

<b>Taxon:</b> <i>Zoysia matrella</i> (L.) Merr.	<b>Family:</b> Poaceae
<b>Common Name(s):</b> Korean grass Manila grass Manila temple grass siglap grass temple grass	<b>Synonym(s):</b> Agrostis matrella L. Osterdamia matrella (L.) Kuntze Zoysia pungens Willd.

<b>Assessor:</b> Chuck Chimera	<b>Status:</b> Assessor Approved	<b>End Date:</b> 1 Apr 2018
<b>WRA Score:</b> 7.0	<b>Designation:</b> H(HPWRA)	<b>Rating:</b> High Risk

**Keywords:** Lawn Grass, Naturalized, Forage, Shade-Tolerant, Spreads Vegetatively

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

Qsn #	Question	Answer Option	Answer
408	Creates a fire hazard in natural ecosystems	y=1, n=0	n
409	Is a shade tolerant plant at some stage of its life cycle	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	y
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	y
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	2
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y=1, n=-1	n
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant		
704	Propagules adapted to wind dispersal	y=1, n=-1	n
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		
801	Prolific seed production (>1000/m <sup>2</sup> )		
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?	n
	Source(s)	Notes
	Tsuruta, S. I., Kobayashi, M., & Ebina, M. (2011). <i>Zoysia</i> . In <i>Wild crop relatives: Genomic and Breeding Resources</i> (pp. 297-309). Springer, Berlin Heidelberg	[No evidence of wild type domestication. Cultivars not evaluated] "By the 1980s, the breeding of zoysia grass had started in Japan as well. "Miyako," a naturally interspecific hybrid between <i>Z. japonica</i> and <i>Z. matrella</i> that was originally selected, was the first cultivar registered in Japan (Asano and Aoki 1998). <i>Z. matrella</i> "Winter Carpet" and "Winter Field" were released by Nagatomi et al. (1993, 1998) in 1995 and 1996. These cultivars were first produced by gamma-irradiation mutagenesis in the sod; they exhibit a completely distinct character: retaining green leaves under the same seasonal conditions in which other varieties of <i>Z. matrella</i> lose their green leaves. Thus far, 41 zoysia grass varieties have been released in Japan. Most cultivated zoysia grasses have been improved through conventional breeding methods such as clonal selection, hybridization, and mutagenesis. Because zoysia grasses show great natural variation, these will likely be the main methods used for the development of new varieties of zoysia grass."

102	Has the species become naturalized where grown?	
	Source(s)	Notes
	WRA Specialist. 2018. Personal Communication	NA

103	Does the species have weedy races?	
	Source(s)	Notes
	WRA Specialist. 2018. Personal Communication	NA

201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	High
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2018. National Plant Germplasm System [Online Database]. <a href="http://www.ars-grin.gov/npgs/index.html">http://www.ars-grin.gov/npgs/index.html</a> . [Accessed 20 Mar 2018]	"Native Asia-Temperate China: China Guangdong, Hainan Eastern Asia: Japan Ryukyu Islands; Taiwan Asia-Tropical Indian Subcontinent: India ; Sri Lanka Indo-China: Thailand ; Vietnam Malesia: Indonesia ; Malaysia ; Philippines Papuasia: Solomon Islands Australasia Australia: Australia Queensland Pacific Northwestern Pacific: Northern Mariana Islands"

Qsn #	Question	Answer
202	Quality of climate match data	High
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2018. National Plant Germplasm System [Online Database]. <a href="http://www.ars-grin.gov/npgs/index.html">http://www.ars-grin.gov/npgs/index.html</a> . [Accessed 20 Mar 2018]	

203	Broad climate suitability (environmental versatility)	n
	Source(s)	Notes
	CABI. 2018. Invasive Species Compendium. Wallingford, UK: CAB International. <a href="http://www.cabi.org/isc">www.cabi.org/isc</a>	"Z. matrella prefers tropical and subtropical environments with regular rainfall (Duble, 2016). It goes dormant in freezing temperatures (Duble, 2016) and Xuan et al. (2009) determined that the temperature at which 50% of the leaves die is -5.35°C. As a turf grass it is not recommended for cooler areas as it turns brown after several hard frosts and remains brown until late spring (Duble, 2016)."

