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)**:**	*Echinochloa crus-galli* (L.) Beauv. (USDA 2005)
Synonyms:	*Panicum crus-galli* L. (USDA 2005)
Common names:	Barnyardgrass, Japanese millet, cockspur grass, cockspur panicum, barnyard millet, summer grass, watergrass, billion dollargrass, chickenpanicum grass
Evaluation date (mm/dd/yy)**:**	11/19/04
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Committee review date:	11/19/04 and 03/01/05
List date:	03/01/05
Re-evaluation date(s):	

Table 2. Scores, Designations, and Documentation Levels

Question		Score	Documentation Level	Section Scores	Overall Score & Designations
1.1	Impact on abiotic ecosystem processes	**C**	Other published material	**"Impact"** **Section 1 Score:** **C**	**"Plant Score"** **Overall Score:** **Low** **Alert Status:** **None**
1.2	Impact on plant community	**D**	Other published material		
1.3	Impact on higher trophic levels	**D**	Observational		
1.4	Impact on genetic integrity	**D**	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:* **9 pts** **Section 2 Score:** **C**	
2.2	Local rate of spread with no management	**U**	Observational		
2.3	Recent trend in total area infested within state	**U**	Observational		
2.4	Innate reproductive potential	**A**	Reviewed scientific publication		
2.5	Potential for human-caused dispersal	**C**	Other published material		
2.6	Potential for natural long-distance dispersal	**B**	Other published material		
2.7	Other regions invaded	**C**	Observational		RED FLAG **NO** Something you should know.
3.1	Ecological amplitude	**A**	Other published material	**"Distribution"** **Section 3 Score:** **B**	
3.2	Distribution	**C**	Observational		

Table 3. Documentation

Question 1.1 Impact on abiotic ecosystem processes *Score:* **C** *Doc'n Level:* **Other pub**.
Identify ecosystem processes impacted: Soil nutrients.
Rationale: Experiments have shown that heavy stands *of Echinochloa crus-galli* can remove 60 to 80% of nitrogen from the soil in a crop area as well as significant amounts of other macronutrients (Holm et al. 1991, Guertin and Halvorson 2003). No tests are known from native plant communities.
Sources of information: See cited literature. Also considered Working Group member observations and discussion.

Question 1.2 Impact on plant community composition, structure, and interactions *Score:* **D** *Doc'n Level:* **Other pub**.
Identify type of impact or alteration: Local displacement of native vegetation; removal of nitrogen and soil nutrients may impact growth and productivity of adjacent native species.
Rationale: In some wetlands of North Dakota, barnyardgrass is the dominant species (Smeins 1971 and Great Plains Flora Association 1986 in Esser 1994). In the southern High Plains region of northern Texas and southern New Mexico, it is a codominant in wet meadow and prairie communities (Bryant and Smith 1988 and Bolen et al. 1989 in Esser 1994). Although barnyardgrass likely replaces native wetland species in Arizona, no data were found on the magnitude of this impact (e.g. changes in species composition or density). According to Van Devender et al. (1997) barnyardgrass, as well as other species of non-native plants in riparian zones of the Sonoran Desert region, are "relatively innocuous with few serious impacts on the flora and vegetation."
Sources of information: See cited literature.

Question 1.3 Impact on higher trophic levels *Score:* **D** *Doc'n Level:* **Obs.**
Identify type of impact or alteration: No negative impacts have been documented although seeds may provide seasonal source of forage for bird species and possibly small mammals.
Rationale: Barnyardgrass is an important source of food and cover for waterfowl in the Sacramento Valley (Mushet at al. 1992), as well as in playa lakes of Texas and New Mexico (Bolen at al. 1989 in Esser 1994). Seeds are eaten by songbirds, waterfowl, and greater prairie chickens (Esser 1994). No references to wildlife species in Arizona were found; however, based on information from other areas, barnyardgrass likely provides a seed source for birds and small mammals.
Sources of information: See cited literature. Also considered Working Group discussion.

Question 1.4 Impact on genetic integrity *Score:* **D** *Doc'n Level:* **Other pub**.
Identify impacts: No information regarding potential for hybridization found in the available literature.
Rationale: The only congener, jungle-rice (*Echinochloa colona* (L.) Link), is also non native.
Sources of information: See Kearney and Peebles (1960) and Guertin and Halvorson (2003).

Question 2.1 Role of anthropogenic and natural disturbance in establishment *Score:* **B** *Doc'n Level:* **Other pub.**
Describe role of disturbance: Fires and scouring floods in riparian areas can reduce or eliminate canopy and ground cover resulting in conditions favorable to colonization.
Rationale: Barnyardgrass is a pioneer species that readily invades disturbed sites. It is most often found in open, unshaded areas and is intolerant of dense shade (Mitich 1990, Esser 1994). Its growth rate and leaf area were reduced, assimilation rate slowed, and the number of tillers and panicles were lower in shady conditions (Maun and Barrett 1986). In an old-field succession deciduous forest in southwestern

Ohio, barnyardgrass was found growing in a two-year-old stand, but was absent in stands 10, 50, 90, or 200 years-old (Vankat and Walter 1991 in Esser 1994).

