

Taxon: <i>Lolium perenne</i> L.	Family: Poaceae
Common Name(s): English ryegrass perennial ryegrass	Synonym(s): <i>Lolium boucheanum</i> Kunth <i>Lolium marschallii</i> Steven

Assessor: Chuck Chimera	Status: Assessor Approved	End Date: 2 May 2016
WRA Score: 15.0	Designation: H(HPWRA)	Rating: High Risk

Keywords: Pasture Grass, Environmental Weed, Forage, Allergen, Animal-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)	Intermediate
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)	n
304	Environmental weed	n=0, y = 2*multiplier (see Appendix 2)	y
305	Congeneric weed	n=0, y = 1*multiplier (see Appendix 2)	y
401	Produces spines, thorns or burrs	y=1, n=0	n
402	Allelopathic		
403	Parasitic	y=1, n=0	n
404	Unpalatable to grazing animals	y=1, n=-1	n
405	Toxic to animals	y=1, n=0	y
406	Host for recognized pests and pathogens		
407	Causes allergies or is otherwise toxic to humans	y=1, n=0	y
408	Creates a fire hazard in natural ecosystems	y=1, n=0	y
409	Is a shade tolerant plant at some stage of its life cycle	y=1, n=0	n

Qsn #	Question	Answer Option	Answer
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y=1, n=0	y
411	Climbing or smothering growth habit	y=1, n=0	n
412	Forms dense thickets	y=1, n=0	y
501	Aquatic	y=5, n=0	n
502	Grass	y=1, n=0	y
503	Nitrogen fixing woody plant	y=1, n=0	n
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y=1, n=0	n
601	Evidence of substantial reproductive failure in native habitat	y=1, n=0	n
602	Produces viable seed	y=1, n=-1	y
603	Hybridizes naturally	y=1, n=-1	y
604	Self-compatible or apomictic	y=1, n=-1	n
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	y
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant		
704	Propagules adapted to wind dispersal	y=1, n=-1	n
705	Propagules water dispersed		
706	Propagules bird dispersed		
707	Propagules dispersed by other animals (externally)	y=1, n=-1	y
708	Propagules survive passage through the gut	y=1, n=-1	y
801	Prolific seed production (>1000/m ²)	y=1, n=-1	y
802	Evidence that a persistent propagule bank is formed (>1 yr)	y=1, n=-1	n
803	Well controlled by herbicides	y=-1, n=1	y
804	Tolerates, or benefits from, mutilation, cultivation, or fire	y=1, n=-1	y
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)		

Supporting Data:

Qsn #	Question	Answer
101	Is the species highly domesticated?	n
	Source(s)	Notes
	Quattrocchi, U. 2006. CRC World Dictionary of Grasses: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	[No evidence of widespread domestication. Assessment of wild type] "variable species cultivated and frequently escaped,"

102	Has the species become naturalized where grown?	
	Source(s)	Notes
	WRA Specialist. 2016. Personal Communication	NA

103	Does the species have weedy races?	
	Source(s)	Notes
	WRA Specialist. 2016. 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"	Intermediate
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network, 2016. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 27 Apr 2016]	"Native: Africa Macaronesia: Portugal - Madeira Islands; Spain - Canary Islands Northern Africa: Algeria; Egypt; Libya; Morocco; Tunisia Asia-Temperate Arabian Peninsula: Saudi Arabia Caucasus: Armenia; Azerbaijan; Georgia; Russian Federation - Dagestan; Russian Federation-Ciscaucasia - Ciscaucasia Western Asia: Afghanistan; Cyprus; Egypt - Sinai; Iran; Iraq; Israel; Jordan; Lebanon; Syria; Turkey Asia-Tropical Indian Subcontinent: India; Pakistan Europe East Europe: Belarus; Moldova; Russian Federation-European part - European part; Ukraine Middle Europe: Austria; Belgium; Czech Republic; Germany; Hungary; Netherlands; Poland; Slovakia; Switzerland Northern Europe: Denmark; Ireland; Norway; Sweden; United Kingdom Southeastern Europe: Albania; Bulgaria; Croatia; Greece; Italy; Romania; Serbia; Slovenia Southwestern Europe: France; Portugal; Spain"

Qsn #	Question	Answer
202	Quality of climate match data	High
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network, 2016. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 27 Apr 2016]	

203	Broad climate suitability (environmental versatility)	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	"a very variable species widely naturalized in temperate regions, typical of oceanic and mild climates, often found in rainy climates,"
	Sullivan, J. 1992. <i>Lolium perenne</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/plants/graminoid/lolper/all.html . [Accessed 29 Apr 2016]	"It is found from Newfoundland to Alaska, south to Virginia and California, occasionally farther south [23]. The most concentrated agricultural use of perennial ryegrass are in the humid southeastern United States and the mediterranean and temperate climates of the Pacific Northwest and California, west of the Cascade Range and the Sierra Nevada [39,40]."
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"naturalized and common in grasslands and pastures, 850-2,440 m" [Elevation range exceeds 1000 m, demonstrating environmental versatility]

Qsn #	Question	Answer
204	Native or naturalized in regions with tropical or subtropical climates	y
	Source(s)	Notes
	<p>USDA, ARS, Germplasm Resources Information Network, 2016. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 27 Apr 2016]</p>	<p>"Naturalized: Africa Macaronesia: Portugal - Azores Southern Africa: Lesotho; South Africa Western Indian Ocean: Mauritius; Reunion Asia-Tropical North Indian Ocean: British Indian Ocean Terr - Diego Garcia Australasia Australia: Australia New Zealand: New Zealand Northern America : Canada; Mexico; United States Subarctic America: Greenland Pacific North-Central Pacific: United States - Hawaii Southwestern Pacific: New Caledonia Southern America Brazil: Brazil Caribbean: West Indies Mesoamerica: Costa Rica; Guatemala; Honduras; Panama Northern South America: French Guiana Southern South America: Argentina; Chile; Uruguay Western South America: Bolivia; Ecuador; Peru"</p>

