-27°C are optimal for growth. Low temperatures retard growth and may reduce leaf-oil content. Even light frost causes severe damage and serious frost is often lethal."
	Dave's Garden. 2018. Citronella - <i>Cymbopogon winterianus</i> . https://davesgarden.com/guides/pf/go/54667/ . [Accessed 28 Feb 2018]	"Hardiness: USDA Zone 9a: to -6.6 °C (20 °F) USDA Zone 9b: to -3.8 °C (25 °F) USDA Zone 10a: to -1.1 °C (30 °F) USDA Zone 10b: to 1.7 °C (35 °F) USDA Zone 11: above 4.5 °C (40 °F)"

Qsn #	Question	Answer
204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	Notes
	Oyen, L.P.A & Dung, N. X. (eds.). (1999). Plant Resource. s of South-East Asia 19, Essential-oil Plants. Prosea Foundation, Bogor, Indonesia	"C. winterianus is only known from cultivation and most probably originated in southern India or Sri Lanka. C. winterianus was brought to Java at an early date and was taken into cultivation before 1900."
	Quattrocchi, U. 2006. CRC World Dictionary of Grasses: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"India, Southeast Asia, Sri Lanka."

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	Notes
	Oyen, L.P.A & Dung, N. X. (eds.). (1999). Plant Resource. s of South-East Asia 19, Essential-oil Plants. Prosea Foundation, Bogor, Indonesia	"At present C. winterianus is cultivated throughout the tropics. In South-East Asia it is important in Indonesia and Vietnam and elsewhere in Brazil, China, Ghana, Guatemala, Haiti, Honduras and India."

301	Naturalized beyond native range	n
	Source(s)	Notes
	Oyen, L.P.A & Dung, N. X. (eds.). (1999). Plant Resource. s of South-East Asia 19, Essential-oil Plants. Prosea Foundation, Bogor, Indonesia	"C. winterianus is only known from cultivation and most probably originated in southern India or Sri Lanka."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Cymbopogon winterianus Jowitt ... References: China-N-1796, Colombia-N-1796, Nicaragua-N-1796, Sri Lanka-N-1796, India-W-1977." [Listed as naturalized, but primary references indicate that this species is not naturalized in the regions specified]
	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	"This species, known only from cultivation, produces citronella oil of a higher quality than that from Cymbopogon nardus."
	Wagner, W.L., Herbst, D.R.& Lorence, D.H. 2018. Flora of the Hawaiian Islands. Smithsonian Institution, Washington, D.C. http://botany.si.edu/ . [Accessed 28 Feb 2018]	No evidence to date

302	Garden/amenity/disturbance weed	n
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence

303	Agricultural/forestry/horticultural weed	n
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence

Qsn #	Question	Answer
304	Environmental weed	n
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	No evidence

305	Congeneric weed	y
	Source(s)	Notes
	BioNET-EAFRINE. 2011. <i>Cymbopogon nardus</i> (Blue Citronella Grass). http://keys.lucidcentral.org/ ... /Cymbopogon_nardus_%28Blue_Citronella_Grass%29.htm . [Accessed 28 Feb 2018]	" <i>Cymbopogon nardus</i> can take over rangelands where it lowers the yield and quality of the forage. It tends to increase where there has been overgrazing though grazing can be used as a management method (see below). The grass is unpalatable to cattle which have been known to die of starvation when it is available in abundance. Buffalo will eat it sparingly and elephants will accept it during the dry season. It has also been detected in national parks in Uganda and may constitute a threat to biodiversity."
	U.S. Fish and Wildlife Service. 2011. Species Assessment Form for <i>Ranunculus hawaiensis</i> . http://ecos.fws.gov/ . [Accessed 28 Feb 2018]	" <i>Ranunculus hawaiensis</i> is threatened by introduced pasture grasses that degrade and destroy habitat and outcompete native plants (HBMP 2008)." ... "Nonnative plants which pose the greatest threats to <i>R. hawaiensis</i> on the island of Maui are: <i>P. clandestinum</i> , <i>H. lanatus</i> , and <i>Cymbopogon refractus</i> (barbwire grass) (A. Medeiros, in litt. 1995)."

