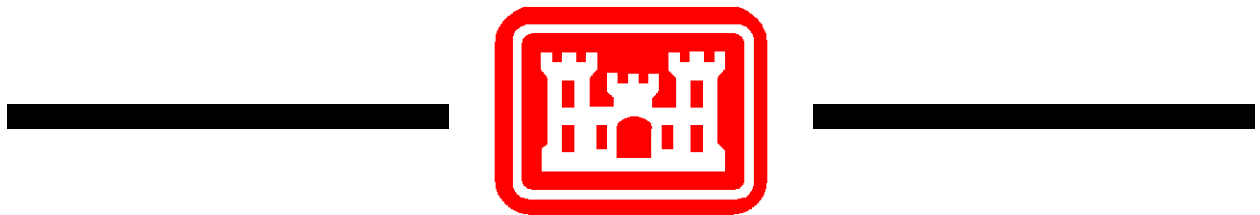


PUBLIC WORKS TECHNICAL BULLETIN 200-1-88  
3 MARCH 2011

**GUIDELINES FOR MANAGEMENT OF WINTER  
ANNUAL GRASSES**



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Public Works Technical Bulletin

3 MARCH 2011

No. 200-1-88

FACILITIES ENGINEERING  
ENVIRONMENTAL  
GUIDELINES FOR MANAGEMENT OF  
WINTER ANNUAL GRASSES

1. Purpose.

a. This Public Works Technical Bulletin (PWTB):

- transmits a comprehensive list of winter annual grass species occurring in the United States, both native and introduced;
- provides distribution and occurrence information of these species;
- describes management practices to control winter annual grasses in general; and
- includes an identification key for the grass genera possessing widespread native and introduced species to aid in separating those species from one another.

b. All PWTBs are available electronically in Adobe® Acrobat® portable document format [PDF]) through the World Wide Web (WWW) at the National Institute of Building Sciences' Whole Building Design Guide (WBDG) Web page, which is accessible through this Universal Resource Locator (URL):

[http://www.wbdg.org/ccb/browse\\_cat.php?o=31&c=215](http://www.wbdg.org/ccb/browse_cat.php?o=31&c=215)

2. Applicability. This PWTB applies to all U.S. Army installations in the continental United States (CONUS).

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### 3. References.

a. Army Regulation (AR) 200-1, "Environmental Protection and Enhancement," 21 February 1997, U.S. Army, Washington, DC.

b. AR 200-3, "Natural Resources - Land, Forest and Wildlife Management," 20 March 2000, U.S. Army, Washington, DC.

c. AR 350-4, "Integrated Training Area Management (ITAM)," 08 May 1998, U.S. Army, Washington, DC.

d. Executive Order (EO) 13112, "Invasive Species," 03 February 1999, Washington, DC.

e. Additional references used in the appendices to this PWTB are listed in Appendix L.

### 4. Discussion.

a. Although winter annual grasses occur in all 50 states, they are most problematic in the arid and semi-arid western United States where they are adapted to take advantage of seasonal precipitation that occurs in fall, winter, and spring. In these types of environments, winter annuals utilize a significant portion of soil moisture before native perennials and other desirable plant species are active. Once the moisture runs out, winter annuals will flower, set seed, and senesce, to create a readily combustible fuel source throughout the hot, dry months of the growing season. Fires associated with these winter annual grass invasion have dramatically decreased the fire return interval from decades to every few years in many locations. Because of the historically low risk of fires in these systems, many native plant species are not adapted to cope with recurring fires and are replaced by winter annuals.

b. Winter annual grasses are grasses whose primary growth occurs in winter and spring. Many of these species germinate in autumn when seasonal rainfall begins, grow through the winter when conditions are favorable, and finish their growth cycle in spring or early summer. However, not all winter annual grasses behave in this fashion everywhere. Some can exist as short-lived perennials under certain circumstances, or exist as annuals when germination conditions are not adequate before winter.

c. The most common winter annual grass genus is *Bromus*, with 14 non-native invasive species, 1 native invasive species, and 1 native non-invasive species. There are four other common genera: (1) *Hordeum* contains three non-native invasive winter annual

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species, one native invasive species, and two native non-invasive species; (2) *Phalaris* contains two non-native invasive species, one non-native non-invasive species, and three native non-invasive species; (3) *Poa* contains one non-native invasive species and four native non-invasive species; and (4) *Vulpia* contains one non-native invasive species, one native invasive species, one non-native non-invasive species, and two native non-invasive species. Separating native from introduced species is important so that control efforts are focused on the non-native problem species and not erroneously conducted on native species that are perceived to be problem species, which can and does happen. Identification keys for the five most common genera given above are included in Appendices F-J.

d. Appendix A contains management information for winter annual grasses.

e. Appendix B lists non-native, invasive winter annual grass species, including synonyms, distribution, and habitat information.

f. Appendix C lists native, invasive winter annual grass species, including synonyms, distribution, and habitat information.

g. Appendix D lists non-native, non-invasive winter annual grass species including synonyms, distribution, and habitat information.

h. Appendix E lists native, non-invasive winter annual grass species, including synonyms, distribution, and habitat information.

i. Appendices F-J provide identification keys for each of the five most common winter annuals of the following species: *Bromus*, *Hordeum*, *Phalaris*, *Poa*, and *Vulpia*.

j. Appendix K shows diagrams of grass inflorescences used in the identification keys.

k. Appendix L lists references and resources used in the Appendices.

l. Appendix M contains a list of abbreviations used in this PWTB, plus a glossary of taxonomic terminology used in the identification keys.

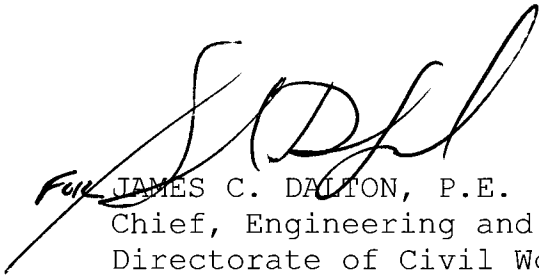
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5. Points of Contact (POC). Headquarters (HQ), U.S. Army Corps of Engineers (USACE) is the proponent for this document. The HQUSACE POC is Mr. Malcolm E. McLeod, CEMP-CEP, 202-761-5696, or e-mail: Malcolm.E.Mcleod@usace.army.mil.