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	Notes
	<p>Quattrocchi, U. 2006. CRC World Dictionary of Grasses: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL</p>	<p>"a very variable species widely naturalized in temperate regions"</p>
	<p>Sullivan, J. 1992. <i>Lolium perenne</i>. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/plants/graminoid/lolper/all.html. [Accessed 29 Apr 2016]</p>	<p>"Native to Eurasia, perennial ryegrass is widely planted in North America for lawns and has many agricultural uses."</p>
	<p>CABI, 2016. <i>Lolium perenne</i>. In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc</p>	<p>"The perennial ryegrass, <i>L. perenne</i>, is native to central Asia, the Middle East, North Africa and southern Europe, from Bulgaria in the east to France in the west. It was introduced by early European pastoralists to many corners of their earlier empires, including North America, Australasia, South Africa and elsewhere."</p>

301	Naturalized beyond native range	y
	Source(s)	Notes

Qsn #	Question	Answer
	<p>Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.</p> <p>USDA, ARS, Germplasm Resources Information Network, 2016. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html. [Accessed 27 Apr 2016]</p>	<p>"Native to Europe, now widely naturalized in temperate regions; in Hawai'i naturalized and common in grasslands and pastures, 850-2,440 m, on Hawai'i. First collected in 1909 (Rock 3179, BISH)."</p> <p>"Naturalized:</p> <p>Africa Macaronesia: Portugal - Azores Southern Africa: Lesotho; South Africa Western Indian Ocean: Mauritius; Reunion</p> <p>Asia-Tropical North Indian Ocean: British Indian Ocean Terr - Diego Garcia</p> <p>Australasia Australia: Australia New Zealand: New Zealand</p> <p>Northern America : Canada; Mexico; United States Subarctic America: Greenland</p> <p>Pacific North-Central Pacific: United States - Hawaii Southwestern Pacific: New Caledonia</p> <p>Southern America Brazil: Brazil Caribbean: West Indies Mesoamerica: Costa Rica; Guatemala; Honduras; Panama Northern South America: French Guiana Southern South America: Argentina; Chile; Uruguay Western South America: Bolivia; Ecuador; Peru"</p>
	<p>Frohlich, D. & Lau, A. 2008. New plant records from O'ahu for 2007. Bishop Museum Occasional Papers 100: 3-12</p>	<p>"Perennial ryegrass was previously known from Hawai'i (Wagner et al. 1999) and Maui (Starr et al. 2003), occurring in higher-elevation sites from 850–2830 m. Widely naturalized in temperate regions, this species was occasionally seen at 213 m in the construction site of a new, large housing development. Seeds were possibly transported on soiled heavy machinery brought in from another island. Material examined. O'AHU: Makakilo (UTM 2362789, 595525), dry lowland housing development construction site, growing in bare soil, clump-forming grass to 0.5 m tall, 213 m (700 ft), A. Lau & D. Frohlich 2007040."</p>
	<p>Starr, F., Starr, K. & Loope, L.L. (2003). New plant records from the Hawaiian Archipelago. Bishop Museum Occasional Papers 74: 23-34</p>	<p>"Previously known from grasslands and pastures on the island of Hawai'i (Wagner et al., 1999), <i>L. perenne</i> (perennial ryegrass) is now also known from similar situations on Maui. Material examined: MAUI: E. Maui, Haleakalā National Park, Kalahaku overlook, growing in cinders next to parking area, 9300 ft [2830 m], 26 Oct 2000, Starr & Martz 001026-2; E. Maui, Ka'ono'ulu, occasional in pastures, 5600 ft [1706 m], 20 May 2001, Oppenheimer H50123."</p>

302	Garden/amenity/disturbance weed	
	Source(s)	Notes

Qsn #	Question	Answer
	Sullivan, J. 1992. <i>Lolium perenne</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/plants/graminoid/lolper/all.html . [Accessed 29 Apr 2016]	"It occasionally escapes and becomes naturalized, mostly in waste places and roadsides [13,39,40,46,57]."
	CABI, 2016. <i>Lolium perenne</i> . In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"Pioneering in disturbed areas" [A disturbance adapted weed with negative environmental impacts]

303	Agricultural/forestry/horticultural weed	n
	Source(s)	Notes
	CABI, 2016. <i>Lolium perenne</i> . In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"Generally, to the countries to which it has been introduced (and those to which it is native) the benefits of <i>L. perenne</i> as a high-producing pasture and forage species outweigh its negative impacts as an invasive species. New Zealand's year round grazing systems, and the country's economy, rely heavily on ryegrass, the seeds of which it grows and exports in substantial quantities. The USA are also major exporters of the seed, producing 8000 MT of perennial ryegrass seed and over 5500 MT of tall fescue seed in 2003-2004 (OGTR, 2013)."

