Plant Assessment Form

For use with the "Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands" by the California Exotic Pest Plant Council and the Southwest Vegetation Management Association (Warner et al. 2003)

Printable version, February 28, 2003
(Modified for use in Arizona, 07/02/04)

Table 1. Species and Evaluator Information

Species name (Latin binomial)**:**	*Lolium perenne* L. (USDA 2005)
Synonyms:	*Lolium perenne* L.: *Lolium multiflorum* Lam., *Lolium perenne* L. ssp. *multiflorum* (Lam.) Husnot; *Lolium perenne* L. ssp. *multiflorum* (Lam.) Husnot: *Lolium multiflorum* Lam., *Lolium multiflorum* Lam. var. *diminutum* Mutel, *Lolium multiflorum* Lam. var. *muticum* DC, *Lolium perenne* L. var. *aristatum* Willd. and *Lolium perenne* L. var. *multiflorum* (Lam.) Parnell; *Lolium perenne* L. ssp. *perenne*: *Lolium multiflorum* Lam. var. *ramosum* Guss. ex Arcang., *Lolium perenne* L. var. *cristatum* Pers. ex B.D. Jackson (USDA 2005)
Common names:	*Lolium perenne* L.: Perennial ryegrass; *Lolium perenne* L. ssp. *multiflorum* (Lam.) Husnot: Italian ryegrass, annual ryegrass; *Lolium perenne* L. ssp. *perenne*: Perennial ryegrass
Evaluation date (mm/dd/yy)**:**	02/25/04
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Committee review date:	12/17/04 and 03/02/05
List date:	03/02/05
Re-evaluation date(s):	

Taxonomic Comment

Kearney and Peebles (1960) lists two perennial ryegrasses that have been introduced to Arizona: *Lolium perenne* and *L. multiflorum*. According to USDA (2005), however, *L. multiflorum* is a subspecies of *L. perenne* (*L. perenne* ssp. m*ultiflorum*) and can be an annual, biennial, or perennial. Another subspecies

taxon, *L. perenne* ssp. p*erenne*, is listed as a perennial. Besides Kearney and Peebles (1960), some authors also distinguish annual ryegrass (*L. perenne* ssp. *multiflorum*) and perennial ryegrass (*L. perenne* ssp. *perenne*) as separate species because of their distinct structural characteristics, even though annual ryegrass was derived artificially from perennial ryegrass and they readily hybridize (Gould and Shaw 1983 in Sullivan 1992). Other authors in addition to USDA (2005) consider *L. multiflorum* to be a variety or subspecies of *L. perenne* (Welsh et al. 1987, Gleason and Cronquist 1991). For this assessment the taxonomy of USDA (2005) is followed and the various taxa included under *Lolium perenne* will be treated collectively.

Table 2. Scores, Designations, and Documentation Levels

Question		Score	Documentation Level	Section Scores	Overall Score & Designations
1.1	Impact on abiotic ecosystem processes	**B**	Other published material	**"Impact"** **Section 1 Score:** **B**	**"Plant Score"** **Overall Score:** **Medium** **Alert Status:** **None**
1.2	Impact on plant community	**B**	Reviewed scientific publication		
1.3	Impact on higher trophic levels	**C**	Other published material		
1.4	Impact on genetic integrity	**U**	Other published material		
2.1	Role of anthropogenic and natural disturbance	**B**	Other published material	**"Invasiveness"** *For questions at left, an A gets 3 points, a B gets 2, a C gets 1, and a D or U gets=0. Sum total of all points for Q2.1-2.7:* **15 pts** **Section 2 Score:** **B**	
2.2	Local rate of spread with no management	**B**	Other published material		
2.3	Recent trend in total area infested within state	**B**	Observational		
2.4	Innate reproductive potential	**A**	Other published material		
2.5	Potential for human-caused dispersal	**A**	Other published material		
2.6	Potential for natural long-distance dispersal	**C**	Observational		
2.7	Other regions invaded	**B**	Other published material		
3.1	Ecological amplitude	**A**	Other published material	**"Distribution"** **Section 3 Score:** **B**	RED FLAG **NO** Something you should know.
3.2	Distribution	**C**	Observational		

Table 3. Documentation

Note: Much of the literature refers to studies of *Lolium perenne* as a pasture grass and its response under different variables, however, some of this information is derived from references to *L. perenne* as a turfgrass component species.