401	Produces spines, thorns or burrs	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] "Perennial, large, tall, herbaceous, terete, smooth, glabrous, tufted, forming large clumps, somewhat glaucous, flowering culms arching, leaf blades smooth and gradually narrowed at the base, shortly rhizomatous, leaves sheathing and drooping, loose inflorescence, large false panicle much branched, spatheoles linear-lanceolate subtending a pair of racemes, racemes ciliate, lowest pedicel not swollen, sessile spikelet with 2 florets, lower floret reduced to an empty lemma, upper floret hermaphrodite, lower glume concave and winged, palea absent, 2 lodicules, 3 stamens, plumose stigmas, pedicelled spikelet male or sterile with florets reduced to a scale"

402	Allelopathic	
	Source(s)	Notes
	Suwitchayanon, P., Pukclai, P., & Kato-Noguchi, H. 2013. Allelopathic activity of <i>Cymbopogon nardus</i> (Poaceae): A preliminary study. <i>Journal of Plant Studies</i> , 2(2): 1-6	[Unknown. Allelopathic properties in other <i>Cymbopogon</i> species] "The results suggest that <i>C. nardus</i> may have allelopathic compounds and may be a candidate for isolation and identification of allelopathic compounds to develop an alternative weed management option."

403	Parasitic	n
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Qsn #	Question	Answer
	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 from a shallowly rooted rhizome. Culms tufted, robust, up to 2 m or more tall." [Poaceae]

404	Unpalatable to grazing animals	y
	Source(s)	Notes
	Gross, E. M., Drouet-Hoguet, N., Subedi, N., & Gross, J. (2017). The potential of medicinal and aromatic plants (MAPs) to reduce crop damages by Asian Elephants (<i>Elephas maximus</i>). <i>Crop Protection</i> , 100, 29-37	[Not consumed by elephants] "In this study, seven medicinal and aromatic plants (MAPs) containing higher amounts of specific plant secondary compounds were explored for their attractiveness to wild Asian elephants against a control of rice (<i>Oryza sativa</i> L.) and maize (<i>Zea mays</i> L.). The results show that chamomile (<i>Matricaria chamomilla</i> L.), coriander (<i>Coriandrum sativum</i> L.), mint (<i>Mentha arvensis</i> L.), basil (<i>Ocimum basilicum</i> L.), turmeric (<i>Curcuma longa</i> L.), lemon grass (<i>Cymbopogon flexuosus</i> (Nees ex Steud.) W.Watson) and citronella (<i>Cymbopogon winterianus</i> Jowitt.) were less attractive and were not consumed by elephants compared to rice." ... "To demonstrate further that lemon grass and citronella are unpalatable to Asian elephants, further research needs to be conducted."

405	Toxic to animals	n
	Source(s)	Notes
	Useful Tropical Plants Database. 2018. <i>Cymbopogon winterianus</i> . http://tropical.theferns.info . [Accessed 28 Feb 2018]	"Known Hazards - None known"
	Quattrocchi, U. 2012. <i>CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology</i> . CRC Press, Boca Raton, FL	No evidence
	Wagstaff, D.J. 2008. <i>International poisonous plants checklist: an evidence-based reference</i> . CRC Press, Boca Raton, FL	No evidence

406	Host for recognized pests and pathogens	
	Source(s)	Notes
	Oyen, L.P.A & Dung, N. X. (eds.). (1999). <i>Plant Resource. s of South-East Asia 19, Essential-oil Plants</i> . Prosea Foundation, Bogor, Indonesia	[Possible host of sugar cane mosaic virus] "Diseases and pests: Leaf blight caused by <i>Curvularia andropogonis</i> may cause serious reductions in leaf and oil production of Java citronella grass. Initial symptoms consist of brownish patches on the tips and margins of leaves, which may dry out later. Prophylactic spraying with dithiocarbamates at intervals of 10-15 days can effectively control the disease. Anthracnose caused by <i>Colletotrichum graminicola</i> may also cause damage and is controlled similarly. In Latin America, sugar cane mosaic virus is the most important disease. No serious pests have been reported."