304	Environmental weed	y
	Source(s)	Notes
	Weber, E. 2003. Invasive Plant Species of the World. A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	"Heath- and shrubland, riparian habitats, freshwater wetlands, coastal beaches. In Europe, this grass is frequently found in grassland, pastures, meadows and disturbed places. Where invasive, it spreads quickly and forms dense swards that displace native grass and forb species and reduce species richness. The grass is highly competitive"

305	Congeneric weed	y
	Source(s)	Notes
	CABI, 2016. <i>Lolium multiflorum</i> . In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	" <i>L. multiflorum</i> is a highly competitive and rapidly growing plant, capable of producing large quantities of seed. It is genetically diverse and displays a high degree of phenotypic plasticity and these characteristics mean that it is highly adaptable. It can invade natural grassland and other plant communities that are subject to frequent disturbance."
	CABI, 2016. <i>Lolium temulentum</i> . In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	" <i>L. temulentum</i> is a serious weed of winter crops, especially wheat (Bor, 1960; Angiras and Modgal, 1981), winter vegetable crops (Gad and El Mahde, 1972), flax (Angiras et al., 1991; Cseresnyes et al., 1987) and sunflower (Sarno et al., 1986). According to Holm et al. (1991), it is a weed of 14 crops in 38 countries."

401	Produces spines, thorns or burrs	n
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Qsn #	Question	Answer
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[No evidence] "Perennial with numerous basal innovations; culms ascending or erect, (3-) 4-9 dm tall, glabrous and smooth. Basal leaves forming tufts up to 1.5-3 dm tall; sheaths smooth, auricles well- developed, crescent-shaped, up to 1.5 (-2) mm long; ligule entire, 0.5-1.5 mm long; blades narrowly linear, 1-3 (-4) mm wide, glabrous and smooth, sometimes scaberulous."

402	Allelopathic	
	Source(s)	Notes
	Newman, E. I., & Rovira, A. D.. (1975). Allelopathy Among Some British Grassland Species. <i>Journal of Ecology</i> , 63(3), 727-737	[Exudate of <i>L. perenne</i> inhibits itself] "Perhaps the most important general conclusion to come out of this work is that the response of different receiver species to the exudates is not the same. This is shown most clearly in comparing the effects of different plant exudates, where four species, <i>Lolium perenne</i> , <i>Hypochoeris radicata</i> , <i>Plantago lanceolata</i> and <i>Trifolium repens</i> , appear to be 'auto-inhibited' (autotoxic), i.e. to be inhibited more by exudate from their own species than other species"
	Kraus, E., Voeten, M., & Lambers, H. (2002). Allelopathic and autotoxic interactions in selected populations of <i>Lolium perenne</i> grown in monoculture and mixed culture. <i>Functional Plant Biology</i> , 29(12), 1465-1473	[Possibly. Autotoxic properties] "Autotoxicity and allelopathy affect the respiration and yield of GL66 and GL72, two populations of perennial ryegrass (<i>Lolium perenne</i> L. cv. S23) that were originally selected for contrasting rates of mature-leaf dark respiration under conditions where allelopathic effects could not occur and autotoxic effects were minimal. The aim of this study was to further investigate growth and biomass allocation of these two populations in relation to their autotoxic and allelopathic properties. To this end, plants were subjected to two conditions (monoculture and mixed culture) and two treatments (growth in 'renewed' and 'replenished' nutrient solution, allowing for short- and long-term accumulation of allelochemicals, respectively). The fast-respiring population, GL66, showed a reduced total yield due to allelopathic effects only when long-term accumulation of allelochemicals was allowed (mixed culture, replenished). However, short-term accumulation (mixed culture, renewed) of allelochemicals was sufficient to affect allocation of biomass to leaf sheaths. The slow-respiring population, GL72, suffered from autotoxicity only when long-term accumulation was allowed (monoculture, replenished), and from allelopathy under both short- and long-term accumulation (mixed culture, either renewed or replenished). The predominant allelopathic and autotoxic effect was on dry matter percentage and dry weight of leaf sheaths. We conclude that the roots of both populations release one or more chemical compounds that primarily affect biomass allocation to leaf sheaths, both of the same and of the other population. Sensitivity to the putative inhibitor(s) released by the other population was greater than sensitivity to the inhibitor(s) released by a population's own roots."

Qsn #	Question	Answer
403	Parasitic	n
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Perennial with numerous basal innovations; culms ascending or erect, (3-) 4-9 dm tall, glabrous and smooth." [Poaceae. No evidence]

404	Unpalatable to grazing animals	n
	Source(s)	Notes
	Sullivan, J. 1992. <i>Lolium perenne</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/plants/graminoid/lolper/all.html . [Accessed 29 Apr 2016]	"Perennial ryegrass is a palatable and nutritious forage for all classes of livestock and most wild ruminants [14,54]. In a study to determine the practicality of using Douglas-fir (<i>Pseudotsuga menziesii</i>) plantations for sheep range, domestic sheep grazed perennial ryegrass in proportion to its availability [32]." ... "Perennial ryegrass is palatable to livestock and big game species. Older plants can become tough and unpalatable, especially during hot dry weather [57]."
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"sown for pastures, provides good forage and hay, the plant tillers freely, nutritious and palatable, older plants can become tough and unpalatable"