Questions and/or comments regarding this subject should be directed to the technical POC:

U.S. Army Engineer Research and Development Center  
Construction Engineering Research Laboratory  
ATTN: CEERD-CN-N (Ryan Busby)  
2902 Newmark Drive  
Champaign, IL 61822-1076  
Tel. (217) 373-7296  
FAX: (217) 373-7266  
E-mail: ryan.r.busby@usace.army.mil

FOR THE COMMANDER:



*Full* JAMES C. DALTON, P.E.  
Chief, Engineering and Construction  
Directorate of Civil Works

## APPENDIX A:

### MANAGEMENT OF WINTER ANNUAL GRASSES

Little, if any, control and management information is available for numerous non-native invasive winter annual grasses. Other species are problematic in other land-use types that are not applicable to training area management (i.e., *Poa annua* control primarily focuses on golf courses and other turfgrass uses; *Aegilops cylindrica* focuses on control in winter wheat). However, a few species are so widespread and problematic in natural areas (especially *Bromus tectorum*), that a great deal of management information exists that is applicable to other winter annual grass species. Types of control depend on the level of infestation of the winter annual grasses and the presence or absence of desirable vegetation. If a light infestation has occurred, more conservative control strategies should be implemented that will not damage desirable vegetation. If no desirable vegetation is present, more drastic controls can be implemented that will then require reseeding to prevent future invasions.

#### Biological Control

Because of the widespread distribution and economic value of grasses, biological controls are not yet recommended, nor have they been developed. Soil fungi and bacteria are currently being studied for potential use with cheatgrass. Grazing can be effective in reducing winter annuals if tightly controlled and limited to intervals where seed production of these species can be reduced while limiting the reduction of desirable vegetation. Treatments must be repeated within a season to reduce seed production and must be repeated for multiple years to deplete the seed bank. Soil biological crusts may impede germination of introduced winter annuals. These crusts are easily destroyed by disturbance and take many years to recover.

#### Chemical Control

Most winter annual grasses are not specified for control on herbicide labels, but this is slowly changing as chemical companies realize the need to control invasive plant species in rangelands and other natural areas and develop application rates and other pertinent information. Non-selective or broad-spectrum herbicides can be used to control many types of vegetation. However, even if a herbicide is labeled to control a particular plant species, the effects on non-target plant species may be

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unknown, so care must be taken if desirable species are present and likely to be exposed to the chemical. Always read and follow herbicide label and safety instructions. Cheatgrass is by far the most commonly specified invasive winter annual grass for control by herbicides. It can be controlled in rangeland systems by using atrazine, glyphosate (Roundup), imazapic (Plateau), glyphosate + imazapic (Journey), rimsulfuron (Matrix), sulfometuron (Oust) or several other herbicides (Pellant, Kaltenecker, and Jirik 1999; Beck 2009). Cheatgrass and medusahead (*Taeniatherum caput-medusae*) can be controlled using sulfometuron + chlorsulfuron (Landmark XP). Atrazine can also be useful for other winter annual grasses (Currie et al. 1987; TNC 2009).

### **Cultural Control**

If timed correctly, controlled burning can be effective at reducing winter annual grasses. Late spring or early summer burning can burn seed before it can fall into the protective litter layer. Burning also reduces the litter layer that aids in germination of these grasses. Fall burning can be effective as well, when it is used to destroy newly germinated winter annual seedlings (TNC 2009).

Reseeding areas to native vegetation following control can prevent re-invasion. Perennial vegetation is preferred long-term, but it is generally slow-growing and prone to re-invasion before becoming established. The use of native annuals and other fast-growing species to compete with undesirable species until the perennials are established can aid in the transition. Maintenance of an adequate soil microbial community, particularly arbuscular mycorrhizal fungi, is another important consideration for successfully restoring native perennial vegetation.

Greenstripping, or planting areas of fire-resistant vegetation to serve as fire breaks, can be used to limit the spread of fires that help winter annual grasses to replace native vegetation (Pellant 1996).

### **Mechanical Control**

Seeds of many plant species, including annual brome grasses, will not emerge after being buried 6-in. deep (Hulbert 1955). Moldboard plowing can achieve this level of burial, but will not be effective in shallow soils and will destroy any desirable vegetation that may be co-occurring.



**APPENDIX B:**

**NON-NATIVE INVASIVE  
WINTER ANNUAL GRASSES**

Beginning on the following page, Table B-1 lists non-native, invasive winter annual grass species, including their synonyms, distribution, and habitat information.

Table B-1. Non-native, invasive winter annual grasses occurring in the United States.

| Genus           | Species             | Synonyms   | Range  | Occurrence at Tier 1 Army Installations       | Nativity<br>I=Introduced;<br>N = Native | Habitat                                | Invasive |
|-----------------|---------------------|--|--|---|---|--|----------|
| <i>Aegilops</i> | <i>cylindrica</i>   | <i>Triticum cylindricum</i>  | AL, AR, AZ, CA, CO, IA, ID, IL, IN, KS, KY, LA, MI, MO, MT, ND, NE, NM, NV, NY, OH, OK, OR, PA, SD, TN, TX, UT, VA, WA, WV, WY | Hood, Leonard Wood, Sill                      | I                                       | Disturbed sites                        | Yes      |
| <i>Aegilops</i> | <i>geniculata</i>   | <i>Aegilops ovata</i> ,<br><i>Triticum ovatum</i>  | CA, NY, VA   | None  | I                                       | Roadsides only in Mendocino County, CA | Yes      |
| <i>Aegilops</i> | <i>triuncialis</i>  | <i>Aegilops squarrosa</i> ,<br><i>Triticum persicum</i> ,<br><i>Triticum triunciale</i>  | CA, MD, NY, PA   | None  | I                                       | Disturbed sites                        | Yes      |
| <i>Aira</i>     | <i>caryophyllea</i> | None   | AK, AL, AR, CA, DT, DE, FL, GA, HI, ID, IL, IN, LA, MA, MD, MO, MS, NC, NH, NJ, NY, OH, OK, OR, PA, SC, TN, TX, VA, VT, WA, WY | Benning, Bragg, Hunter Liggett, Lewis, Rucker | I                                       | Disturbed soil                         | Yes      |
| <i>Aira</i>     | <i>elegans</i>      | <i>Aira caryophyllea</i> var. <i>capillaris</i> ,<br><i>Aira capillaris</i> ,<br><i>Aspris capillaris</i> ,<br><i>Aira elegantissima</i> | AL, AR, CA, FL, GA, HI, LA, MD, MO, MS, NC, NJ, NM, OK, OR, SC, TN, TX, VA, WA   | Benning                                       | I                                       | Disturbed soil                         | Yes      |