Barnyardgrass may colonize burned areas from soil-stored seed after fires. Fires that thin or remove canopy vegetation produce conditions that may be conducive to colonization by barnyardgrass (Esser 1994).

Maun and Barrett (1986) suggest that barnyardgrass's plastic response to environmental conditions enables the species to survive and reproduce under a wide range of conditions in unpredictable environments that are common in seasonally flooded lands. No observations have been made of barnyardgrass becoming established in vegetation communities outside of riparian areas or agricultural settings.

Sources of information: See cited literature. Also considered Working Group member observations and discussion.

Question 2.2 Local rate of spread with no management *Score:* **U** *Doc'n Level:* **Obs**.

Describe rate of spread: No published data found.

Rationale: According to F. Northam (personal communication, 2004) barnyardgrass is widespread and has been in Arizona for over 100 years, but is not a species that is "on the move." Because this species, however, is a minor part of the non-native flora in wetland, riparian, and aquatic sites, no one had a good estimate of its rate of spread in localized situations.

Sources of information: Personal communication with F. Northam (Weed Biologist, Tempe, Arizona, 2004) and Working Group discussion.

Question 2.3 Recent trend in total area infested within state *Score:* **U** *Doc'n Level:* **Obs.**

Describe trend: Unknown.

Rationale: The earliest known record in Arizona is from Pima County in 1891. The species can now be found in agricultural, riparian, and mesic situations throughout the state. No information was found to indicate an upward trend in area infested. Not a species that has received much attention in Arizona.

Sources of information: Personal communication with F. Northam (Weed Biologist, Tempe, Arizona, 2004) and Working Group discussion.

Question 2.4 Innate reproductive potential *Score:* **A** *Doc'n Level:* **Rev. sci. pub.**

Describe key reproductive characteristics: See Worksheet A.

Rationale: A warm-weather, C4, tufted, annual graminoid that is also self-pollinating, reproducing from seed (Guertin and Halvorson 2003). Seed production is highly variable, dependent and responding to site conditions, especially nutrient availability, day length, and plant density. Stevens (1932) reports that an average, well-developed barnyardgrass plant growing with little competition produces 7160 seeds/plant. A "healthy full-season barnyardgrass in California's Central Valley can produce 750,000 to 1,000,000 seeds" and up to "2,250,000 seeds under optimal conditions" (R. Norris, personal communication in Mitich 1990). Barnyardgrass seed is primarily water dispersed. Holm et al. (1991) state that single plants in the U.S. have produced 5,000 to 7,000 seeds and "such production, in a weedy field, could result in a yield of 1,100 kg of weed seeds per hectare."

Barnyardgrass can vegetatively propagate when possessing a prostrate growth habit by rooting at its nodes and producing new shoots (Holm et al. 1991). Roots of the weed can extend to 46 inches (116 cm) deep and 42 inches (106 cm) wide in porous, well-drained soil enabling the plant to withstand drought conditions (Maun and Barrett 1986). Barnyardgrass flowering dates in Arizona are from July to September and from July to October in California (Esser 1994).

Barnyardgrass seeds have an innate dormancy and Manidool (1992) reports that in the U.S. dormancy ranges from 4 to 48 months. Seeds germinate and seedling emergence is better when soil is compact (Holm et al. 1991). Germination occurs optimally when soil water-holding capacity ranges between 70 to 90% of its maximum (Arai and Miyahara 1963, Holm et al. 1991). Barnyardgrass seed germinates over a wide temperature range, 55 to 104°F with optimum germination occurring from 68 to 86°F (Esser 1994).

Seed viability in soil is variable. In Mississippi seed viability was 1% after burial for 2.5 years; less than 6% of seed survived 6 months or longer (Egley and Chandler 1978); however, according to Dawson and Bruns (1975) barnyardgrass seed may be viable in the soil for up to 13 years.

Sources of information: See cited literature.

Question 2.5 Potential for human-caused dispersal *Score:* **C** *Doc'n Level:* **Other pub.**

Identify dispersal mechanisms: Dispersed as a common contaminant of crop seeds or when used in erosion control (Guertin and Halvorson 2003). It is readily grazed by livestock in Arizona (Kearney and Peebles 1960).

Rationale: Barnyardgrass seed is primarily dispersed by water. Direct human spread to, within, and between agricultural landscapes is likely facilitated by irrigation systems. Movement of livestock from agricultural to natural areas could facilitate spread.