405	Toxic to animals	y
	Source(s)	Notes

Qsn #	Question	Answer
	<p>CABI, 2016. <i>Lolium perenne</i>. In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc</p>	<p>"The endophyte present in ryegrass (<i>Neotyphodium lolii</i>) grows intercellularly as hyaline, sparsely septate hyphae which are present in the leaf sheaths and flowering stems of <i>L. perenne</i>, less so in the leaf blades, and they do not occur in the roots (Menna et al., 2012). Although 'wild-type' endophytic fungi can cause severe grass staggers problems in livestock grazing pastures in Australia, New Zealand and elsewhere (see Economic Impact section), improved endophytes are now being used in <i>L. perenne</i> and these confer resistance to several insect pests without causing serious damage to livestock (Menna et al., 2012; Johnson et al., 2013). Endophytic fungi are only transmitted through infected seed, and the fungus can be killed in the seed by treatment with fungicides, by heat treatment (although this often reduces germination and seedling size), or simply by storage at 50C or higher for 14 months or more (Rolston et al., 1986). Some authors such as Cunningham et al. (1993) suggested that at least 3 years of storage at room temperature is needed to kill the endophyte. Besides the toxins responsible for ryegrass staggers and some other disorders in grazing livestock, the endophyte/ryegrass symbiosis also produces toxins that help protect the ryegrass from insect attack. Peramine, for example, is a potent toxin that protects against Argentine stem weevil (<i>Listronotus bonariensis</i>), whilst ergovaline deters feeding by adult weevils and by adult black beetles (<i>Heteronychus arator</i>) (Menna, 2012) (but is also toxic to mammals). Endophyte infected ryegrass also reduced numbers of pasture mealy bug (<i>Balanococcus poae</i>) (Pennell et al., 2005). The natural ('wild') endophyte strains in ryegrass can have moderate but inconsistent or transient effects on porina (<i>Wiseana</i> spp.), root aphid (<i>Aploneura lentisci</i>), slugs, and plant parasitic nematodes (Eerens et al., 1998; Jensen and Popay, 2004; Popay et al., 2004; Barker, 2008)."</p>
	<p>Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL</p>	<p>"The entire plant is considered toxic, contains loliolide and several alkaloids, can cause rye-grass staggers in stock."</p>

406	Host for recognized pests and pathogens	
	Source(s)	Notes
	<p>Sullivan, J. 1992. <i>Lolium perenne</i>. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/plants/graminoid/lolper/all.html. [Accessed 29 Apr 2016]</p>	<p>"Diseases and Pests: Crown rust (<i>Puccinia coronata</i>) may severely reduce forage value in wet areas. Other fungal infections include brown rust (<i>Puccinia dispersa</i>), and red thread (<i>Corticium fuciforme</i>). Occasional attacks by <i>Helminthosporium</i> species also occur. Ergot (<i>Claviceps purpurea</i>) and blind-seed disease (<i>Phialea temulenta</i>) reduce seed yield and quality [14]. Leaf blotch (<i>Helminthosporium spiciferum</i>), ergot and blind seed disease can be substantially controlled by burning perennial ryegrass fields in the spring [21]."</p>

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

Qsn #	Question	Answer
	Simon, H.-U. (2000). CRC Desk Reference for Allergy and Asthma. CRC Press, Boca Raton, FL	"Allergenicity (see allergen) important grass pollens include bermuda grass (<i>Cynodon dactylon</i>), rye grass (<i>Lolium perenne</i>), timothy grass (<i>Phleum pratense</i>), and orchard grass (<i>Dactylis glomerata</i> ; see also aeroallergens)."
	Pollen Library. 2016. Perennial Rye Grass (<i>Lolium perenne</i>). http://www.pollenlibrary.com/Specie/Lolium+perenne/ . [Accessed 2 May 2016]	"Allergenicity: Perennial Rye Grass (<i>Lolium perenne</i>) is a severe allergen."

408	Creates a fire hazard in natural ecosystems	y
	Source(s)	Notes
	CABI, 2016. <i>Lolium perenne</i> . In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"Impact outcomes ... Modification of fire regime"
	Garry Oak Ecosystems Recovery Team. 2003. Invasive species in Garry Oak and associated ecosystems in British Columbia. Garry Oak Ecosystems Recovery Team, Victoria, BC	"Non-native grasses are present in most Garry oak ecosystems and may cover a combined total of 50-80 percent of the landscape." ... "Perennial ryegrass also readily establishes and spreads on disturbed and bare soils. Competition for water continues throughout the year, becoming critical during the dry summer months. As the grasses die off, they form a dense litter layer that blocks light and thus suppresses the regeneration and establishment of native species. The litter also provides fuel and creates conditions for detrimental high-intensity fires."
	D'Antonio, C. M., & Vitousek, P. M. (1992). Biological invasions by exotic grasses, the grass/fire cycle, and global change. <i>Annual review of ecology and systematics</i> , 23, 63-87	"Zedler et al (189) demonstrated that seeding burned California chaparral with the alien annual <i>Lolium perenne</i> as an erosion control measure fueled a second fire in an area that had burned less than 1 year previously."

409	Is a shade tolerant plant at some stage of its life cycle	n
	Source(s)	Notes
	Sullivan, J. 1992. <i>Lolium perenne</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/plants/graminoid/lolper/all.html . [Accessed 29 Apr 2016]	"Perennial ryegrass is probably not shade tolerant; photosynthetic capacity of leaf bases decreases when they are shaded [64]"
	Garry Oak Ecosystems Recovery Team. 2003. Invasive species in Garry Oak and associated ecosystems in British Columbia. Garry Oak Ecosystems Recovery Team, Victoria, BC	"Unsuitable conditions include severe wetness or dryness, shade or long periods at extreme temperatures."