| Genus             | Species            | Synonyms                    | Range  | Occurrence at Tier 1 Army Installations | Nativity<br>I=Introduced;<br>N = Native | Habitat                       | Invasive |
|-------------------|--------------------|-----------------------------|--|---|---|-------------------------------|----------|
| <i>Aira</i>       | <i>praecox</i>     | <i>Aspris praecox</i>       | CA, CT, DE, MA, MD, NC, NJ, NY, OR, PA, VA, WA   | Lewis                                   | I                                       | Disturbed coastal soils       | Yes      |
| <i>Alopecurus</i> | <i>myosuroides</i> | None                        | AL, CA, DE, KS, KY, LA, MA, MD, ME, MI, MS, NC, NJ, NM, NY, OH, OR, PA, RI, SC, TX, VA, WA, WV | Riley                                   | I                                       | Disturbed sites, moist ground | Yes      |
| <i>Apera</i>      | <i>interrupta</i>  | <i>Agrostis interrupta</i>  | AZ, CA, CO, HI, ID, IL, IN, MA, ME, MI, MO, MT, NJ, NM, NV, NY, OH, OR, UT, WA, WI, WY         | None                                    | I                                       | Disturbed soil                | Yes      |
| <i>Apera</i>      | <i>spica-venti</i> | <i>Agrostis spica-venti</i> | CA, CT, DE, ID, KY, MA, MD, ME, MI, MO, NY, OH, OR, PA, TX, VT, WA                             | Hunter Liggett                          | I                                       | Disturbed soil                | Yes      |
| <i>Avena</i>      | <i>barbata</i>     | <i>Avena hirsuta</i>        | AZ, CA, HI, MA, MT, NM, NV, OR, WA   | Hunter Liggett                          | I                                       | Disturbed soil                | Yes      |

| Genus               | Species           | Synonyms   | Range  | Occurrence at Tier 1 Army Installations        | Nativity<br>I=Introduced;<br>N = Native | Habitat                        | Invasive |
|---------------------|-------------------|--|--|--|---|--------------------------------|----------|
| <i>Avena</i>        | <i>fatua</i>      | None   | AL, AK, AZ, CA, CO, CT, DE, FL, HI, IA, ID, IL, IN, KS, KY, LA, MA, MD, ME, MI, MN, MO, MS, MT, ND, NE, NH, NJ, NM, NV, NY, OH, OK, OR, PA, RI, SD, TN, TX, UT, VA, VT, WA, WI, WV, WY | Bliss, Hood, Hunter Liggett, Riley, Wainwright | I                                       | Disturbed soil                 | Yes      |
| <i>Avena</i>        | <i>sativa</i>     | <i>Avena byzantina</i> ,<br><i>Avena fatua</i> var.<br><i>sativa</i> | All 50   | Hood, Lewis                                    | I                                       | Disturbed soil                 | Yes      |
| <i>Avena</i>        | <i>sterilis</i>   | None   | CA, NJ, OR, PA   | None   | I                                       | Open ground                    | Yes      |
| <i>Brachypodium</i> | <i>distachyon</i> | <i>Bromus distachyos</i> ,<br><i>Trachynia distachyos</i>            | CA, CO, HI, OR, TX   | None   | I                                       | Disturbed soil                 | Yes      |
| <i>Briza</i>        | <i>maximia</i>    | None   | CA, CO, GA, IL, MA, MI, NJ, NY, VT, WA, WI   | Hunter Liggett                                 | I                                       | Disturbed soil, dry grasslands | Yes      |
| <i>Briza</i>        | <i>minor</i>      | None   | AL, AR, CA, CT, DE, FL, GA, HI, ID, IL, LA, MD, MS, NC, NJ, NM, NY, OK, OR, PA, SC, TN, TX, VA, WA   | Benning, Hunter Liggett, Rucker, Stewart       | I                                       | Moist soil                     | Yes      |

| Genus         | Species            | Synonyms   | Range  | Occurrence at Tier 1 Army Installations  | Nativity<br>I=Introduced;<br>N = Native | Habitat        | Invasive |
|---------------|--------------------|--|--|--|---|----------------|----------|
| <i>Bromus</i> | <i>arenarius</i>   | None   | AZ, CA, NV,<br>OR, PA  | Hunter Liggett   | I                                       | Disturbed soil | Yes      |
| <i>Bromus</i> | <i>arvensis</i>    | <i>Bromus japonicus</i> ,<br><i>Bromus patulus</i> ,<br><i>Bromus anatolicus</i>   | Contiguous 48  | Benning,<br>Bliss, Carson,<br>Hood, Hunter<br>Liggett,<br>Irwin, Leonard<br>Wood, Riley,<br>Sill | I                                       | Disturbed soil | Yes      |
| <i>Bromus</i> | <i>berteroanus</i> | <i>Bromus trinii</i>   | AZ, CA, NV,<br>OR, UT  | Hunter<br>Liggett, Irwin   | I                                       | Disturbed soil | Yes      |
| <i>Bromus</i> | <i>briziformis</i> | <i>Bromus brizaeformis</i>   | AK, CA, CO,<br>CT, DE, ID,<br>IL, IN, MA,<br>MD, MI, MT,<br>ND, NE, NJ,<br>NM, NV, NY,<br>OH, OR, PA,<br>SD, UT, VT,<br>WA, WY                                   | None   | I                                       | Disturbed soil | Yes      |
| <i>Bromus</i> | <i>catharticus</i> | <i>Bromus brevis</i> ,<br><i>Bromus haenkeanus</i> ,<br><i>Bromus unioides</i> ,<br><i>Bromus wiildenowii</i> ,<br><i>Festuca unioides</i> | AL, AR, AZ,<br>CA, CO, FL,<br>GA, HI, IA,<br>IL, KS, KY,<br>LA, MD, MO,<br>MS, NC, ND,<br>NE, NJ, NM,<br>NV, NY, OH,<br>OK, OR, PA,<br>SC, SD, TN,<br>TX, UT, VA | Benning,<br>Bliss, Bragg,<br>Hood, Rucker,<br>Sill   | I                                       | Disturbed soil | Yes      |