204	Native or naturalized in regions with tropical or subtropical climates	y
	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	"Coastal sands. Guangdong, Hainan, Taiwan [India, Indonesia, Japan (S Kyushu and Ryukyu Islands), Malaysia, Philippines, Sri Lanka, Thailand, Vietnam]."

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	Notes
	Quattrocchi, U. 2006. CRC World Dictionary of Grasses: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"extensively cultivated, easily established"
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	"Widespread throughout tropical Asia on the coasts of the Indian and western Pacific Oceans and cultivated extensively as a lawn grass..."

301	Naturalized beyond native range	y
	Source(s)	Notes
	Flynn, T. & Lorence, D. H. 1998. New naturalized plant records for the Hawaiian Islands. Bishop Museum Occasional Papers 56: 5-6	"This common ornamental grass is naturalized locally above the high water line on coral sand beach, spreading by rhizomes from old lawn areas behind the beach. Material examined: KAUA'I: Koloa District: Allerton Gardens, Lawa'i-Kai at mouth of Lawa'i Str, west side; strand vegetation with Ipomoea pes-caprae, Vigna marina, Pluchea indica, near sea level, 10 Apr 1995, Lorence & Flynn 7651 (BISH, PTBG, US)."

302	Garden/amenity/disturbance weed	

Qsn #	Question	Answer
	<b>Source(s)</b>	<b>Notes</b>
	Duble, R. L. 2018. Zoysiagrass. <a href="https://aggie-horticulture.tamu.edu/plantanswers/turf/publications/zoysia.html">https://aggie-horticulture.tamu.edu/plantanswers/turf/publications/zoysia.html</a> . [Accessed 1 Apr 2018]	"Zoysia matrella must be propagated from sprigs and is quite slow to become established." [Suggests it may be less invasive]
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	[Potential problem in landscaping] "The grass stems can grow so thick that they choke out other plants, even other grasses."
	CABI. 2018. Invasive Species Compendium. Wallingford, UK: CAB International. <a href="http://www.cabi.org/isc">www.cabi.org/isc</a>	[Potentially aggressive] "Z. matrella is a warm season grass which has been widely planted as a turf grass in tropical and subtropical regions around the world and has naturalized mainly close to where it was planted in disturbed areas. It grows slowly and primarily spreads by rhizomes and stolons, but could also spread by seed. There is no information available on its impacts. It forms dense stands and could displace native species through competition for resources."
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	Cited as a weed of rice, cocoa and coconut crops. Impacts unspecified

303	Agricultural/forestry/horticultural weed	
	<b>Source(s)</b>	<b>Notes</b>
	Morris, H., and Waterhouse, D.F. 2001. The distribution and importance of arthropod pests and weeds of agriculture in Myanmar. ACIAR Monograph No. 67, 73 pp.	"Table 18. Weeds of Myanmar" ... [Zoysia matrella is listed as a "++ widespread and important" weed of cocoa & coconut crops, but impacts are unspecified]
	Moody, K. 1989. Weeds Reported in Rice in South and Southeast Asia. International Rice Research Institute, Manila, Philippines	Reported as a weed of rice crops in Brunei & the Philippines. Impacts unspecified
	Galinato, M.I., Moody, K. & Piggin, C.M. 1999. Upland rice weeds of south and southeast Asia. International Rice Research Institute, Los Baños, Philippines	Reported as a weed of upland rice crops in the Philippines. Impacts unspecified

304	Environmental weed	
	<b>Source(s)</b>	<b>Notes</b>
	CABI. 2018. Invasive Species Compendium. Wallingford, UK: CAB International. <a href="http://www.cabi.org/isc">www.cabi.org/isc</a>	[Unknown] "Z. matrella is present in some conservation areas including Toro Negro State Forest, Maricao Forest Reserve, and Las Cabezas de San Juan Nature Reserve in Puerto Rico (Plants of the Island of Puerto Rico, 2016; UPRRP, 2016) and several parks in south Florida (Institute for Regional Conservation, 2016); however, no information was available on impacts." ... "Very little information is available on impacts and control of Z. matrella in natural areas."