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

Qsn #	Question	Answer
	CABI, 2016. <i>Lolium perenne</i> . In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"Perennial ryegrass grows best on fertile, well-drained soils but has a wide range of soil adaptability, and tolerates both acidic and alkaline soils (pH range of 5.2 to 8.0; Cool et al., 2004). It responds well to applications of nitrogen (either as fertiliser N or N fixed by legumes) and phosphorus, and is moderately tolerant of acid soils although there is a sensitivity to aluminium concentration when soil pH is low (pH _{Ca} < 4.4) (Waller and Sale, 2001)."
	Sullivan, J. 1992. <i>Lolium perenne</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/plants/graminoid/lolper/all.html . [Accessed 29 Apr 2016]	"Perennial ryegrass is adapted to a wide range of soil types and drainage conditions and can be grown successfully on earth structures such as dams and dikes, in grass waterways, and in flood channels [14,20,57]."
	Garry Oak Ecosystems Recovery Team. 2003. Invasive species in Garry Oak and associated ecosystems in British Columbia. Garry Oak Ecosystems Recovery Team, Victoria, BC	"Perennial ryegrass is well-adapted to live in a broad range of soil types and topography. Optimal soil conditions are mesic to moist, normally drained, nutrient rich to very rich, slightly acidic to neutral and clay or loam textures. Its preferred topography is shallow to steep slopes at moderate elevations and with primarily southern aspects."

411	Climbing or smothering growth habit	n
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Perennial with numerous basal innovations; culms ascending or erect, (3-) 4-9 dm tall, glabrous and smooth. Basal leaves forming tufts up to 1.5-3 dm tall; sheaths smooth, auricles well developed, crescent-shaped, up to 1.5 (-2) mm long; ligule entire, 0.5-1.5 mm long; blades narrowly linear, 1-3 (-4) mm wide, glabrous and smooth, sometimes scaberulous."

412	Forms dense thickets	y
	Source(s)	Notes
	Weber, E. 2003. Invasive Plant Species of the World. A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	"Where invasive, it spreads quickly and forms dense swards that displace native grass and forb species and reduce species richness. The grass is highly competitive"

501	Aquatic	n
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Terrestrial] "in Hawai'i naturalized and common in grasslands and pastures."

Qsn #	Question	Answer
502	Grass	y
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network, 2016. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 27 Apr 2016]	"Family: Poaceae (alt.Gramineae) Subfamily: Pooideae Tribe: Poeae Subtribe: Loliinae"

503	Nitrogen fixing woody plant	n
	Source(s)	Notes
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. 1999. Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	[Poaceae] "Perennials with numerous basal innovations; culms ascending or erect, (3-)4-9 dm tall, glabrous and smooth."

504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	Notes
	Quattrocchi, U. 2012. CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	"Perennial, annual or short-lived perennial, herbaceous, easily established, robust, erect or spreading or decumbent, loosely to densely tufted, roots densely fasciculate"

601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	Notes
	USDA, ARS, Germplasm Resources Information Network, 2016. National Plant Germplasm System [Online Database]. http://www.ars-grin.gov/npgs/index.html . [Accessed 27 Apr 2016]	No evidence. Widespread native & naturalized ranges.

602	Produces viable seed	y
	Source(s)	Notes
	Sullivan, J. 1992. <i>Lolium perenne</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/plants/graminoid/lolper/all.html . [Accessed 29 Apr 2016]	"The seeds are relatively large (0.00027 ounce [7.5 mg]), with no innate dormancy. There are 247,000 to 330,000 seeds per pound [7,34]. The seeds tolerate a wide range of diurnal temperature fluctuation, and germinate in either light or darkness [18]." ... "Perennial ryegrass seeds will germinate as soon as moisture conditions permit, regardless of cold treatment [18,50]."

603	Hybridizes naturally	y
	Source(s)	Notes

Qsn #	Question	Answer
	DiTomaso, J. M., Kyser, G. B., Oneto, et al. 2013. Weed Control in Natural Areas in the Western United States. Weed Research and Information Center, University of California, Davis, CA	"Italian ryegrass is usually distinguished from perennial ryegrass by having lemma awns. However, they readily hybridize with one another. The offspring are highly fertile and can intrograde with either parent, resulting in populations of plants that are difficult to categorize as either species, with a continuity of characteristics. Because of this, taxonomists often classify them as the same species (<i>L. perenne</i>)."
	Gymer, P. T., & Whittington, W. J. (1975). Hybrids between <i>Lolium perenne</i> and <i>Festuca pratensis</i> . <i>New Phytologist</i> , 74(2), 295-306	"Naturally occurring populations of hybrids between <i>Lolium perenne</i> and <i>Festuca pratensis</i> which are both diploid, are known to contain diploid and triploid individuals, with 14 and 21 chromosomes respectively (Peto, 1933; Wit, 1959, 1964; Essad, 1964, 1966, 1968; Ahloowalia, 1965b)."

604	Self-compatible or apomictic	n
	Source(s)	Notes
	Sullivan, J. 1992. <i>Lolium perenne</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/plants/graminoid/lolper/all.html . [Accessed 29 Apr 2016]	"Perennial ryegrass is considered self-incompatible [14]."

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	Poaceae [anemophilous. Wind-pollinated]

606	Reproduction by vegetative fragmentation	n
	Source(s)	Notes
	Sullivan, J. 1992. <i>Lolium perenne</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/plants/graminoid/lolper/all.html . [Accessed 29 Apr 2016]	"Along roadsides and in disturbed habitats in the United Kingdom, perennial ryegrass will reproduce well from seed. In neighboring lawns or pastures it may be entirely dependent on vegetative reproduction (probably because the flowering stems are removed before seed production can occur) [18]."
	CABI, 2016. <i>Lolium perenne</i> . In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	" <i>L. perenne</i> does not produce stolons or rhizomes, its shoot buds arise at or near the soil level in young plants but may develop from higher nodes in large single plants."