Question 1.1 Impact on abiotic ecosystem processes *Score:* **B** *Doc'n Level:* **Other pub.**
Identify ecosystem processes impacted: Increased fire frequency in areas where seeded. The relatively sufficient fibrous root system can affect the soil water table level as well as stabilize soil.
Rationale: Dense stands of dry ryegrass burn readily and have the potential to increase the fire frequency (Care 1995). An example of this occurred in Otay Mountain, California where a natural fire burned chaparral vegetation and was reseeded with *L. perenne*. With near record precipitation, the ryegrass did exceptionally well. A second fire occurred the following year killing nearly all of the shrubs (Zedler et al. 1983). One of the reasons *L. perenne* is used in postfire seeding is because the fibrous root system appears to effectively stabilize surface soil (Barro and Conard 1987). Robichaud et al. (2000) conducted an extensive literature review of post fire rehabilitation using various seeding treatments. In general, a negative relationship exists between ryegrass cover and erosion (see Blanford and Gunter 1972, Krammes and Hill 1963). Gautier (1983) measured less erosion from plots in which ryegrass seeding increased total plant cover. On the other hand, Taskey et al. (1989) found no effect of ryegrass on first-year postfire erosion with average rainfall and no intense storms, despite higher average cover on seeded plots. In a more extensive study in chaparral (Beyers et al.1998a, b, Wohlgemuth et al. 1998) postfire erosion was greatest during the first year after fire and was not significantly affected by ryegrass seeding (Wohlgemuth et al. 1998). In later postfire years, some sites had significantly less erosion on seeded than on unseeded plots, but this happened only after erosion rates had dropped to prefire levels, which occurred in as little as two years on some sites (Wohlgemuth et al. 1998). The Working Group assumed similar affects apply in Arizona
Sources of information: See cited literature. Working Group members also applied inference.

Question 1.2 Impact on plant community composition, structure, and interactions *Score:* **B** *Doc'n Level:* **Rev. sci. pub.**
Identify type of impact or alteration: Dense stands of ryegrass, especially where it is reseeded, can cause changes in species composition. Ryegrass can quickly colonize a site, but cannot tolerate shade and can be succeeded by perennial species and shrubs.
Rationale: From Robichaud et al. (2000): most of the studies of *L. perenne* impact on native plant communities come from studying chaparral in California. An inverse relationship between ryegrass cover and native herbaceous plant cover was observed. Cover or biomass of native chaparral vegetation, especially herbaceous species, tended to be lower on plots with high ryegrass cover, both in operationally seeded areas (Keeley et al. 1981, Nadkarni and Odion 1986) and on hand-seeded experimental plots (Gautier 1983, Taskey et al. 1989). Native plant species richness was lower on plots containing ryegrass (Nadkarni and Odion 1986, Taskey et al. 1989). Native herbaceous plant cover and species richness were lower on seeded plots when ryegrass cover was high (Beyers et al. 1994, 1998b). Taskey et al. (1989) also noted bare areas appearing in seeded plots where ryegrass died out after three years, resulting in lower cover than on unseeded plots. These studies suggested that ryegrass grows at the expense of native vegetation. Several studies (see Schultz et al. 1955, Gautier 1983, Taskey et al. 1989) demonstrated that higher seeded grass cover and seeded plots found lower density of shrub seedlings, especially species killed by fire and warned that longterm chaparral species composition could potentially be affected by grass

seeding. However, Beyers et al. (1998a) did not find significantly lower shrub seedling density on seeded plots. Amaranthus et al. (1993) reported significantly lower survival of planted sugar pine (*Pinus lambertiana*) seedlings in plots heavily seeded with annual ryegrass than in unseeded controls during the first postfire year in southern Oregon. The soil moisture was significantly lower and pine seedlings showed significantly greater water stress in the seeded plots. *Lolium perenne* reduced growth of ponderosa pine seedlings in tests conducted in California (Baron 1962). Field studies on aerial seeded sites in California found low pine seedling densities on most plots with annual ryegrass cover higher than 40 percent (Griffin 1982, Conard et al. 1991). By the second year, planted pine seedlings had significantly greater survival and lower water stress on seeded plots than on controls. By then, dead ryegrass formed dense mulch on the seeded plots, but no live grass was found. Native shrub cover was significantly greater on the unseeded plots the second year and soil moisture was lower (Amaranthus et al. 1993). Ryegrass thus acted as a detrimental competitor to tree seedlings the first year after fire, but provided a beneficial mulch and reduced competition from woody plants the second year.