| Genus         | Species            | Synonyms  | Range  | Occurrence at Tier 1 Army Installations | Nativity<br>I=Introduced;<br>N = Native | Habitat           | Invasive |
|---------------|--------------------|---|--|---|---|-------------------|----------|
| <i>Bromus</i> | <i>diandrus</i>    | <i>Bromus rigidus</i> ,<br><i>Bromus maximus</i> ,<br><i>Bromus villosus</i>  | AR, AZ, CA,<br>CO, DE, GA,<br>HI, ID, IL,<br>LA, MA, MD,<br>MO, MT, NC,<br>NJ, NV, NY,<br>OK, OR, SC,<br>TX, UT, VA,<br>WA   | Hunter<br>Liggett,<br>Irwin, Lewis      | I                                       | Disturbed<br>soil | Yes      |
| <i>Bromus</i> | <i>hordeaceus</i>  | <i>Bromus molliformis</i> ,<br><i>Bromus mollis</i> ,<br><i>Bromus</i><br><i>pseudothominii</i> ,<br><i>Bromus thominei</i> | AK, AR, AZ,<br>CA, CO, CT,<br>DE, HI, IA,<br>ID, IL, IN,<br>KS, KY, LA,<br>MA, MD, ME,<br>MI, MO, MT,<br>NC, ND, NE,<br>NH, NJ, NM,<br>NV, NY, OH,<br>OK, OR, PA,<br>RI, SC, SD,<br>TN, TX, UT,<br>VA, WA, WI,<br>WY | Hunter<br>Liggett, Lewis                | I                                       | Disturbed<br>soil | Yes      |
| <i>Bromus</i> | <i>madritensis</i> | <i>Bromus madritensis</i><br><i>ssp. madritensis</i> ,<br><i>Anisantha</i><br><i>madritensis</i>                            | AZ, HI, IL,<br>MD, MI, MS,<br>NV, OR, VA,<br>WA  | None                                    | I                                       | Disturbed<br>soil | Yes      |

| Genus         | Species          | Synonyms   | Range  | Occurrence at Tier 1 Army Installations                                  | Nativity<br>I=Introduced;<br>N = Native | Habitat           | Invasive |
|---------------|------------------|--|--|--|---|-------------------|----------|
| <i>Bromus</i> | <i>racemosus</i> | <i>Bromus commutatus</i> ,<br><i>Bromus popovii</i>                          | AL, AK, AR,<br>AZ, CA, CO,<br>CT, DE, FL,<br>GA, IA, ID,<br>IL, IN, KS,<br>KY, LA, MA,<br>MD, ME, MI,<br>MO, MS, MT,<br>NC, ND, NE,<br>NH, NJ, NM,<br>NV, NY, OH,<br>OK, OR, PA,<br>RI, SC, TN,<br>TX, UT, VA,<br>VT, WA, WI,<br>WV, WY            | Benning,<br>Bragg,<br>Campbell,<br>Drum, Leonard<br>Wood, Lewis,<br>Polk | I                                       | Disturbed<br>soil | Yes      |
| <i>Bromus</i> | <i>rubens</i>    | <i>Bromus madritensis</i><br><i>ssp. rubens</i> ,<br><i>Anisantha rubens</i> | AZ, CA, HI,<br>ID, MA, MD,<br>MT, NM, NV,<br>NY, OR, SC,<br>TX, UT, VA,<br>WA  | Bliss, Hunter<br>Liggett, Irwin  | I                                       | Disturbed<br>soil | Yes      |
| <i>Bromus</i> | <i>secalinus</i> | None   | AL, AK, AR,<br>AZ, CA, CO,<br>CT, DE, FL,<br>GA, HI, IA,<br>ID, IL, IN,<br>KS, KY, LA,<br>MA, MD, ME,<br>MI, MN, MO,<br>MS, MT, NC,<br>NE, NH, NJ,<br>NM, NV, NY,<br>OH, OK, OR,<br>PA, RI, SC,<br>SD, TN, TX,<br>UT, VA, VT,<br>WA, WI, WV,<br>WY | Bragg  | I                                       | Disturbed<br>soil | Yes      |

| Genus            | Species           | Synonyms                  | Range  | Occurrence at Tier 1 Army Installations   | Nativity<br>I=Introduced;<br>N = Native | Habitat        | Invasive |
|------------------|-------------------|---------------------------|--|---|---|----------------|----------|
| <i>Bromus</i>    | <i>squarrosus</i> | None                      | AR, CO, CT,<br>HI, ID, IL,<br>IN, KS, KY,<br>MI, MO, MT,<br>ND, NE, NJ,<br>NY, OR, PA,<br>SD, VT, WA,<br>WI, WY  | None  | I                                       | Disturbed soil | Yes      |
| <i>Bromus</i>    | <i>sterilis</i>   | <i>Anisantha sterilis</i> | AL, AR, AZ,<br>CA, CO, CT,<br>DE, HI, ID,<br>IL, IN, KY,<br>MA, MD, MI,<br>MO, MS, NC,<br>NJ, NM, NV,<br>NY, OH, OK,<br>OR, PA, RI,<br>TN, TX, UT,<br>VA, WA, WV | None  | I                                       | Disturbed soil | Yes      |
| <i>Bromus</i>    | <i>tectorum</i>   | None                      | All 50   | Bliss, Bragg,<br>Carson, Drum,<br>Hood, Hunter<br>Liggett,<br>Irwin, Leonard<br>Wood, Lewis,<br>Riley, Sill | I                                       | Disturbed soil | Yes      |
| <i>Cynosurus</i> | <i>echinatus</i>  | None                      | AL, AR, CA,<br>CT, GA, LA,<br>MD, MI, MO,<br>MS, MT, NC,<br>NJ, NY, OH,<br>OK, OR, PA,<br>SC, TN, VA,<br>WA, WV  | Hunter<br>Liggett, Lewis  | I                                       | Disturbed soil | Yes      |