607	Minimum generative time (years)	1
	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 , annual or short-lived perennial , herbaceous, easily established"

Qsn #	Question	Answer
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y
	Source(s)	Notes
	Hodkinson, D. J., & Thompson, K.. (1997). Plant Dispersal: The Role of Man. <i>Journal of Applied Ecology</i> , 34(6), 1484–1496	"Appendix Species associated with each of the dispersal vectors studied. Nomenclature follows Stace (1991)." [Lolium perenne = Motor vehicles]
	Office of the Gene Technology Regulator, (2008). The Biology of <i>Lolium multiflorum</i> Lam. (Italian ryegrass), <i>Lolium perenne</i> L. (perennial ryegrass) and <i>Lolium arundinaceum</i> (Schreb.) Darbysh (tall fescue). Australian Government OGTR, Canberra, ACT	"Human activity is also a likely source of seed dispersal with perennial ryegrass seed transported on cars (Hodkinson & Thompson 1997)."

702	Propagules dispersed intentionally by people	y
	Source(s)	Notes
	Sullivan, J. 1992. <i>Lolium perenne</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/plants/graminoid/lolper/all.html . [Accessed 29 Apr 2016]	"Perennial ryegrass is a popular turf grass, especially in the south where it remains green all winter [14]. Perennial ryegrass can be used as a winter cover or forage crop in warmer climates [14,54,57]. It is used in mixtures with red clover (<i>Trifolium pratense</i>) in rotation with strawberries (<i>Fragaria x annassa</i>), nursery stock, or vegetables. Perennial ryegrass is usually allowed to grow for 3 years, providing soil improvement and sanitation (in addition to silage and hay crops), then is plowed under as green manure [20]."

703	Propagules likely to disperse as a produce contaminant	
	Source(s)	Notes
	Conn, J. S. (2012). Pathways of invasive plant spread to Alaska: III. Contaminants in crop and grass seed. <i>Invasive Plant Science and Management</i> , 5(2): 270-281	"Table 2. Occurrence frequency and mean number of seeds (kg21) of weeds and crop contaminants in grass seed imported to Alaska." [Seeds of <i>Lolium</i> spp. occur as seed contaminants. Identity unknown]
	CABI, 2016. <i>Lolium perenne</i> . In: <i>Invasive Species Compendium</i> . Wallingford, UK: CAB International. www.cabi.org/isc	[Generally considered a desirable forage grass, but seeds may be accidentally moved if growing with other pasture species] "It is highly likely that perennial ryegrass has mainly been introduced deliberately, as it is widely seen as one of the most valuable pasture species, well known for its palatability, nutritious qualities and growth in many environments."

704	Propagules adapted to wind dispersal	n
	Source(s)	Notes
	CABI, 2016. <i>Lolium perenne</i> . In: <i>Invasive Species Compendium</i> . Wallingford, UK: CAB International. www.cabi.org/isc	"Seeds have no special characteristics to aid their dispersal by wind or water. The plants can spread laterally to some extent through tillering, sending up new shoots from the base of the plant."

705	Propagules water dispersed	
	Source(s)	Notes

Qsn #	Question	Answer
	CABI, 2016. <i>Lolium perenne</i> . In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"Seeds have no special characteristics to aid their dispersal by wind or water."
	Office of the Gene Technology Regulator, (2008). The Biology of <i>Lolium multiflorum</i> Lam. (Italian ryegrass), <i>Lolium perenne</i> L. (perennial ryegrass) and <i>Lolium arundinaceum</i> (Schreb.) Darbysh (tall fescue). Australian Government OGTR, Canberra, ACT	[Unknown, but possible that <i>L. perenne</i> may be water dispersed] "Seed dispersal in irrigation water has been observed for <i>Lolium</i> spp. in Chile, with germinable seeds recovered from the irrigation water (Tosso et al. 1986)."

706	Propagules bird dispersed	
	Source(s)	Notes
	Office of the Gene Technology Regulator, (2008). The Biology of <i>Lolium multiflorum</i> Lam. (Italian ryegrass), <i>Lolium perenne</i> L. (perennial ryegrass) and <i>Lolium arundinaceum</i> (Schreb.) Darbysh (tall fescue). Australian Government OGTR, Canberra, ACT	[Birds likely act as seed predators] "While some bird species have been shown to graze on <i>Lolium</i> spp. (Patton & Frame 1981) no literature is available on the potential of seed dispersal by birds."

707	Propagules dispersed by other animals (externally)	y
	Source(s)	Notes
	CABI, 2016. <i>Lolium perenne</i> . In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"In a study of seed dispersal by sheep, seeds of Italian and perennial ryegrass were transported in the wool of grazing sheep, and in the case of perennial ryegrass the seeds remained in the wool for 1-2 months (Fischer et al., 1996)."

708	Propagules survive passage through the gut	y
	Source(s)	Notes
	CABI, 2016. <i>Lolium perenne</i> . In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"Grass seeds are capable of germination after passing through the digestive systems of grazing animals such as cattle, sheep (Janzen, 1984; Chambers and MacMahon, 1994; Hulme, 1994; OGTR, 2007) or horses (Campbell and Gibson, 2001; OGTR, 2007). When the potential of cattle to disperse the seeds of perennial ryegrass was assessed by Yamada and Kawaguchi (1972) and Yamada et al. (1972), seeds could be recovered from faeces 12-24 hours after feeding. Viable seeds were recovered and seedlings started to emerge after one week."

Qsn #	Question	Answer
801	Prolific seed production (>1000/m2)	y
	Source(s)	Notes
	DiTomaso, J. M., Kyser, G. B., Oneto, et al. 2013. Weed Control in Natural Areas in the Western United States. Weed Research and Information Center, University of California, Davis, CA	"Plants reproduce by abundant seed production. Seed germination is usually during fall, but can occur year-round under favorable conditions. Most seeds fall below the parent plant."
	Sullivan, J. 1992. <i>Lolium perenne</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/plants/graminoid/lolper/all.html . [Accessed 2 May 2016]	"There are 247,000 to 330,000 seeds per pound [7,34]."