407	Causes allergies or is otherwise toxic to humans	n
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Qsn #	Question	Answer
	Source(s)	Notes
	Useful Tropical Plants Database. 2018. <i>Cymbopogon winterianus</i> . http://tropical.theferns.info . [Accessed 28 Feb 2018]	"Known Hazards None known"
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"Scented essential oils used as insect repellents, germicide, deodorant, medicinal, antibacterial, antidepressant, antispasmodic, rheumatism and arthritic pain."
	Wagstaff, D.J. 2008. International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	No evidence

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	Notes
	Oyen, L.P.A & Dung, N. X. (eds.). (1999). Plant Resource. s of South-East Asia 19, Essential-oil Plants. Prosea Foundation, Bogor, Indonesia	"C. winterianus is only known from cultivation and most probably originated in southern India or Sri Lanka." [Does not occur outside cultivation]

409	Is a shade tolerant plant at some stage of its life cycle	n
	Source(s)	Notes
	Oyen, L.P.A & Dung, N. X. (eds.). (1999). Plant Resource. s of South-East Asia 19, Essential-oil Plants. Prosea Foundation, Bogor, Indonesia	"C. winterianus is sometimes intercropped with young rubber, cocoa, pepper or vanilla or underplanted in tall tree plantations. The degree of canopy shade determines the reduction in herbage yield."
	Useful Tropical Plants Database. 2018. <i>Cymbopogon winterianus</i> . http://tropical.theferns.info . [Accessed 1 Mar 2018]	"Grows best in a dry to moist, well-drained soil and a position in full sun [200]."
	Dave's Garden. 2018. Citronella - <i>Cymbopogon winterianus</i> . https://davesgarden.com/guides/pf/go/54667/ . [Accessed 28 Feb 2018]	"Sun Exposure: Full Sun Sun to Partial Shade"

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	n
	Source(s)	Notes
	Oyen, L.P.A & Dung, N. X. (eds.). (1999). Plant Resource. s of South-East Asia 19, Essential-oil Plants. Prosea Foundation, Bogor, Indonesia	"C. winterianus requires more fertile soils than the other <i>Cymbopogon</i> grasses and on poor soils its economic life is short. It prefers neutral to slightly acid, well-drained, loamy soils with an adequate supply of moisture and nutrients. It tolerates only short periods of waterlogging and is intolerant of salinity."
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"intolerant of salinity, tolerates only short periods of waterlogging, best on neutral to slightly acid well-drained loamy soils"

411	Climbing or smothering growth habit	n
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Qsn #	Question	Answer
	Source(s)	Notes
	Oyen, L.P.A & Dung, N. X. (eds.). (1999). Plant Resource. s of South-East Asia 19, Essential-oil Plants. Prosea Foundation, Bogor, Indonesia	"Perennial, tufted, aromatic grass with numerous erect culms arising from a short rhizome. Culm (stem) up to 2.5 m tall, terete, smooth, glabrous."

412	Forms dense thickets	n
	Source(s)	Notes
	Oyen, L.P.A & Dung, N. X. (eds.). (1999). Plant Resource. s of South-East Asia 19, Essential-oil Plants. Prosea Foundation, Bogor, Indonesia	[No evidence. Only cultivated] "C. winterianus is only known from cultivation and most probably originated in southern India or Sri Lanka. C. winterianus was brought to Java at an early date and was taken into cultivation before 1900. Large-scale production and the use of improved selections and distillation equipment in Java started around 1900. At present C. winterianus is cultivated throughout the tropics. In South-East Asia it is important in Indonesia and Vietnam and elsewhere in Brazil, China, Ghana, Guatemala, Haiti, Honduras and India."
	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] "Commonly cultivated. Guangdong, Hainan, Sichuan, Yunnan [origin unknown; cultivated mainly in Indonesia]. This species, known only from cultivation, produces citronella oil of a higher quality than that from <i>Cymbopogon nardus</i> ."