| Genus            | Species        | Synonyms   | Range   | Occurrence at Tier 1 Army Installations | Nativity<br>I=Introduced;<br>N = Native | Habitat        | Invasive |
|------------------|----------------|--|---|---|---|----------------|----------|
| <i>Hordeum</i>   | <i>marinum</i> | <i>Hordeum geniculatum</i> ,<br><i>Hordeum gussonianum</i> ,<br><i>Hordeum hystrix</i> ,<br><i>Critesion marinum</i> ,<br><i>Critesion geniculatum</i> | AZ, CA, ID,<br>IL, MA, MT,<br>NJ, NV, OH,<br>OK, OR, PA,<br>UT, WA  | Hunter Liggett                          | I                                       | Disturbed soil | Yes      |
| <i>Hordeum</i>   | <i>murinum</i> | <i>Hordeum glaucum</i> ,<br><i>Hordeum stebbinsii</i> ,<br><i>Critesion glaucum</i> ,<br><i>Hordeum leporinum</i> ,<br><i>Critesion murinum</i>        | AL, AZ, CA,<br>CO, CT, DE,<br>GA, HI, ID,<br>MA, MD, ME,<br>MT, NC, NJ,<br>NM, NV, NY,<br>OK, OR, PA,<br>SC, TX, UT,<br>VA, WA, WY  | Bliss, Hunter Liggett,<br>Irwin, Lewis  | I                                       | Disturbed soil | Yes      |
| <i>Hordeum</i>   | <i>vulgare</i> | <i>Hordeum aegiceras</i> ,<br><i>Hordeum distichon</i> ,<br><i>Hordeum hexastichon</i> ,<br><i>Hordeum irregulare</i> ,<br><i>Hordeum sativum</i>      | AL, AK, AR,<br>AZ, CA, CO,<br>CT, FL, HI,<br>IA, ID, IL,<br>IN, KS, KY,<br>LA, MA, MD,<br>ME, MI, MN,<br>MO, MS, MT,<br>NC, ND, NE,<br>NH, NJ, NM,<br>NV, NY, OH,<br>OK, OR, PA,<br>RI, SC, SD,<br>TN, TX, UT,<br>VA, VT, WA,<br>WI, WY | None                                    | I                                       | Disturbed soil | Yes      |
| <i>Lamarckia</i> | <i>aurea</i>   | <i>Cynosurus aureus</i>  | AZ, CA, HI,<br>TX   | Hunter Liggett                          | I                                       | Disturbed soil | Yes      |

| Genus             | Species                                | Synonyms  | Range  | Occurrence at Tier 1 Army Installations                  | Nativity<br>I=Introduced;<br>N = Native | Habitat                 | Invasive |
|-------------------|--|---|--|--|---|-------------------------|----------|
| <i>Lolium</i>     | <i>perenne</i> ssp. <i>multiflorum</i> | <i>Lolium multiflorum</i>                           | All 50   | Benning, Hood, Hunter Liggett, Lewis, Rucker, Wainwright | I                                       | Disturbed soil          | Yes      |
| <i>Lolium</i>     | <i>temulentum</i>                      | None  | AL, AK, AR, AZ, CA, CT, DE, FL, GA, HI, IA, ID, IL, KS, KY, LA, MA, MD, ME, MI, MN, MO, MS, MT, NC, ND, NJ, NM, NY, OH, OK, OR, PA, RI, SC, SD, TN, TX, VA, VT, WA, WV, WY | Hood, Hunter Liggett                                     | I                                       | Disturbed soil          | Yes      |
| <i>Parapholis</i> | <i>incurva</i>                         | <i>Aegilops incurva</i> , <i>Pholiurus incurvus</i> | Al, CA, DE, LA, MD, MI, MS, NC, NJ, OR, PA, TX, VA   | None   | I                                       | Disturbed coastal soils | Yes      |

| Genus            | Species            | Synonyms | Range  | Occurrence at Tier 1 Army Installations  | Nativity<br>I=Introduced;<br>N = Native | Habitat             | Invasive |
|------------------|--------------------|----------|--|--|---|---------------------|----------|
| <i>Phalaris</i>  | <i>canariensis</i> | None     | AL, AK, AR, AZ, CA, CO, CT, DE, FL, GA, HI, IA, ID, IL, IN, KS, KY, LA, MA, MD, ME, MI, MN, MO, MS, MT, NC, ND, NE, NH, NJ, NM, NY, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VA, VT, WA, WI, WV, WY | Bliss, Hood  | I                                       | Disturbed soil      | Yes      |
| <i>Phalaris</i>  | <i>minor</i>       | None     | AK, AL, AZ, CA, CO, FL, HI, LA, NJ, NM, OR, PA, SC, TX   | Hunter Liggett, Irwin  | I                                       | Disturbed soil      | Yes      |
| <i>Poa</i>       | <i>annua</i>       | None     | All 50   | Benning, Bliss, Bragg, Campbell, Drum, Hood, Hunter Liggett, Lewis, Rucker, Sill, Wainwright | I                                       | Disturbed soil      | Yes      |
| <i>Polypogon</i> | <i>maritimus</i>   | None     | CA, FL, GA, NV, SC   | Hunter Liggett   | I                                       | Disturbed, wet soil | Yes      |

| Genus              | Species              | Synonyms  | Range  | Occurrence at Tier 1 Army Installations   | Nativity<br>I=Introduced;<br>N = Native | Habitat                   | Invasive |
|--------------------|----------------------|---|--|---|---|---------------------------|----------|
| <i>Polypogon</i>   | <i>monspeliensis</i> | <i>Alopecurus monspeliensis</i>                       | AL, AK, AR, AZ, CA, CO, CT, DE, FL, GA, HI, ID, KS, LA, MA, MD, ME, MI, MN, MS, MT, NC, ND, NE, NH, NJ, NM, NV, NY, OK, OR, PA, RI, SC, SD, TN, TX, UT, VA, WA, WI, WY | Bliss, Hood, Hunter, Liggett, Irwin, Polk | I                                       | Disturbed, wet soil       | Yes      |
| <i>Schismus</i>    | <i>arabicus</i>      | None  | AZ, CA, NM, NV, UT   | Irwin                                     | I                                       | Disturbed soil            | Yes      |
| <i>Schismus</i>    | <i>barbatus</i>      | <i>Schismus calycinus</i> ,<br><i>Festuca bartata</i> | AZ, CA, NM, NV, TX, UT   | Irwin                                     | I                                       | Disturbed soil            | Yes      |
| <i>Sclerochloa</i> | <i>dura</i>          | <i>Cynosurus durus</i>                                | AR, CA, CO, GA, IA, ID, IL, IN, KS, KY, LA, MD, MI, MO, MS, MT, NE, NM, NV, NY, OH, OK, OR, TN, TX, UT, VA, WA   | Sill                                      | I                                       | Disturbed, compacted soil | Yes      |