802	Evidence that a persistent propagule bank is formed (>1 yr)	n
	Source(s)	Notes
	Garry Oak Ecosystems Recovery Team. 2003. Invasive species in Garry Oak and associated ecosystems in British Columbia. Garry Oak Ecosystems Recovery Team, Victoria, BC	"The large seeds do not go dormant and are therefore not persistent in the seedbank."
	Sullivan, J. 1992. <i>Lolium perenne</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/plants/graminoid/lolper/all.html . [Accessed 29 Apr 2016]	"The seeds are relatively large (0.00027 ounce [7.5 mg]), with no innate dormancy." ... "Seedbanks of perennial ryegrass are limited and transient; even where perennial ryegrass is a major component of pastures in the Netherlands, it ranks seventh among grasses in numbers of viable seeds and does not accumulate reserves of seeds [18,52]." ... "The lack of a persistent seedbank explains the tendency of perennial ryegrass to be replaced by native grasses with persistent seedbanks, especially in the more northerly latitudes [50]."
	CABI, 2016. <i>Lolium perenne</i> . In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"The seeds of <i>L. perenne</i> do not seem to persist for long in the soil. Roberts (1986) found that when seeds were incorporated into the soil, very few emerged after the first flush, which occurred soon after sowing in September in the UK."

803	Well controlled by herbicides	y
	Source(s)	Notes

Qsn #	Question	Answer
	CABI, 2016. <i>Lolium perenne</i> . In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"Chemical Control Treatment of isolated individual plants and of very large areas of perennial ryegrass with glyphosate has been a widely established agricultural practice for many years now. Initial problems with temporary spring-time resistance to the herbicide were overcome with the addition of appropriate surfactants to the herbicide (Bishop and Field, 1987). DiTomaso et al. (2013) suggest the following herbicides for control of <i>L. perenne</i> in the western USA: aminocyclopyrachlor and chlorsulfuron, clethodim, fluzifop, hexazinone, imazapic, imazapyr, sethoxydim, sulfometuron, as well as glyphosate. Some of these are selective, killing grasses and not broad-leaf plants; others will kill most plants. However, when using herbicides, care must be taken not to encourage the development of herbicide resistance, which usually arises from repeated use of the same herbicide or of herbicides from the same resistance group. Although only a few cases have been reported, <i>L. perenne</i> has shown resistance to some of the more commonly used herbicides. In Argentina, resistance to glyphosate has developed in some biotypes of <i>L. perenne</i> where the species is a weed in barley, cropland, soybean, and wheat (Heap, 2013). Glyphosate is a 'Group G/9' herbicide, known as glycines (inhibition of EPSP synthase), and <i>L. perenne</i> may be cross-resistant to other Group G/9 herbicides. Positive identification of glyphosate resistant populations has now been found in New Zealand (Ghanizadeh et al., 2013). Resistance to Group A/1 (ACCase inhibitors) such as clodinafop-propargyl and diclofop-methyl has been found in Chile, where <i>L. perenne</i> is a weed in cereals. In Germany this species first evolved multiple resistance (to two herbicide sites of action) in 2008 and infests wheat. Multiple resistance there has now evolved to herbicides in Groups A/1, and B/2 (ALS inhibitors). These particular biotypes are known to have resistance to iodosulfuron-methyl-sodium, pinoxaden, and pyroxsulam and may be cross-resistant to other herbicides in the Groups A/1, and B/2 (Heap, 2013). In California and Texas, perennial ryegrass growing on roadsides and along railways has developed resistance to sulfometuron-methyl in the B/2 group of herbicides."
	Garry Oak Ecosystems Recovery Team. 2003. Invasive species in Garry Oak and associated ecosystems in British Columbia. Garry Oak Ecosystems Recovery Team, Victoria, BC	"Populations too large for manual removal can be managed by cautious application of herbicides. Herbicides should only be used with extreme caution, and under expert advice, in sensitive Garry oak ecosystems."
	DiTomaso, J. M., Kyser, G. B., Oneto, et al. 2013. Weed Control in Natural Areas in the Western United States. Weed Research and Information Center, University of California, Davis, CA	A number of different herbicides are recommended for effective control of <i>L. perenne</i>

804	Tolerates, or benefits from, mutilation, cultivation, or fire	y
	Source(s)	Notes
	Sullivan, J. 1992. <i>Lolium perenne</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. http://www.fs.fed.us/database/feis/plants/graminoid/lolper/all.html . [Accessed 29 Apr 2016]	"As with most perennial grasses, perennial ryegrass is well adapted to fire. It is top-killed and will sprout quickly from the rhizome. Fire is beneficial to grass swards; by removing litter, it allows more light to penetrate to the leaf bases and new tillers [59]."