501	Aquatic	n
	Source(s)	Notes
	Oyen, L.P.A & Dung, N. X. (eds.). (1999). Plant Resource. s of South-East Asia 19, Essential-oil Plants. Prosea Foundation, Bogor, Indonesia	[Terrestrial] "Perennial, tufted, aromatic grass with numerous erect culms arising from a short rhizome." ... "C. winterianus requires more fertile soils than the other <i>Cymbopogon</i> grasses ..."

502	Grass	y
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2018. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 28 Feb 2018]	Family: Poaceae (alt.Gramineae) Subfamily: Panicoideae Tribe: Andropogoneae Subtribe: Anthristirinae

503	Nitrogen fixing woody plant	n
	Source(s)	Notes
	Oyen, L.P.A & Dung, N. X. (eds.). (1999). Plant Resource. s of South-East Asia 19, Essential-oil Plants. Prosea Foundation, Bogor, Indonesia	"Perennial, tufted, aromatic grass with numerous erect culms arising from a short rhizome."

Qsn #	Question	Answer
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 from a shallowly rooted rhizome. Culms tufted, robust, up to 2 m or more tall."

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	Notes
	Oyen, L.P.A & Dung, N. X. (eds.). (1999). Plant Resource. s of South-East Asia 19, Essential-oil Plants. Prosea Foundation, Bogor, Indonesia	"C. winterianus is only known from cultivation and most probably originated in southern India or Sri Lanka. C. winterianus was brought to Java at an early date and was taken into cultivation before 1900. Large-scale production and the use of improved selections and distillation equipment in Java started around 1900. At present C. winterianus is cultivated throughout the tropics. In South-East Asia it is important in Indonesia and Vietnam and elsewhere in Brazil, China, Ghana, Guatemala, Haiti, Honduras and India."

602	Produces viable seed	y
	Source(s)	Notes
	Useful Tropical Plants Database. 2018. <i>Cymbopogon winterianus</i> . http://tropical.theferns.info . [Accessed 1 Mar 2018]	"Propagation: Seed - this is often not formed. Seedlings should not be used, other than in breeding programmes, since they are likely to be inferior to the parent plant in essential oil production."
	Oyen, L.P.A & Dung, N. X. (eds.). (1999). Plant Resource. s of South-East Asia 19, Essential-oil Plants. Prosea Foundation, Bogor, Indonesia	[Yes, but sterile cultivars exist] "Many cultivars of <i>C. winterianus</i> , if allowed to flower, do not produce viable seed." ... " <i>C. winterianus</i> is generally propagated vegetatively, as propagation by seed takes a long time and carries the risk of including hybrids of <i>C. winterianus</i> and <i>C. nardus</i> ."

603	Hybridizes naturally	y
	Source(s)	Notes
	Oyen, L.P.A & Dung, N. X. (eds.). (1999). Plant Resource. s of South-East Asia 19, Essential-oil Plants. Prosea Foundation, Bogor, Indonesia	[Suggests that hybridization occurs naturally] " <i>C. winterianus</i> is generally propagated vegetatively, as propagation by seed takes a long time and carries the risk of including hybrids of <i>C. winterianus</i> and <i>C. nardus</i> ."

604	Self-compatible or apomictic	
	Source(s)	Notes
	Connor, H. E. (1979). Breeding systems in the grasses: a survey. <i>New Zealand Journal of Botany</i> , 17(4): 547-574	[Unknown for <i>C. winterianus</i>] "Table 6 Genera with self-incompatible species. or principally cross-fertilised species." [Includes <i>Cymbopogon</i>]

605	Requires specialist pollinators	n
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Qsn #	Question	Answer
	Source(s)	Notes
	Zomlefer, W.B. 1994. Guide to Flowering Plant Families. The University of North Carolina Press, Chapel Hill & London	"The reduced flowers are anemophilous" [Poaceae]