| Genus               | Species              | Synonyms  | Range   | Occurrence at Tier 1 Army Installations                   | Nativity<br>I=Introduced;<br>N = Native | Habitat           | Invasive |
|---------------------|----------------------|---|---|---|---|-------------------|----------|
| <i>Secale</i>       | <i>cereale</i>       | <i>Triticum cereale</i> ,<br><i>Secale montanum</i> ,<br><i>Secale strictum</i>                             | AL, AK, AR,<br>AZ, CA, CO,<br>CT, FL, GA,<br>IA, ID, IL,<br>IN, KS, KY,<br>LA, MA, MD,<br>ME, MI, MN,<br>MO, MS, MT,<br>NC, ND, NE,<br>NH, NJ, NM,<br>NV, NY, OH,<br>OR, PA, RI,<br>SC, SD, TN,<br>TX, UT, VA,<br>VT, WA, WI,<br>WY | Benning,<br>Bragg, Polk,<br>Rucker,<br>Stewart            | I                                       | Disturbed<br>soil | Yes      |
| <i>Taeniatherum</i> | <i>caput-medusae</i> | <i>Elymus caput-<br/>medusae</i> ,<br><i>Taeniatherum<br/>asperum</i> ,<br><i>Taeniatherum<br/>crinitum</i> | CA, CT, ID,<br>MT, NV, NY,<br>OR, PA, UT,<br>WA   | Hunter Liggett  | I                                       | Disturbed<br>soil | Yes      |
| <i>Vulpia</i>       | <i>myuros</i>        | <i>Festuca megalura</i> ,<br><i>Festuca myuros</i> ,<br><i>Vulpia megalura</i>                              | AL, AK, AR,<br>AZ, CA, CT,<br>DE, FL, GA,<br>HI, IA, ID,<br>IL, IN, KS,<br>KY, LA, MA,<br>MD, ME, MI,<br>MO, MS, MT,<br>NC, NH, NJ,<br>NM, NV, NY,<br>OH, OK, OR,<br>PA, RI, SC,<br>TN, TX, UT,<br>VA, WA, WI,<br>WV                | Bragg, Hunter<br>Liggett,<br>Leonard Wood,<br>Lewis, Polk | I                                       | Disturbed<br>soil | Yes      |

**APPENDIX C:**

**NATIVE, INVASIVE WINTER ANNUAL GRASSES**

Beginning on the following page, Table C-1 lists native, invasive winter annual grass species in the United States, including their synonyms, distribution, and habitat information.

Table C-1. Native, invasive winter annual grasses occurring in the United States.

| Genus             | Species             | Synonyms  | Range  | Occurrence at Tier 1 Army Installations   | Nativity | Habitat              | Invasive |
|-------------------|---------------------|---|--|---|----------|----------------------|----------|
| <i>Alopecurus</i> | <i>carolinianus</i> | <i>Alopecurus macounii</i> ,<br><i>Alopecurus ramosus</i> | AL, AR, AZ, CA, CO, CT, DE, FL, GA, IA, ID, IL, IN, KS, KY, LA, MA, MD, MI, MN, MO, MS, MT, NC, ND, NE, NJ, NM, NY, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VA, WA, WI, WV, WY         | Benning, Campbell, Leonard Wood, Lewis, Sill  | N        | Moist, open habitats | Yes      |
| <i>Bromus</i>     | <i>carinatus</i>    | <i>Bromus laciniatus</i>                                  | AK, CA, OR, WA   | Bliss, Hunter Liggett, Lewis  | N        | Disturbed soil       | Yes      |
| <i>Hordeum</i>    | <i>pusillum</i>     | <i>Critesion pusillum</i>                                 | AL, AR, AZ, CA, CO, CT, DE, FL, GA, IA, ID, IL, IN, KS, KY, LA, MA, MD, ME, MI, MN, MO, MS, MT, NC, ND, NE, NH, NJ, NM, NV, NY, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VA, WA, WI, WY | Benning, Bliss, Bragg, Hood, Leonard Wood, Riley, Rucker, Sill, Stewart               | N        | Open ground          | Yes      |
| <i>Trisetum</i>   | <i>interruptum</i>  | None  | AZ, CO, LA, NM, OK, TX   | Bliss, Hood   | N        | Open ground          | Yes      |
| <i>Vulpia</i>     | <i>octoflora</i>    | None  | Contiguous 48  | Benning, Bliss, Bragg, Hood, Hunter Liggett, Irwin, Leonard Wood, Riley, Rucker, Sill | N        | Disturbed soil       | Yes      |

**APPENDIX D:**

**NON-NATIVE, NON-INVASIVE WINTER ANNUAL GRASSES**

On the following page, Table D-1 lists non-native, non-invasive winter annual grasses occurring in the United States, including their synonyms, distribution, and habitat information.



Table D-1. Non-native non-invasive winter annual grasses occurring in the United States.

| Genus             | Species              | Synonyms   | Range   | Occurrence at Tier 1 Army Installations | Nativity | Habitat         | Invasive |
|-------------------|----------------------|--|---|---|----------|-----------------|----------|
| <i>Aegilops</i>   | <i>tauschii</i>      | <i>Aegilops squarrosa</i>  | AZ, CA  | None                                    | I        | Disturbed soil  | No       |
| <i>Eremopyrum</i> | <i>triticeum</i>     | <i>Agropyron prostratum</i> ,<br><i>Agropyron triticeum</i>  | AZ, CO, ID,<br>MT, NE, NM,<br>NV, NY, OR,<br>UT, WA, WY   | None                                    | I        | Disturbed sites | No       |
| <i>Lolium</i>     | <i>persicum</i>      | <i>Lolium dorei</i>  | CO, MO, MT,<br>ND, WY   | None                                    | I        | Disturbed soil  | No       |
| <i>Lolium</i>     | <i>rigidum</i>       | <i>Lolium loliaceum</i> ,<br><i>Lolium strictum</i> ,<br><i>Lolium subulatum</i>                                       | AZ, CA, LA,<br>MO, MS, OR,<br>TX  | None                                    | I        | Disturbed soil  | No       |
| <i>Phalaris</i>   | <i>brachystachys</i> | None   | CA, HI, LA,<br>MO, OR, TX   | None                                    | I        | Disturbed soil  | No       |
| <i>Rostraria</i>  | <i>cristata</i>      | <i>Festuca cristata</i> ,<br><i>Koeleria gerardii</i> ,<br><i>Koeleria phleoides</i> ,<br><i>Lophochloa cristata</i>   | AL, AZ, CA,<br>FL, LA, MD,<br>NY, OR, PA,<br>SC, TX   | None                                    | I        | Disturbed soil  | No       |
| <i>Vulpia</i>     | <i>bromoides</i>     | <i>Bromus dertonensis</i> ,<br><i>Festuca bromoides</i> ,<br><i>Festuca dertonensis</i> ,<br><i>Vulpia dertonensis</i> | AL, AZ, AR,<br>CA, DE, FL,<br>GA, HI, ID,<br>IL, KY, LA,<br>MA, ME, MO,<br>MT, NV, NC,<br>NM, NY, OH,<br>OK, OR, SC,<br>TN, TX, UT,<br>VA, WA | Hunter Liggett,<br>Lewis                | I        | Disturbed soil  | No       |

**APPENDIX E:**

**NATIVE, NON-INVASIVE WINTER ANNUAL GRASSES**

On the following page, Table E-1 lists native, non-invasive winter annual grasses occurring in the United States, including their synonyms, distribution, and habitat information.