Qsn #	Question	Answer
	<p>DiTomaso, J. M., Kyser, G. B., Oneto, et al. 2013. Weed Control in Natural Areas in the Western United States. Weed Research and Information Center, University of California, Davis, CA</p>	<p>"Ryegrasses tolerate trampling, mowing and grazing. However, small patches can be controlled by hand pulling before they reproduce. Mowing is not considered an effective tool for the control of ryegrass, as it will readily recover with any soil moisture remaining. Tillage is not usually practical for the control of ryegrasses. It is primarily effective when plants are young, but at this time the soil is usually moist and either new plants will germinate or tilled plants will recover. By the time soils dry out in late spring or early summer, ryegrass has generally produced seed or has completed its life cycle and tillage is not effective."</p>

805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	
	Source(s)	Notes
	<p>CABI, 2016. <i>Lolium perenne</i>. In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc</p>	<p>"Beddows (1967) lists a number of insects and fungi and a virus that attack <i>L. perenne</i> in Europe. They include <i>Melolontha melolontha</i> (Coleoptera), <i>Contarinia lolii</i> (Diptera), <i>Oscinella frit</i> (fruit fly – Diptera), <i>Ligniera junci</i> (Plasmodiophorales, attacks the roots), <i>Gaeumannomyces graminis</i> (attacks the stem base), <i>Puccinia coronata</i> var. <i>lolii</i> (affects the leaves), <i>Erysiphe graminis</i> (affects the leaves), <i>Rhynchosporium secalis</i> (affects the leaves), <i>Helminthosporium siccans</i> (affects the leaves), <i>Monographella nivalis</i> (affects the leaves), <i>Gibberella zeae</i> (affects the leaves), <i>Laetisaria fuciformis</i> (affects the leaves), <i>Ustilago striiformis</i> (affects the seedheads), <i>Tilletia lolii</i> (affects the seedheads), <i>Claviceps purpurea</i> (affects the seedheads), <i>Gloeotinia granigena</i> (affects the seedheads), and the virus barley yellow dwarf virus (BYDV). In New Zealand this nutritious grass has attracted the attention of two native insect species; grass grub (<i>Costelytra zealandica</i>) and porina (<i>Wiseana</i> spp.). Abundance of both species of insect has increased as the grass has become more widely used in pastures. Grass grubs are the larvae of the grass grub beetle; they live in the soil and attack the roots of grasses, often severing the tops of the plants completely so the turf can be peeled back. They generally remain in the ground as larvae from December through to October (although in cooler environments they may be in the ground for nearly two years), with most damage occurring from March onwards. They then pupate in October and November, emerging as beetles to fly, mate and feed. The females lay two or three batches of eggs, usually close to where they emerge, so infestations tend to be localised. The best control in permanent pasture is to do nothing – eventually natural cycles of disease organisms will balance the population which then remains at manageable levels. However, insecticides and biological control agents are available (Zydenbos et al., 2011). Porina is found in southern north island and South Island. The large, unattractive caterpillar causes the damage, emerging from its burrow at night and consuming any vegetation within reach. The larvae pupate around September (depending on species) and the adults emerge mainly in October but some further emergence occurs until February. Females drop eggs whilst flying above pasture, with many but not all dropping eggs close to where they emerged (Zydenbos et al., 2011). Other native pests include manuka beetle (<i>Pyronota</i> spp.) and pasture mealybug (<i>Balanococcus poae</i>). Introduced pests</p>

		<p>include Tasmanian grass grub (<i>Aphodius tasmaniae</i>), Argentine stem weevil (<i>Listronotus bonariensis</i>), black beetle (<i>Heteronychus arator</i>), root aphid (<i>Aploneura lentisci</i>) and soldier fly (<i>Inopus rubriceps</i>). The main insect pests of perennial ryegrass in Australia are black field cricket, black headed pasture cockchafer, red headed pasture cockchafer, common army worm, common cutworm, pasture tunnel moth and cereal rust mite (Cunningham et al., 1994). Pasture scarabs and Corbie grubs attack roots just below the ground. The main fungal pathogens of perennial ryegrass in Australia are crown rust, stem rust, net blotch and blind seed disease (Cunningham et al., 1994). Crown rust can seriously damage perennial ryegrass turf in the Autumn, especially under conditions of low fertility (Meyer and Belanger, 1997). Stem rust and blind seed disease can be serious problems for grass seed production in southern Australia. Blind seed disease reduces seed quality and yield and has cost the Victorian seed industry up to \$2.5 million in some years, especially when humidity is high during seed harvest (Cunningham et al., 1994). Barley yellow dwarf virus (BYDV) and ryegrass mosaic potyvirus (RMV) have been reported in perennial ryegrass in Australia (Eagling et al., 1989; Eagling et al., 1992)."</p>
	<p>Garry Oak Ecosystems Recovery Team. 2003. Invasive species in Garry Oak and associated ecosystems in British Columbia. Garry Oak Ecosystems Recovery Team, Victoria, BC</p>	<p>"No known biological agents are available."</p>

Summary of Risk Traits:

High Risk / Undesirable Traits

- Elevation range exceeds 1000 m, demonstrating environmental versatility
- Broad climate suitability
- Able to grow in areas with tropical climates
- Naturalized on Hawaii, Maui & Oahu islands, & widely naturalized elsewhere
- A disturbance adapted grass with negative environmental impacts
- Other *Lolium* species are invasive
- May contain endophytic fungi that can be toxic to livestock
- Pollen regarded as a severe allergen
- Increases fire risk
- Tolerates many soil types
- Forms dense swards that displace native grass and forb species and reduce species richness
- Reproduces by seed
- Hybridizes with other grasses
- Able to reach maturity in <1 year
- Seeds dispersed internally & externally by animals, by water, & both intentionally & accidentally by humans
- Prolific seed production
- Tolerates mowing, tilling, grazing & fire

Low Risk Traits

- Unarmed (no spines, thorns or burrs)
- Provides fodder for livestock (palatable despite reports of toxicity)
- Ornamental
- Shade intolerant
- Not reported to spread vegetatively (does not produce stolons or rhizomes)
- Self-incompatible
- Seeds not persistent in seedbank
- Several herbicides provide effective control