From Wardle et al. (1999): in an experimental removal study where different functional groups were removed (conducted in New Zealand). "C3 perennial grass, consisting almost entirely of *L. perenne*, was responsible for many of the treatment effects. *Lolium perenne* clearly exerted a disproportionate effect on the other components of the flora, meaning that the ecophysiological traits of this species presumably conferred some competitive advantage. …removal of all C3 grasses resulted in a highly significant enhancement of the total shoot mass to root mass ratio in the gaps….Removing *L. perenne* enables greater C4 grass seedling establishment, inducing greater C4 grass growth during periods in the summer when other species are suppressed by moisture limitation. This study provides clear evidence that removal of *L. perenne* enhanced spatial variability and biomass of C4 species. Removal of *L. perenne* also enhanced the species richness of the dicotyledonous weeds and, in the early summer period that of the C4 grasses. This means that at the within-gap scale, some plant species are simply excluded by competition from *L. perenne*."

From McKell et al. (1969): in an experimental (lab) study, ryegrass when seeded with other species (*Poa pratensis*, *Phalaris tuberosa* var. *stemoptera*, *Bromus mollis*, and *Avena fatua*) produced significantly larger plants than any other species (except *Avena fatua* which responded similarly) regardless of the planting combinations. The author considers this a large factor in their success as aggressors since a rapid increase in size is important in dominating a given micro-environment. In addition, ryegrass produced plants with greater mass of surface roots than any of the other grasses (Similar results for the field study indicated, ryegrass was suppressed more by itself than by any other species or combination of species and was most productive when grown with *P. pratensis*. In a third experiment, ryegrass plants were planted in alternating rows with *P. pratensis*, *Festuca arundinacea*, *P. tuberosa* var. *stemoptera*, *A. fatua,* and *Triflorium hirtum*. The growth of these species planted between rows of ryegrass was considerably less than growth of the same species planted without the influence of ryegrass. The reduction of the stand of perennial species may well be considerable (McKell et al. 1965) and is a probably cause of lowered production in succeeding years. In the same study, McKell et al (1965) found that after 11 years *L. perenne* was a very minor component of the seeded pastures.
A postfire study (tributary of Ventura River in southern California) where *L. perenne* was seeded, the first year of growth resulted in ryegrass dry biomass dominated the plant communities. Overall species richness of annals decreased in the second year after the fire due to the predominance of ryegrass, although perennials took over the riparian zone to a larger extant (Davis et al. 1989).

From Sullivan (1992): In Arizona seedings that included *L. perenne* had low initial cover values immediately following wildfire. By the seventh or eighth year, cover values had increased to nearly three times the values on unburned control plots, after which there was a slight drop in cover values (Lowe et al. 1978)

Sources of information: See cited literature.

Question 1.3 Impact on higher trophic levels *Score:* **C** *Doc'n Level:* **Other pub.**
Identify type of impact or alteration: Positive impacts-forage value; negative impacts- poor habitat cover.
Rationale: *Lolium perenne* is considered good forage for livestock and wildlife (Frakes 1973 in Sullivan 1992). *Lolium perenne* is highly nutritious (Smoliak et al. 1981 in Carey 1995). In Montana *L. perenne* is considered poor cover for some mammal and waterfowl species (Dittberner and Olson 1983 in Carey 1995). Cover values in North Dakota rate *L. perenne* as poor for mule deer, white-tailed deer and pronghorn; and fair for upland game birds and waterfowl (Dittberner and Olson 1983 in Sullivan 1992). Pocket gophers increase in areas seeded with *L. perenne* possibly because of increased cover. Meadow mice and white-tailed deer graze *L. perenne* (Taskey et al. 1989 in Carey 1995). According to the draft California plant assessment for the taxon identified as *Lolium multiflorum* by J. DiTomaso (reviewed by the California list committee on August 1, 2003 and revised in September 2005), ryegrass outcompetes *Plantago erecta,* which is the sole source of food for the larvae of bay checkerspot butterflies in California. Suppression of native plant regeneration could potentially reduce browse species for wildlife (Keeley et al. 1981, Conard et al. 1991, Keeler-Wolf 1995, Loftin et al. 1998); however, no peer-published research was found that quantifies this.
Sources of information: See cited literature. Also considered the draft California *Lolium multiflorum* plant assessment by J. DiTomaso (available online at: http://www.cal-ipc.org/list_revision/completed_pafs.html; information current as of September 2005). Note: DiTomaso apparently considered *L. multiflorum* a distinct species from *L. perenne*.