Table E-1. Native, non-invasive winter annual grasses occurring in the United States.

| Genus             | Species            | Synonyms  | Range  | Occurrence at Tier 1 Army Installations | Nativity | Habitat                          | Invasive |
|-------------------|--------------------|---|--|---|----------|----------------------------------|----------|
| <i>Agrostis</i>   | <i>elliottiana</i> | <i>Agrostis exigua</i>  | AL, AR, AZ, CA, FL, GA, IL, IN, KS, KY, LA, MA, MD, ME, MO, MS, NC, NM, OH, OK, PA, SC, TN, TX, VA | Benning, Leonard Wood, Polk             | N        | Pastures, old fields, open woods | No       |
| <i>Agrostis</i>   | <i>hendersoni</i>  | <i>Agrostis aristiglumis</i> ,<br><i>Agrostis microphylla</i> ssp. <i>hendersonii</i> | CA, OR   | None                                    | N        | Vernal pool edges                | No       |
| <i>Agrostis</i>   | <i>mycrophylla</i> | <i>Agrostis inflata</i>   | CA, OR, WA   | Hunter Liggett                          | N        | Pacific Coast unproductive soils | No       |
| <i>Agrostis</i>   | <i>rossiae</i>     | <i>Agrostis variabilis</i>  | WY   | None                                    | N        | Yellowstone hot spring edges     | No       |
| <i>Alopecurus</i> | <i>saccatus</i>    | <i>Alopecurus howellii</i>  | CA, ID, OR, WA   | None                                    | N        | Moist meadows, vernal pools      | No       |
| <i>Bromus</i>     | <i>arizonicus</i>  | None  | AZ, CA, NV, TX   | None                                    | N        | Open ground                      | No       |
| <i>Hordeum</i>    | <i>arizonicum</i>  | <i>Critesion arizonicum</i>   | AZ, CA, NM   | None                                    | N        | Wet soil                         | No       |
| <i>Hordeum</i>    | <i>depressum</i>   | <i>Critesion depressum</i>  | CA, ID, OR, WA   | Hunter Liggett                          | N        | Vernal pool edges                | No       |
| <i>Limnodea</i>   | <i>arkansana</i>   | <i>Cinna arkansana</i>  | AL, AR, FL, LA, MS, OK, SC, TX   | Hood, Sill                              | N        | Dry, sandy soil                  | No       |
| <i>Phalaris</i>   | <i>angusta</i>     | None  | AL, AZ, CA, FL, GA, LA, MS, NM, OR, SC, TX   | None                                    | N        | Wet soil                         | No       |
| <i>Phalaris</i>   | <i>caroliniana</i> | None  | AL, AR, AZ, CA, CO, DE, FL, GA, KY, LA, MD, MO, MS, NC, NE,  | Benning, Bliss, Hood, Sill, Stewart     | N        | Wet soil                         | No       |

| Genus              | Species             | Synonyms  | Range   | Occurrence at Tier 1 Army Installations    | Nativity | Habitat                       | Invasive |
|--------------------|---------------------|---|---|--|----------|-------------------------------|----------|
|                    |                     |   | NM, NV, OH,<br>OK, OR, SC,<br>TN, TX, VA  |  |          |                               |          |
| <i>Phalaris</i>    | <i>lemmonii</i>     | None  | CA  | None                                       | N        | Wet soil                      | No       |
| <i>Pleuropogon</i> | <i>californicus</i> | None  | CA  | None                                       | N        | Wet soil, vernal<br>pools     | No       |
| <i>Poa</i>         | <i>bigelovii</i>    | None  | AZ, CA, CO,<br>NM, NV, OK,<br>UT, TX  | Bliss                                      | N        | Arid uplands                  | No       |
| <i>Poa</i>         | <i>bolanderi</i>    | <i>Poa horneri</i>                                | CA, ID, NV,<br>OR, UT, WA   | Lewis                                      | N        | Forest openings               | No       |
| <i>Poa</i>         | <i>chapmaniana</i>  | None  | AL, AR, DE,<br>FL, GA, IA,<br>IL, IN, KS,<br>KY, LA, MA,<br>MD, MO, MS,<br>NC, NE, NY,<br>OH, OK, SC,<br>TN, TX, VA, WV | Benning,<br>Bragg,<br>Campbell,<br>Stewart | N        | Disturbed forest              | No       |
| <i>Poa</i>         | <i>howellii</i>     | <i>Poa bolanderi</i> ssp.<br><i>howellii</i>      | CA, OR, WA  | Hunter<br>Liggett, Lewis                   | N        | Rocky banks,<br>forest slopes | No       |
| <i>Puccinellia</i> | <i>parishii</i>     | None  | AZ, CA, CO, NM  | None                                       | N        | Wet, salty soil               | No       |
| <i>Puccinellia</i> | <i>simplex</i>      | None  | CA, UT  | None                                       | N        | Central CA<br>saline soils    | No       |
| <i>Scribneria</i>  | <i>bolanderi</i>    | None  | CA, OR, WA  | Hunter Liggett                             | N        | Diverse habitats              | No       |
| <i>Vulpia</i>      | <i>elliotta</i>     | <i>Festuca sciurea</i> ,<br><i>Vulpia sciurea</i> | AL, AR, DE,<br>FL, GA, IA,<br>KY, LA, MD,<br>MO, MS, NC,<br>NJ, OK, SC,<br>TX, VA                                       | Benning,<br>Bragg, Stewart                 | N        | Open, sandy soil              | No       |

| Genus  | Species             | Synonyms   | Range                                  | Occurrence at Tier 1 Army Installations | Nativity | Habitat          | Invasive |
|--------|---------------------|--|--|---|----------|------------------|----------|
| Vulpia | <i>microstachys</i> | <i>Vulpia arida</i> ,<br><i>Festuca arida</i> ,<br><i>Festuca microstachys</i> ,<br><i>Vulpia eastwoodiae</i> ,<br><i>Festuca eastwoodiae</i> , <i>Vulpia grayi</i> , <i>Festuca grayi</i> , <i>Vulpia confusa</i> , <i>Festuca confusa</i> , <i>Vulpia tracyi</i> , <i>Vulpia pacifica</i> , <i>Festuca pacifica</i> , <i>Vulpia reflexa</i> , <i>Festuca reflexa</i> | AZ, CA, CO, ID, MT, NM, NV, OR, UT, WA | Bliss, Hunter Liggett, Irwin, Lewis     | N        | Open, sandy soil | No       |

**APPENDIX F:**

**IDENTIFICATION KEY FOR WINTER ANNUAL *BROMUS* SPECIES**

***BROMUS***

Spikelets strongly flattened; lemmas strongly folded at midvein; lower glumes 3-9 veined...Group 1 (*Ceratochola*)

Spikelets cylindrical or somewhat flattened; lemmas rounded over midvein; lower glumes 1-5 veined...