305	Congeneric weed	
	<b>Source(s)</b>	<b>Notes</b>
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	Zoysia japonica, Zoysia macrostachya, Zoysia sinica, & Zoysia tenuifolia are listed as weeds. Impacts are unclear or unspecified

Qsn #	Question	Answer
401	Produces spines, thorns or burrs	n
	Source(s)	Notes
	Wu, Z.Y., Raven, P.H. & Hong, D.Y. ( eds.). 2006. Flora of China. Vol. 22 (Poaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[No evidence] "Perennial, stoloniferous, mat-forming, also with shallow underground rhizomes. Culms up to 20 cm tall. Leaf sheaths glabrous, bearded at mouth with 4–5 mm hairs; leaf blades flat or involute, tough, suberect to spreading, 3–8 cm, 1.5–2.5 mm wide, glabrous or adaxial surface thinly pilose, apex acute. Inflorescence linear, 2–4 × 0.2–0.3 cm, exerted above leaves; spikelets 10–30, loosely overlapping; rachis somewhat wavy; pedicels shorter than spikelet, 1–3 mm, widened at apex. Spikelets 2–3 × ca. 1 mm, yellowish brown or purplish brown; lower glume usually absent; upper glume lanceolate, 5-veined, midrib prominent, sometimes scabrous toward apex, lateral veins obscure, apex obtuse; lemma oblong-ovate, 2–2.5 mm, obscurely 3-veined, midvein sometimes shortly excurrent; palea lanceolate, 1/2 as long as lemma. Anthers 1–1.5 mm. Caryopsis ca. 1.5 mm."

402	Allelopathic	
	Source(s)	Notes
	Qi, G. L., Chen, P., & Zhong, W. J. (2006). Effect of extracting solution from <i>Hemarthria altissima</i> , <i>Ageratum conyzoides</i> and <i>Zoysia matrella</i> on germination and seedling growth of <i>Merremia hederacea</i> and <i>Cajanus cajan</i> . <i>Grassland and Turf</i> , 4, 46-48	[Potentially Yes. Demonstrated unde controlled, laboratory conditions] "The extracting solution from <i>Zoysia matrella</i> slightly showed the inhibition effect to <i>Merremia hederacea</i> and <i>Cajanus cajan</i> (cultivar No.3) in general, but it decreased the seedling fresh weight of <i>Cajanus cajan</i> (cultivar No.4) significantly."

403	Parasitic	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, stoloniferous, mat-forming, also with shallow underground rhizomes." [Poaceae. No evidence]

404	Unpalatable to grazing animals	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	"required frequent grazing to stimulate new growth, young leaves palatable to stock"
	CABI. 2018. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc	"Used as forage on sandy sites and grazed in coconut plantations (FAO, 2015)."

Qsn #	Question	Answer
405	Toxic to animals	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] "required frequent grazing to stimulate new growth, young leaves palatable to stock"
	Wagstaff, D.J. 2008. International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	No evidence

406	Host for recognized pests and pathogens	
	Source(s)	Notes
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	"relatively free of pests and diseases if well tended."
	Bryan Unruh, J., Trenholm, L. E. & Cisar, J. L. 2016. Zoysiagrass for Florida Lawns. ENH11. Revised. Institute of Food and Agricultural Sciences, University of Florida. <a href="http://edis.ifas.ufl.edu">http://edis.ifas.ufl.edu</a> . [Accessed 1 Apr 2018]	[In Florida, impacted by some pests & diseases] "Like other lawn grasses grown in Florida, zoysiagrass lawns encounter pest problems. Periodic control of one or more of these problems is necessary to grow a healthy turf." ... "The most serious insect on zoysiagrass is the Hunting billbug. Billbugs feed on roots, causing the turf to die in irregular-shaped patches." ... "Mole crickets and white grubs can also negatively impact zoysiagrass." ... "Sod webworms can cause periodic cosmetic injury but are not believed to severely damage the turf." ... "Many turf managers state that nematodes are serious pests on zoysiagrasses; however, this is not well documented in scientific literature." ... "Without a doubt, the most troubling disease for zoysiagrass is large (brown) patch (Figure 3). This disease becomes active when soil temperatures (4-inch depth) are between 65°F and 75°F each fall and can be a problem through the following spring."