Question 1.4 Impact on genetic integrity *Score:* **U** *Doc'n Level:* **Other pub.**
Identify impacts: No known native species in the genus *Lolium* occur in Arizona (Kearney and Peebles 1960).
Rationale: There are no native *Lolium* species in Arizona; however, there are several native species in the genus *Festuca* in Arizona (Kearney and Peebles 1960). Ryegrass is closely related to the genus *Festuca*; as a result, numerous natural hybrids between ryegrasses and European species of *Festuca* have been reported. Natural hybrids have resulted in great variation in the characteristics of ryegrass species (Gould and Shaw 1983 in Sullivan 1992). So the potential impacts on genetic integrity are still largely unknown.
Sources of information: See cited literature.

Question 2.1 Role of anthropogenic and natural disturbance in establishment *Score:* **B** *Doc'n Level:* **Other pub.**
Describe role of disturbance: Moderate invasive potential-occasionally establish in undisturbed areas.
Rationale: The practice of seeding ryegrass for erosion control after fires provides a ready means for establishing this species. It is generally found in disturbed sites, but can move into relatively undisturbed grasslands (DiTomaso and Healy In Press). Colonization of disturbed sites and adjacent areas can take place by seed dispersal (Thompson 1979 in Sullivan 1992).
Sources of information: See cited literature.

Question 2.2 Local rate of spread with no management *Score:* **B** *Doc'n Level:* **Other pub.**
Describe rate of spread: Increasing, but less rapidly than doubling in <years.
Rationale: Still being used in postfire seed mixes (Robichaud et al. 2000). Still used in lawn mixes. **Note:** The use of *L. perenne* for soil stabilization and rangeland conversion is becoming more questionable, because the effect of such species on the community structure of native plants is still poorly understood. Management considerations must take into account both the benefits of erosion

control, shrub control, and the reduction of shrub competition with conifers and the negative aspects of competition for space and soil moisture with native herbs and shrubs (Gross et al. 1989).
Sources of information: See cited literature.

Question 2.3 Recent trend in total area infested within state	*Score:* **B** *Doc'n Level:* **Obs.**
Describe trend: Increasing, but less rapidly than doubling in total area infested in <10 years.	
Rationale: Development codes often encourage seeding. *Lolium perenne* is often a major component of seed mixes. Irrigation is required to ensure the survival of ryegrass in prolonged periods of drought (Beard 1973). Given climatic trends over the past 10 years, this suggests that statewide doubling of range seems improbable. Increased urbanization adjacent to wildlands provides opportunities for invasion.	
Sources of information: See cited literature. Score based on inference drawn from the literature.	

Question 2.4 Innate reproductive potential	*Score:* **A** *Doc'n Level:* **Other pub.**
Describe key reproductive characteristics: Ryegrass is an annual, biennial, and perennial. Reproduces by seed.	
Rationale: Ryegrass produces many seeds per year, and is cross- and self-pollinated, and seed is relatively short-lived in the soil. Longevity of buried *L. perenne* seed is not known (Carey 1995). High germination rate and initial rapid growth (Sullivan 1992, Carey 1995). Ryegrass is large seeded and possesses a rapid rate of seed germination, establishment, and vertical leaf extension (Beard 1973). Seedbanks of ryegrass are limited and transient and tend to germinate as soon as moisture conditions permit (Sullivan 1992). The lack of a persistent seedbank explains the tendency of ryegrass to be replaced by native grasses with persistent seedbanks in the more northerly latitudes (Thompson 1979 in Sullivan 1992). Flowering of ryegrass occurs April to August, depending on environmental conditions (Frakes 1973 in Sullivan 1992). In lawns or pastures ryegrass may be entirely dependent on vegetative reproduction (probably because the flowering stems are removed before seed production can occur; Grime 1979 in Sullivan 1992).	
Sources of information: See cited literature.	