Spread to wildlands is possible from sumps adjacent to riparian areas during overbank flooding; however, successful establishment is considered to be infrequent due to flood frequency and seed viability factors. Other than riparian areas, spread into uplands would not be expected. Barnyardgrass is adapted to wet sites and waterlogged conditions, growing best where sites have 35 to 65% soil moisture (Maun and Barrett 1986).

Sources of information: See cited literature. Also considered Working Group discussion.

Question 2.6 Potential for natural long-distance dispersal *Score:* **B** *Doc'n Level:* **Other pub**.

Identify dispersal mechanisms: Primarily water and birds.

Rationale: Seeds are easily dispersed in water, with seeds able to float, consequently being spread by flood or natural flows of rivers, creeks, etc. After four to five days, 50% of seed were documented to be afloat (Esser 1994). Could be spread by large ungulates at wallows; seeds have been found matted in fur/hair of bison (Ridley 1930 in Guertin and Halvorson 2003). Spread by ducks, waders, and seed-eating birds. Barnyardgrass is an important source of food and cover for waterfowl in the Sacramento Valley of California (Mushet et al. 1992). Draining barnyardgrass fields in the spring, followed by discing, is a management practice used to perpetuate stands of barnyardgrass in California to benefit waterfowl (Esser 1994).

Sources of information: See cited literature. Also considered Working Group discussion.

Question 2.7 Other regions invaded *Score:* **C** *Doc'n Level:* **Obs.**.

Identify other regions: Widespread species wherever moist soils occur. In the southern High Plains region of northern Texas and southern New Mexico it is also found in prairie communities and shinnery communities. In South Dakota it occurs in mixed-grass prairie dominated by blue grama (*Bouteloua gracilis*), buffalo grass (*Buchloë dactyloides*), western wheatgrass (*Agropyron smithii*), and needle grass (*Stipa* spp.). It is also found in tallgrass prairies of northeast Kansas. At Gettysburg National Military Park in Pennsylvania, barnyardgrass occurs in a variety of forest cover types as an understory species (Esser 1994).

Rationale: Equivalent sites in Arizona will be major ecological types with warm temperatures and soils that remain moist during the hot portions of the growing season (May to October) and include: freshwater systems, non-riparian wetlands and riparian sites. Herbarium records (SEINet 2004) indicate

each of these ecological types have established populations of barnyardgrass (see rationale in questions 3.1 and 3.2). Therefore, this question is rated as **C** because all types of moist areas in Arizona's wildlands already have established barnyardgrass populations.

Sources of information: See cited literature. Score based on inference drawn from the literature, information from SEINet (Southwest Environmental Information Network), Arizona herbaria specimen database (available online at: http://seinet.asu.edu/collections; accessed December 17, 2004), and Working Group discussion.

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: Barnyardgrass is now a common weed of most of the agricultural areas of the world except Africa. A native of Europe and India, it has a range extending from latitude 50N to 40S. It is a cosmopolitan weed that is troublesome in both temperate and tropical crops (Holm et al. 1991). On the North American continent, it is found throughout the United States, Canada, and Mexcio.

There apparently is no documented introduction into the United States (Guertin and Halvorson 2003). Barnyardgrass was recorded in various locations in eastern Canada from as early as 1829 (Maun and Barrett 1986). It was recorded in California between 1825 to 1848 (Guertin and Halvorson 2003).

Barnyardgrass is adapted to wet sites and waterlogged conditions, and it thrives in hot, wet conditions from sea level to 8,200 feet (Manidool 1992 in Guertin and Halvorson 2003), growing best where sites have 35 to 65% soil moisture (Maun and Barrett 1986 in Guertin and Halvorson 2003). In drier soils it is not as tall and the yield of seeds and the numbers of panicles and tillers are reduced. It grows best in rich, moist soils with a high nitrogen content, but it can also thrive on sand and loamy soils (Holm et al. 1991). Barnyardgrass is intolerant of dense shade (Mitich 1990).

In the southwestern U.S., barnyardgrass occurs in moist loamy soils (often disturbed), in marshes, seepage sites, and in the mud and water of lakes, ditches, and floodplains. It is a troublesome weed in the moist soils of all agricultural areas in Arizona, found in irrigated fields and orchards, pastures, roadside swales, ditches and also reservoirs and streams to 7,000 feet (Parker 1972). Based on the collections accessed through SEINet (2004), there is a record of barnyardgrass from Apache County (Reservation Ranch on the "Apache Indian Reservation") from 9500'.

According to SEINet (2004) the earliest documented record of the species in Arizona is a record from "Pima County, Tucson" from 1891. It also was collected from Walnut Canyon in Coconino County in 1898.

Rationale: Barnyardgrass populations have been observed in three major Arizona ecological types, Freshwater Systems, Riparian, and Non-Riparian Wetlands, and seven minor ecological types. See Worksheet B.