Qsn #	Question	Answer
407	Causes allergies or is otherwise toxic to humans	
	Source(s)	Notes
	Ogren, T.L. 2015. <i>The Allergy-Fighting Garden</i> . Ten Speed Press, Berkeley, CA	[Possible mild allergen] "Three species of common lawn grass for milder areas of the United States. <i>Z. japonica</i> is Korean grass; <i>Z. matrella</i> is Japanese carpet or Manila grass; and <i>Z. tenuifolia</i> is Mascarene or Korean velvet grass. All three are propagated from plugs or by stolons. Zoysia lawns are popular in parts of zones 9 and 10. The lawns are coarse, thick, and spongy and tend to produce a great deal of thatch. Unlike Bermuda grass, Zoysia does not often flower while it is short, so regular mowing eliminates almost all pollen-producing potential. Zoysia sometimes escapes cultivation to become a problem weed in vacant lots. In these circumstances, it will produce pollen that, while allergenic, is not nearly as potent as that of other lawn grasses."
	Global Species. 2018. <i>Zoysia matrella</i> (Manila grass). <a href="http://www.globalspecies.org/ntaxa/864035#cite_1">http://www.globalspecies.org/ntaxa/864035#cite_1</a> . [Accessed 1 Apr 2018]	Allergen Potential - Medium
	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

408	Creates a fire hazard in natural ecosystems	n
	Source(s)	Notes
	CABI. 2018. <i>Invasive Species Compendium</i> . Wallingford, UK: CAB International. <a href="http://www.cabi.org/isc">www.cabi.org/isc</a>	[No evidence from native or introduced range, despite widespread cultivation] " <i>Z. matrella</i> prefers tropical and subtropical environments with regular rainfall (Duble, 2016). It goes dormant in freezing temperatures (Duble, 2016) and Xuan et al. (2009) determined that the temperature at which 50% of the leaves die is -5.35°C. As a turf grass it is not recommended for cooler areas as it turns brown after several hard frosts and remains brown until late spring (Duble, 2016). It is shade tolerant and adapted to wet and saline sites (FAO, 2015), but is also extremely tolerant of drought (Duble, 2016)."

409	Is a shade tolerant plant at some stage of its life cycle	y
	Source(s)	Notes
	CABI. 2018. <i>Invasive Species Compendium</i> . Wallingford, UK: CAB International. <a href="http://www.cabi.org/isc">www.cabi.org/isc</a>	"It is shade tolerant and adapted to wet and saline sites (FAO, 2015), but is also extremely tolerant of drought (Duble, 2016)."

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
	Source(s)	Notes



Qsn #	Question	Answer
	CABI. 2018. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc	"Soil drainage free Soil reaction acid neutral Soil texture light medium Special soil tolerances infertile saline shallow"
	Bryan Unruh, J., Trenholm, L. E. & Cisar, J. L. 2016. Zoysiagrass for Florida Lawns. ENH11. Revised. Institute of Food and Agricultural Sciences, University of Florida. http://edis.ifas.ufl.edu. [Accessed 1 Apr 2018]	"Zoysiagrasses are adapted to a variety of soil types and have good tolerance to shade, salt, and traffic."