606	Reproduction by vegetative fragmentation	n
	Source(s)	Notes
	Oyen, L.P.A & Dung, N. X. (eds.). (1999). Plant Resource. s of South-East Asia 19, Essential-oil Plants. Prosea Foundation, Bogor, Indonesia	[Propagated vegetatively by division. Short rhizome, with no evidence of natural vegetative spread] "Perennial, tufted, aromatic grass with numerous erect culms arising from a short rhizome." ... "Splits of a clump of <i>C. winterianus</i> root easily, usually within 3 weeks after planting and tillering starts after the 4th week." ... " <i>C. winterianus</i> is generally propagated vegetatively, as propagation by seed takes a long time and carries the risk of including hybrids of <i>C. winterianus</i> and <i>C. nardus</i> . Offshoots for planting are obtained by division of clumps."

607	Minimum generative time (years)	1
	Source(s)	Notes
	Oyen, L.P.A & Dung, N. X. (eds.). (1999). Plant Resource. s of South-East Asia 19, Essential-oil Plants. Prosea Foundation, Bogor, Indonesia	[Flowers after 1-year from division. Some plantlets may form on inflorescence. Probably within first year] "Clumps of <i>C. winterianus</i> can become up to 0.5 m in diameter and economic lifetime is about 6 years. Flowering starts about 8 months after planting, but plants are cut preferably just prior to flowering. Many cultivars of <i>C. winterianus</i> , if allowed to flower, do not produce viable seed. Viviparous formation of plantlets has been observed in inflorescences that had flowered before the start of the rainy season. The plantlets appear to arise from the nodes or the axil of the spatheoles. They sometimes produce their own inflorescence while still attached to the mother plant."

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	n
	Source(s)	Notes
	Oyen, L.P.A & Dung, N. X. (eds.). (1999). Plant Resource. s of South-East Asia 19, Essential-oil Plants. Prosea Foundation, Bogor, Indonesia	[No evidence. Fruit & seeds sometimes not produced. No means of external attachment] "Fruit a cylindrical to subglobose caryopsis, with basal hilum." ... "Many cultivars of <i>C. winterianus</i> , if allowed to flower, do not produce viable seed. Viviparous formation of plantlets has been observed in inflorescences that had flowered before the start of the rainy season. The plantlets appear to arise from the nodes or the axil of the spatheoles. They sometimes produce their own inflorescence while still attached to the mother plant."

702	Propagules dispersed intentionally by people	y
	Source(s)	Notes

Qsn #	Question	Answer
	Oyen, L.P.A & Dung, N. X. (eds.). (1999). Plant Resource. s of South-East Asia 19, Essential-oil Plants. Prosea Foundation, Bogor, Indonesia	"At present <i>C. winterianus</i> is cultivated throughout the tropics. In South-East Asia it is important in Indonesia and Vietnam and elsewhere in Brazil, China, Ghana, Guatemala, Haiti, Honduras and India."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Dispersed by: Humans"

703	Propagules likely to disperse as a produce contaminant	n
	Source(s)	Notes
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Dispersed by: Humans" [No evidence]
	Oyen, L.P.A & Dung, N. X. (eds.). (1999). Plant Resource. s of South-East Asia 19, Essential-oil Plants. Prosea Foundation, Bogor, Indonesia	[No evidence] "Flowering starts about 8 months after planting, but plants are cut preferably just prior to flowering. Many cultivars of <i>C. winterianus</i> , if allowed to flower, do not produce viable seed. Viviparous formation of plantlets has been observed in inflorescences that had flowered before the start of the rainy season." ... " <i>C. winterianus</i> is generally propagated vegetatively, as propagation by seed takes a long time and carries the risk of including hybrids of <i>C. winterianus</i> and <i>C. nardus</i> ."
	Useful Tropical Plants Database. 2018. <i>Cymbopogon winterianus</i> . http://tropical.theferns.info . [Accessed 1 Mar 2018]	[No evidence] "Propagation: Seed - this is often not formed. Seedlings should not be used, other than in breeding programmes, since they are likely to be inferior to the parent plant in essential oil production. Division of the clumps is very easy, with the divisions rooting quickly and forming new stems within a month[310]."