Question 2.5 Potential for human-caused dispersal	*Score:* **A** *Doc'n Level:* **Other pub.**
Identify dispersal mechanisms: Ryegrass seed is present in hay and turf grass seed mixes and is used in lawns, as forage, for erosion control, and for revegetation.	
Rationale: *Lolium perenne* is a quick, effective groundcover for erosion control and as a winter cover crop. Although ryegrass is one of the most commonly used grasses for revegetating burned sites, its use is controversial. Ryegrass is used as turf grass in the southern U.S. and is grown for winter pasture, hay, and silage (Carey 1995). Perennial ryegrass is widely planted in North America for range, pasture, hay and turf (Sullivan 1992). Available in turf mixes throughout the U.S.	
Sources of information: See cited literature.	

Question 2.6 Potential for natural long-distance dispersal	*Score:* **C** *Doc'n Level:* **Obs**.
Identify dispersal mechanisms: Most seeds fall close to parent plant (large seed). Natural long distance dispersal is rare.	
Rationale: Small mammals may transport the seeds. Ryegrass does not have a long distance dispersal mechanism for the transport of seed.	
Sources of information: Inference drawn from the literature	

Question 2.7 Other regions invaded	*Score:* **B** *Doc'n Level:* **Other pub.**
Identify other regions: From Carey (1995): *Lolium perenne* ssp. *multiflorum* is native to Europe. Records of its cultivation in Italy date back to the thirteenth and fourteenth centuries. Ryegrass has been	

introduced throughout the temperate regions of the world as a commercial species. *Lolium perenne* ssp. *multiflorum* occurs throughout the U.S., including Alaska and Hawaii, and in adjacent Canadian provinces. Difficulties in distinguishing *Lolium perenne* ssp. *multiflorum* from *Lolium perenne* ssp *perenne* make knowing the full range difficult.

Lolium perenne ssp. *multiflorum* is reported to grow at less than 3,280 feet (1,000 m) in California, at 6,400 feet (1,350 m) in Utah, 6,500 feet (1,380 m) in Montana, and 4,000 to 8,000 feet (1,220 to 2,440 m) in Colorado. *Lolium perenne* is native to Eurasia and North Africa. It is widely planted in North America for lawns and has many agricultural uses. It occasionally escapes and becomes naturalized, mostly in waste places and roadsides (several authors cited by Sullivan 1992).

Rationale: In California, ryegrass occurs in coastal prairie, valley and foothill grassland, Great Basin grassland, meadows and seeps, and pinyon-juniper woodland. As a result, plains and Great Basin shrub-grassland and Great Basin conifer woodland are two minor ecological types in Arizona that invasion by *L. perenne* has not yet been documented but have been invaded elsewhere.

Sources of information: See cited literature. Also considered information from the Utah State University herbarium (available online at: http://www.herbarium.usu.edu/) and the draft California *Lolium multiflorum* plant assessment by J. DiTomaso (available online at: http://www.cal-ipc.org/list_revision/completed_pafs.html; information current as of September 2005). Note: DiTomaso apparently considered *L. multiflorum* a distinct species from *L. perenne*.

Question 3.1 Ecological amplitude *Score:* **A** *Doc'n Level:* **Other pub.**

Describe ecological amplitude, identifying date of source information and approximate date of introduction to the state, if known: First record of ryegrass (*L. perenne multiflorum*) in Arizona is from 1884 along the Colorado River in the Grand Canyon. The next earliest record, for *L. perenne*, is 1913 in Tucson (SEINet 2004). Ryegrass invades at least four major and six minor ecological types in Arizona (see Worksheet B).

Rationale: Perennial ryegrass is adapted to a wide range of soil types and drainage (Sullivan 1992). It does not thrive where there are extended periods of low temperatures or drought. Perennial ryegrass will do well in areas that are too wet for other grasses, and short periods of flooding will not severely reduce good stands (Wheeler and Hill 1957, Frakes 1973).

Sources of information: See cited literature. Also considered information from SEINet (Southwest Environmental Information Network), Arizona herbaria specimen database (available online at: http://seinet.asu.edu/collections; accessed May and November 2004) and the personal observations of Working Group members.