411	Climbing or smothering growth habit	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, stoloniferous, mat-forming, also with shallow underground rhizomes. Culms up to 20 cm tall. Leaf sheaths glabrous, bearded at mouth with 4–5 mm hairs; leaf blades flat or involute, tough, suberect to spreading, 3–8 cm, 1.5–2.5 mm wide, glabrous or adaxial surface thinly pilose, apex acute."

412	Forms dense thickets	y
	Source(s)	Notes
	CABI. 2018. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc	"Z. matrella is a warm season grass which has been widely planted as a turf grass in tropical and subtropical regions around the world and has naturalized mainly close to where it was planted in disturbed areas." ... "It forms dense stands and could displace native species through competition for resources."
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	[Dense, low cover can outcompete and exclude other vegetation] "The grass stems can grow so thick that they choke out other plants, even other grasses."

501	Aquatic	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	[Terrestrial] "Perennial, stoloniferous, mat-forming, also with shallow underground rhizomes." ... "Coastal sands." ... "Zoysia matrella is a good sand-binding and lawn grass."

Qsn #	Question	Answer
502	Grass	y
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2018. National Plant Germplasm System [Online Database]. <a href="http://www.ars-grin.gov/npgs/index.html">http://www.ars-grin.gov/npgs/index.html</a> . [Accessed 20 Mar 2018]	Family: Poaceae (alt.Gramineae) Subfamily: Chloridoideae Tribe: Zoysieae Subtribe: Zoysiinae

503	Nitrogen fixing woody plant	n
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network. 2018. National Plant Germplasm System [Online Database]. <a href="http://www.ars-grin.gov/npgs/index.html">http://www.ars-grin.gov/npgs/index.html</a> . [Accessed 20 Mar 2018]	Family: Poaceae (alt.Gramineae) Subfamily: Chloridoideae Tribe: Zoysieae Subtribe: Zoysiinae

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	Notes
	Quattrocchi, U. 2006. CRC World Dictionary of Grasses: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"Perennial, caespitose, sod forming, short, erect, slow growing, variable, flowering culms erect, often strongly stoloniferous and branched, weakly rhizomatous with well-developed creeping rhizome, leaf blades flexible lanceolate contracted into a short pseudopetiole, leaf sheath loose and bearded at mouth, ligule very shallow sometimes with long hairs, distichous leaves erect or ascending and filiform or sometimes almost pungent,"

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	Notes
	CABI. 2018. Invasive Species Compendium. Wallingford, UK: CAB International. <a href="http://www.cabi.org/isc">www.cabi.org/isc</a>	[No evidence. Widespread native & introduced range] "Z. matrella was introduced to the USA from Manila, Philippines in 1911 by C. V. Piper, a USDA botanist (Duble, 2016). A large number of collections were also introduced to the USA for turf grass breeding from Japan, Korea, Taiwan and the Philippines in 1982 (Casler and Duncan, 2003). It is planted widely in tropical and subtropical regions around the world as a turfgrass (Clayton et al., 2016). It is an occasional escape in Costa Rica (Hammel et al., 2003), and naturalizes in the southeastern USA (Kartesz, 2016)."

Qsn #	Question	Answer
602	Produces viable seed	y
	Source(s)	Notes
	CABI. 2018. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc	"Florets of the genus are self-compatible but in <i>Z. matrella</i> they are protogynous with pistils maturing 7-10 days before stamens (Tsuruta et al., 2011). Seeds show low germination rates under field conditions (Forbes and Ferguson, 1948). Mechanical hulling increases germination rates (Forbes and Ferguson, 1948). All turf grass production of <i>Z. matrella</i> is vegetative (Samples, 2007)."

603	Hybridizes naturally	y
	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	" <i>Zoysia matrella</i> ... This species forms natural hybrids with <i>Zoysia sinica</i> ."