704	Propagules adapted to wind dispersal	
	Source(s)	Notes
	Oyen, L.P.A & Dung, N. X. (eds.). (1999). Plant Resource. s of South-East Asia 19, Essential-oil Plants. Prosea Foundation, Bogor, Indonesia	[Unknown. Wind may facilitate movement, but fruit & seeds sometimes not produced] "Fruit a cylindrical to subglobose caryopsis, with basal hilum." ... "Many cultivars of <i>C. winterianus</i> , if allowed to flower, do not produce viable seed. Viviparous formation of plantlets has been observed in inflorescences that had flowered before the start of the rainy season. The plantlets appear to arise from the nodes or the axil of the spatheoles. They sometimes produce their own inflorescence while still attached to the mother plant."

Qsn #	Question	Answer
705	Propagules water dispersed	n
	Source(s)	Notes
	Oyen, L.P.A & Dung, N. X. (eds.). (1999). Plant Resource. s of South-East Asia 19, Essential-oil Plants. Prosea Foundation, Bogor, Indonesia	[Buoyance unknown. Fruit & seeds sometimes not produced. No evidence of spread along riparian corridors or in proximity to aquatic habitats] "C. winterianus is only known from cultivation and most probably originated in southern India or Sri Lanka." ... "Fruit a cylindrical to subglobose caryopsis, with basal hilum." ... "Many cultivars of C. winterianus, if allowed to flower, do not produce viable seed. Viviparous formation of plantlets has been observed in inflorescences that had flowered before the start of the rainy season. The plantlets appear to arise from the nodes or the axil of the spatheoles. They sometimes produce their own inflorescence while still attached to the mother plant."

706	Propagules bird dispersed	n
	Source(s)	Notes
	Oyen, L.P.A & Dung, N. X. (eds.). (1999). Plant Resource. s of South-East Asia 19, Essential-oil Plants. Prosea Foundation, Bogor, Indonesia	[No evidence] "Fruit a cylindrical to subglobose caryopsis, with basal hilum." ... "Many cultivars of C. winterianus, if allowed to flower, do not produce viable seed. Viviparous formation of plantlets has been observed in inflorescences that had flowered before the start of the rainy season. The plantlets appear to arise from the nodes or the axil of the spatheoles. They sometimes produce their own inflorescence while still attached to the mother plant."

707	Propagules dispersed by other animals (externally)	n
	Source(s)	Notes
	Oyen, L.P.A & Dung, N. X. (eds.). (1999). Plant Resource. s of South-East Asia 19, Essential-oil Plants. Prosea Foundation, Bogor, Indonesia	[No evidence. Fruit & seeds sometimes not produced. No means of external attachment] "Fruit a cylindrical to subglobose caryopsis, with basal hilum." ... "Many cultivars of C. winterianus, if allowed to flower, do not produce viable seed. Viviparous formation of plantlets has been observed in inflorescences that had flowered before the start of the rainy season. The plantlets appear to arise from the nodes or the axil of the spatheoles. They sometimes produce their own inflorescence while still attached to the mother plant."

708	Propagules survive passage through the gut	n
	Source(s)	Notes
	Oyen, L.P.A & Dung, N. X. (eds.). (1999). Plant Resource. s of South-East Asia 19, Essential-oil Plants. Prosea Foundation, Bogor, Indonesia	[No evidence of spread into pastures or wildlands where grazing animals would presumably disperse seeds] "C. winterianus is only known from cultivation and most probably originated in southern India or Sri Lanka."
	WRA Specialist. 2018. Personal Communication	Seeds unlikely to be consumed due to lack of palatability of grass, & limited seed production in cultivation.