Question 3.2 Distribution *Score:* **C** *Doc'n Level:* **Obs.**

Describe distribution: Occurs in Grand Canyon National Park mainly in waste places and disturbed ground, as well as in the riparian corridor of the Colorado River. Also noted at the mouth of Bright Angel Creek and along the Colorado River (river mile 20.5) under tamarisk (L. Makarick, personal communication, 2004). It occurs in the Huachuca Mountains, Catalina Mountains., San Pedro River floodplain , Oak Creek Canyon, Hassayampa River Preserve. In Cibecue Ridge Watershed No. 1, 60+ acres cleared of trees and seeded with *L. perenne* in 1967.

Rationale: In each minor ecological type in which it occurs, its distribution within the type is limited. See Worksheet B.

Sources of information: Information from SEINet (Southwest Environmental Information Network), Arizona herbaria specimen database (available online at: http://seinet.asu.edu/collections; accessed May and November 2004) and personal communication with L. Makarick (Below the Rim Vegetation Program Manager, National Park Service, Grand Canyon National Park Science Center, Flagstaff, Arizona, 2004).

Worksheet A. Reproductive Characteristics

Complete this worksheet to answer Question 2.4.

Reaches reproductive maturity in 2 years or less	**Yes**	**No**	**1 pt.**
Dense infestations produce >1,000 viable seed per square meter	**Yes**	**No**	**2 pt.**
Populations of this species produce seeds every year.	**Yes**	**No**	**1 pt.**
Seed production sustained for 3 or more months within a population annually	**Yes**	**No**	**1 pt.**
Seeds remain viable in soil for three or more years	**Yes**	**No**	**2 pt.**
Viable seed produced with *both* self-pollination and cross-pollination	**Yes**	**No**	**1 pt.**
Has quickly spreading vegetative structures (rhizomes, roots, etc.) that may root at nodes	**Yes**	**No**	**1 pt.**
Fragments easily and fragments can become established elsewhere	**Yes**	**No**	**2 pt.**
Resprouts readily when cut, grazed, or burned	**Yes**	**No**	**1 pt.**
	Total pts: 8 Total unknowns: 0		
	Score : A		

Note any related traits:

Worksheet B. Arizona Ecological Types

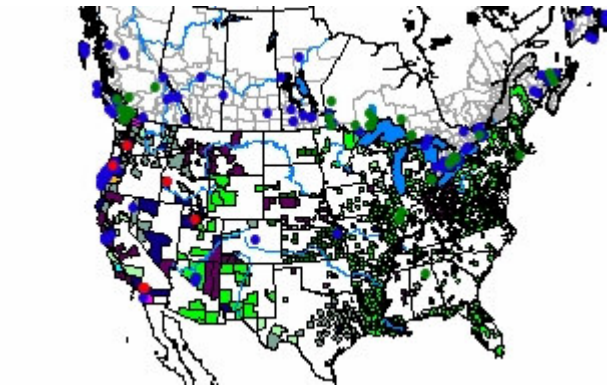
(*sensu* Brown 1994 and Brown et al. 1998)

Major Ecological Types	Minor Ecological Types	Code*
Dunes	Dunes	
Scrublands	Great Basin montane scrub	**U**
	southwestern interior chaparral scrub	**U**
Desertlands	Great Basin desertscrub	**U**
	Mohave desertscrub	
	Chihuahuan desertscrub	
	Sonoran desertscrub	**D**
Grasslands	alpine and subalpine grassland	
	plains and Great Basin shrub-grassland	**U**
	semi-desert grassland	**U**
Freshwater Systems	lakes, ponds, reservoirs	
	rivers, streams	
Non-Riparian Wetlands	Sonoran wetlands	
	southwestern interior wetlands	
	montane wetlands	**U**
	Playas	
Riparian	Sonoran riparian	**D**
	southwestern interior riparian	**C**
	montane riparian	**D**
Woodlands	Great Basin conifer woodland	**U**
	Madrean evergreen woodland	**D**
Forests	Rocky Mountain and Great Basin subalpine conifer forest	**D**
	montane conifer forest	**D**
Tundra (alpine)	tundra (alpine)	

*A means >50% of type occurrences are invaded; B means >20% to 50%; C means >5% to 20%; D means present but ≤5%; U means unknown (unable to estimate percentage of occurrences invaded).

From Grass Manual on the Web (http://www.herbarium.usu.edu/webmanual/default.htm)

Lolium perenne



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