604	Self-compatible or apomictic	y
	Source(s)	Notes
	Tsuruta, S. I., Kobayashi, M., & Ebina, M. (2011). <i>Zoysia</i> . In Wild crop relatives: Genomic and Breeding Resources (pp. 297-309). Springer, Berlin Heidelberg	"The genus is self-compatible, however, and has very low canopy height and comparatively heavy pollen, so the ratio of allogamous crossing in natural habitats is open to question." ... "The species are also protogynous hermaphroditic plants with both a pistil and three stamens in a single flower. The pistil matures 7–10 days earlier than stamens, and the green or yellow lemma turns dark brown at the tip as the pistil matures (Honda and Kono 1963). The difference in maturation stage between the pistil and stamens promotes outcrossing, although plants can be artificially self-pollinated at the stage when both the pistil and stamens are mature because of the lack of physiological self-incompatibility mechanisms (Asano and Aoki 1998)."

605	Requires specialist pollinators	n
	Source(s)	Notes
	Zomlefer, W.B. 1994. Guide to Flowering Plant Families. The University of North Carolina Press, Chapel Hill & London	"The reduced flowers are anemophilous, although pollen-gathering insects have been reported for some grass species (Soderstrom and Calderon 1971; Terrell and Batra 1984)."

606	Reproduction by vegetative fragmentation	y
	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, stoloniferous, mat-forming, also with shallow underground rhizomes."
	Flynn, T. & Lorence, D. H. 1998. New naturalized plant records for the Hawaiian Islands. Bishop Museum Occasional Papers 56: 5-6	"This common ornamental grass is naturalized locally above the high water line on coral sand beach, spreading by rhizomes from old lawn areas behind the beach."

Qsn #	Question	Answer
607	Minimum generative time (years)	2
	Source(s)	Notes
	CABI. 2018. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc	[Probably between 1 & 2 years] "Z. matrella grows as a low, rhizomatous, perennial grass." ... "Short day length and high temperatures are required for flowering, as well as a minimum amount of growth of upright culms (Casler and Duncan, 2003). 15°C seems to be the minimum temperature for growth of Z. matrella (Youngner, 1961)."

701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	n
	Source(s)	Notes
	CABI. 2018. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc	"It grows slowly and primarily spreads by rhizomes and stolons, but could also spread by seed." [Unlikely. No means of external attachment]

702	Propagules dispersed intentionally by people	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	"extensively cultivated, easily established"
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	"Widespread throughout tropical Asia on the coasts of the Indian and western Pacific Oceans and cultivated extensively as a lawn grass, Z. matrella is a variable species that includes two varieties."

703	Propagules likely to disperse as a produce contaminant	
	Source(s)	Notes
	CABI. 2018. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc	"Seeds may be dispersed by grazing animals (Reynolds, 1995). Most spread has been intentional, as the species is widely planted as a turfgrass (Samples, 2007)."
	WRA Specialist. 2018. Personal Communication	Possibly. Reported as a weed of some crops [see 3.04]. Could possibly become a contaminant in cultivated settings, if seeds are produced

704	Propagules adapted to wind dispersal	n
	Source(s)	Notes
	CABI. 2018. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc	"Seeds may be dispersed by grazing animals (Reynolds, 1995). Most spread has been intentional, as the species is widely planted as a turfgrass (Samples, 2007)."

Qsn #	Question	Answer
705	Propagules water dispersed	n
	Source(s)	Notes
	CABI. 2018. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc	"Seeds may be dispersed by grazing animals (Reynolds, 1995). Most spread has been intentional, as the species is widely planted as a turfgrass (Samples, 2007)."

706	Propagules bird dispersed	n
	Source(s)	Notes
	CABI. 2018. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc	"Seeds may be dispersed by grazing animals (Reynolds, 1995). Most spread has been intentional, as the species is widely planted as a turfgrass (Samples, 2007)."