801	Prolific seed production (>1000/m2)	n
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Qsn #	Question	Answer
	Source(s)	Notes
	Oyen, L.P.A & Dung, N. X. (eds.). (1999). Plant Resource. s of South-East Asia 19, Essential-oil Plants. Prosea Foundation, Bogor, Indonesia	"Flowering starts about 8 months after planting, but plants are cut preferably just prior to flowering. Many cultivars of <i>C. winterianus</i> , if allowed to flower, do not produce viable seed. Viviparous formation of plantlets has been observed in inflorescences that had flowered before the start of the rainy season." ... " <i>C. winterianus</i> is generally propagated vegetatively, as propagation by seed takes a long time and carries the risk of including hybrids of <i>C. winterianus</i> and <i>C. nardus</i> ."
	Useful Tropical Plants Database. 2018. <i>Cymbopogon winterianus</i> . http://tropical.theferns.info . [Accessed 1 Mar 2018]	"Propagation: Seed - this is often not formed. Seedlings should not be used, other than in breeding programmes, since they are likely to be inferior to the parent plant in essential oil production."

802	Evidence that a persistent propagule bank is formed (>1 yr)	
	Source(s)	Notes
	Royal Botanic Gardens Kew. (2018) Seed Information Database (SID). Version 7.1. Available from: http://data.kew.org/sid/ . [Accessed 1 Mar 2018]	Unknown. Several related <i>Cymbopogon</i> species have orthodox seeds

803	Well controlled by herbicides	
	Source(s)	Notes
	BioNET-EAFRINE. 2011. <i>Cymbopogon nardus</i> (Blue Citronella Grass). http://keys.lucidcentral.org/ ... /Cymbopogon_nardus_%28Blue_Citronella_Grass%29.htm . [Accessed 28 Feb 2018]	[Unknown. Other <i>Cymbopogon</i> species effectively controlled by herbicides] "Spot spraying with a suitable herbicide reduces <i>C. nardus</i> without negatively impacting indigenous species and indigenous species respond positively to <i>C. nardus</i> reduction (Ssegawa 2007)."
	WRA Specialist. 2018. Personal Communication	Unknown. No information on herbicide efficacy or chemical control of this species

804	Tolerates, or benefits from, mutilation, cultivation, or fire	y
	Source(s)	Notes
	Oyen, L.P.A & Dung, N. X. (eds.). (1999). Plant Resource. s of South-East Asia 19, Essential-oil Plants. Prosea Foundation, Bogor, Indonesia	[Tolerates repeated cutting & harvesting] "The first harvest of <i>C. winterianus</i> is usually taken 6-12 months after planting and subsequently 3-4 times per year, depending on the rate of regrowth. In Indonesia, up to 6 cuts per year are sometimes possible, but 4 annual harvests give the highest oil yield. In northern India, the timing of harvesting is related to the onset and duration of the monsoon. In Assam, crops planted in April-May are first harvested after 3-4 months and subsequently every 2 months. During the dry winter season (November-February), only 2 harvests are taken. Many farmers use plant height as an indicator of the best time for harvesting. In Guatemala a crop 140 cm tall is considered ready for harvesting. <i>C. winterianus</i> can be harvested for up to 5-6 years, but it is generally more economical to replace a crop after 4 years."

Qsn #	Question	Answer
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	Notes
	WRA Specialist. 2018. Personal Communication	Unknown

Summary of Risk Traits:

High Risk / Undesirable Traits

- Thrives in tropical climates (increases probability that it could establish in Hawaiian Islands)
- Other *Cymbopogon* species have become invasive
- Unpalatable to grazing animals
- Reproduces by seed (rarely)
- Hybridizes with *C. nardus*
- Able to reach maturity in one growing season
- Intentionally cultivated (& dispersed) by people
- Tolerates and can regrow after repeated cutting & harvesting

Low Risk Traits

- Known only from cultivation (no verified reports of naturalization or invasiveness)
- Unarmed (no spines, thorns, or burrs)
- Source of essential oil
- Grows best in full sun
- Grows on limited soil types
- Not reported to spread vegetatively
- Limited or absent seed production reduces risk of inadvertent dispersal