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 December 17, 2004), personal communication with F. Northam (Weed Biologist, Tempe, Arizona, 2004), and Working Group member observations.

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

Describe distribution: In Arizona barnyardgrass is found in wet areas of every county except La Paz.

Rationale: Distribution records from the Arizona State University Vascular Plant Herbarium, University of Arizona Herbarium, and Northern Arizona University Vascular Plant Herbarium as recorded in SEINet (2004):

Cochise County: Ramsey Canyon, Huachuca Mountains, seep in pine-oak woodland, 6,300 feet; San Pedro River floodplain, near Cascabel, grassland with sparse tamarisk, at 150 m from river, 929 m;
Graham County: five miles south of Safford in cultivated field; Upper Turkey Creek, 5 miles west of Point of Pines, dry creek bed, Ponderosa Pine habitat, 6200 feet;
Greenlee County: Apache-Sitgreaves National Forest, along Coal Creek, at 2 km southwest of Arizona-New Mexico state line along Arizona Highway78, ponderosa pine-oak forest, "rooting in the water" 1700 m; US 666, 62 miles south of Alpine, 7.6 miles south of Hog Trail Saddle, roadside in juniper/grassland;
Apache County: Canyon de Chelly National Monument, very common along stream in upper Canyon del Muerto, 6900 feet; Hubbell Trading Post National Historic Site, Pueblo Colorado Wash, common along intermittent Stream, 6320 feet;
Navajo County: Clear Creek Reservoir, at 6 miles southeast of Winslow, mesic area around Reservoir, 4900 feet; Fort Apache Indian Reservation, pond on north side of Big Springs road, 6880 feet;
Coconino County: Lake Mary, in moist soil along lake, 6900 feet; Kaibab National Forest, Pine Flat Hunting Camp, in moist soil at stock reservoir, 6900 feet;
Mohave County: Clack's Canyon, northwest of Kingman, in water near dairy; Grand Canyon, Hualapai Indian Reservation, Colorado River Mile 259.7, head of Burnt Canyon, 1100 feet;
Yuma County: "Along irrigated ditches" (1912); Cabeza Prieta Game Range (no additional data);
Yavapai County: Verde River, west of Perkinsville, wet bank at river's edge, 3820 feet; Jerome, wet ground below storage tank;
Pima County: Cabeza Prieta National Wildlife Refuge, artificial dirt charco on San Cristobal Wash, 1090 feet; Santa Cruz River, 2160 feet;
Santa Cruz County: 1 km north of Canelo Pass summit, rocky slope on oak-juniper area, on the margin of a cattle Tank "full of water," 1650 m; Nature Conservancy Patagonia-Sonoita Creek Sanctuary, southwest of Patagonia, 4000 feet;
Pinal County: Experimental farm near Sacaton, ditchbank; San Pedro River near Dudleyville, middle aged cottonwood woodland with tamarisk, 607 m;
Gila County: Tonto National Forest, Sierra Ancha Wilderness, along Forest Service Road 203 at 6.2 km south of Board Tree Saddle 4300 feet; Tonto National Forest, 3-Bar Watershed, "wet site in chaparral," 3800 feet;
Maricopa County: Tonto National Forest, Seven Springs Wash, riparian, 3300 feet; edge of irrigation ditch between Tempe and Mesa.

Sources of information: SEINet (Southwest Environmental Information Network), Arizona herbaria specimen database (available online at: http://seinet.asu.edu/collections; accessed December 17, 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: Flowering dates in Arizona are between July and September (Kearney and Peebles 1960). Maun and Barrett (1986) suggest *Echinochloa crus-gallis*'s plastic response to environmental conditions enables the species to survive and reproduce under a wide range of conditions in unpredictable environments that are common in seasonally flooded lands. They also attribute this plant's success to heavy seed production, seed dormancy, its ability to grow and reproduce quickly over a wide range of photoperiods, and substantial herbicide resistance**.**

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	
	southwestern interior chaparral scrub	
Desertlands	Great Basin desertscrub	
	Mohave desertscrub	
	Chihuahuan desertscrub	
	Sonoran desertscrub	
Grasslands	alpine and subalpine grassland	
	plains and Great Basin shrub-grassland	
	semi-desert grassland	
Freshwater Systems	lakes, ponds, reservoirs	**C**
	rivers, streams	**C**
Non-Riparian Wetlands	Sonoran wetlands	**D**
	southwestern interior wetlands	**D**
	montane wetlands	**D**
	playas	
Riparian	Sonoran riparian	**C**
	southwestern interior riparian	**C**
	montane riparian	**U**
Woodlands	Great Basin conifer woodland	
	Madrean evergreen woodland	
Forests	Rocky Mountain and Great Basin subalpine conifer forest	
	montane conifer forest	
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).

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