707	Propagules dispersed by other animals (externally)	n
	Source(s)	Notes
	CABI. 2018. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc	[No means of external attachment. Seeds, if produced, may be small enough to cling to animals, but direct evidence is lacking]

708	Propagules survive passage through the gut	
	Source(s)	Notes
	Yamashiro, A., & Yamashiro, T. 2006. Seed Dispersal by Kerama Deer ( <i>Cervus nippon keramae</i> ) on Aka Island, the Ryukyu Archipelago, Japan. <i>Biotropica</i> , 38(3): 405-413	"APPENDIX. The number of seeds, germination rate, size, and fruit type at each site." [Of 7 <i>Zoysia matrella</i> seeds found in the dung of deer, 100% rotted & did not germinate]
	CABI. 2018. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc	[Potentially, if seeds are produced] "Seeds may be dispersed by grazing animals (Reynolds, 1995). Most spread has been intentional, as the species is widely planted as a turfgrass (Samples, 2007)."

801	Prolific seed production (>1000/m2)	
	Source(s)	Notes
	CABI. 2018. Invasive Species Compendium. Wallingford , UK: CAB International. www.cabi.org/isc	[Unknown] "Florets of the genus are self-compatible but in <i>Z. matrella</i> they are protogynous with pistils maturing 7-10 days before stamens (Tsuruta et al., 2011). Seeds show low germination rates under field conditions (Forbes and Ferguson, 1948). Mechanical hulling increases germination rates (Forbes and Ferguson, 1948). All turf grass production of <i>Z. matrella</i> is vegetative (Samples, 2007)."

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: <a href="http://data.kew.org/sid/">http://data.kew.org/sid/</a> . [Accessed 1 Apr 2018]	[Unknown] "Storage Behaviour: No data available for species or genus. Of 1572 known taxa of family POACEAE, 97.20% Orthodox (p/?), 0.19% Recalcitrant(?), 0.19% Intermediate(?), 2.42% Uncertain"

803	Well controlled by herbicides	
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Qsn #	Question	Answer
	<b>Source(s)</b>	<b>Notes</b>
	Bryan Unruh, J., Trenholm, L. E. & Cisar, J. L. 2016. Zoysiagrass for Florida Lawns. ENH11. Revised. Institute of Food and Agricultural Sciences, University of Florida. <a href="http://edis.ifas.ufl.edu">http://edis.ifas.ufl.edu</a> . [Accessed 1 Apr 2018]	[May not be effectively controlled. Further information needed] "zoysiagrass is very tolerant to many effective pre- and postemergence herbicides, giving a wide range of options to the turf manager"

<b>804</b>	<b>Tolerates, or benefits from, mutilation, cultivation, or fire</b>	<b>Y</b>
	<b>Source(s)</b>	<b>Notes</b>
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	"When used as a lawn grass, zoysia should always be cut with a rotary mower to a height of 0.5-0.75".

<b>805</b>	<b>Effective natural enemies present locally (e.g. introduced biocontrol agents)</b>	
	<b>Source(s)</b>	<b>Notes</b>
	Staples, G.W. & Herbst, D.R. 2005. A Tropical Garden Flora - Plants Cultivated in the Hawaiian Islands and Other Tropical Places. Bishop Museum Press, Honolulu, HI	[Probably No] "relatively free of pests and diseases if well tended."
	WRA Specialist. 2018. Personal Communication	Unknown. Cultivated in the Hawaiian Islands with no reported problems.

**Summary of Risk Traits:**

## High Risk / Undesirable Traits

- Able to grow in regions with tropical climates
- Naturalized on Kauai (Hawaiian Islands)
- Reported as a weed of rice & other crops in Asia (impacts unspecified)
- Pollen may be an allergen to susceptible individuals
- Shade tolerant
- Tolerates many soil types
- Forms dense cover that can choke out other vegetation
- Reproduces by seeds (some cultivars may be sterile) & vegetatively by rhizomes
- Hybridizes with *Zoysia sinica*
- Self-compatible
- Grazing animals may disperse seeds; intentionally cultivated as a turf grass
- Tolerates mowing & grazing

## Low Risk Traits

- Despite reports of weediness, no detrimental impacts have been quantified.
- Unarmed (no spines, thorns, or burrs)
- Provides forage for grazing animals
- Valued lawn grass
- Propagated vegetatively. Seed production in cultivation may be limited, & minimize risk of long-distance dispersal (esp. for some cultivars)