    Awns abruptly bent; lemmas with bristles at the tips of teeth...Group 2 (*Neobromus*)

    Awns, if present, straight or arced, not abruptly bent; lemmas smooth or with non-bristled teeth...

        Lower glumes 1-3 veined, upper glumes 3-5 veined...Group 3  
        (*Eubromus* = *Genea*)

        Lower glumes 3-5 veined, upper glumes 5-9 veined...Group 4  
        (*Bromium* = *Bromus*)

Group 1

Lemmas unawned or with awns <4 mm long...***Bromus catharticus***

Lemma awns >4 mm long...

    Spikelets 5-7 flowered; upper glume as long as lowest lemma in each spikelet...***Bromus arizonicus***

    Spikelets 6-12 flowered; upper glume shorter than the lowest lemma in each spikelet...

        Lemmas 9-13 veined, veins raised and rib-like...***Bromus catharticus***

        Lemmas 7-9 veined, veins not raised...***Bromus carinatus***

Group 2

***Bromus berterioanus***

Group 3

Lemmas >20 mm long...***Bromus diandrus***

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Lemmas <20 mm long...

Spikelets longer than the panicle branches...

Stems hairy below panicle; panicle branches less than 1 cm long and usually not readily visible...***Bromus rubens***

Stems smooth below panicle; panicle branches 1-3 cm long and mostly visible...***Bromus madritensis***

Spikelets mostly shorter than the panicle branches...

Some branches contain 4-8 spikelets; lemmas 9-12 mm long; upper glume <1 cm long...***Bromus tectorum***

Branches rarely contain more than 3 spikelets; lemmas 14-20 mm long; upper glumes >1 cm long...***Bromus sterilis***

#### Group 4

Lemmas puffy, 6-8 mm wide, awnless or with awns to 1 mm long...***Bromus briziformis***

Lemmas not puffy, 1-7 mm wide, with awns >2 mm long...

Lemma and palea bases and spikelet stem internodes visible at maturity; lemma margins inrolled at maturity...

Spikelets often purplish; lower leaf sheaths soft flat-hairy...***Bromus arvensis***

Spikelets not purplish; lower leaf sheaths smooth, sparsely hairy or stiff hairy...

Lower leaf sheaths smooth or sparsely hairy...***Bromus secalinus***

Lower leaf sheaths stiff-hairy...***Bromus racemosus***

Lemma and palea bases and spikelet stem internodes concealed at maturity; lemma margins not inrolled at maturity...

Panicle branches shorter than spikelets...***Bromus hordeaceus***

At least some panicle branches longer than spikelets...

Awns attached <1.5mm below lemma tip, not twisted at base...

Lower leaf sheaths soft flat-hairy...***Bromus arvensis***

Lower leaf sheaths stiff-hairy...***Bromus racemosus***

Awns attached >1.5mm below lemma tip, often twisted at base...

Lower glumes 7-10 mm long, upper glumes 8-12 mm long...***Bromus arenarius***

Lower glumes 4-7 mm long, upper glumes 5-8 mm long...

Spikelets often purplish...***Bromus arvensis***

Spikelets not purplish...

Panicle branches droopy or wavy, often with more than 1 spikelet; lemmas with transparent margins <0.6 mm wide...***Bromus arvensis***

Panicle branches not droopy or wavy, often with 1 spikelet; lemmas with transparent margins >0.6 mm wide...***Bromus squarrosus***



**APPENDIX G:**

**IDENTIFICATION KEY FOR WINTER ANNUAL *HORDEUM* SPECIES**

***HORDEUM***

Glumes of central spikelet flattened near base...***Hordeum arizonicum***

Glumes of central spikelet bristle-like...

Blades with well-developed auricles to 8 mm long throughout; lemmas of lateral florets 6-15 mm long...

Lateral spikelets sessile, spikelet stems continuous at maturity; glumes of central spikelet covered in hairs; lemmas of central florets >3 mm wide, unawned or with awns <2 cm long; at least 1 lateral spikelet per node is seed forming...***Hordeum vulgare***

Lateral spikelets stalked, spikelet stems separating at maturity; glumes of central spikelet hairy on the margins; lemmas of central florets <2 mm wide, with awns >2 cm long; lateral spikelets not seed forming (staminate)...***Hordeum murinum***

Blades with auricles absent or to 0.3 mm long; lemmas of lateral florets 1.7 to 8.5 mm long...

Glumes bent, strongly divergent at maturity...***Hordeum arizonicum***

Glumes straight...

Glumes of fertile (central) spikelet widest above base...***Hordeum pusillum***

Glumes of fertile (central) spikelet bristle-like, widest at base...

Lemmas of lateral spikelets with awns 3-8 mm long...***Hordeum marinum***

Lemmas of lateral spikelets, unawned or with awns <3 mm long...

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Lemmas of central spikelets with awns 3-12 mm long;  
ligules 0.3-0.8 mm long; spikes 4-8 mm wide...***Hordeum***  
***depressum***

Lemmas of central spikelets with awns 10-22 mm long;  
ligules 0.6-1.8 mm long; spikes 6-20 m wide...***Hordeum***  
***arizonicum***

APPENDIX H:

IDENTIFICATION KEY  
FOR WINTER ANNUAL *PHALARIS* SPECIES

***PHALARIS***

Glumes more or less wingless, with wings <0.2 mm wide

Fertile floret tips smooth; glumes gradually tapering to a point, lateral veins and basal fold rough; fertile lemma swollen, with a smooth tip...***Phalaris lemmonii***

Fertile floret tips hairy; glumes sharply pointed, smooth or with rough lateral veins; fertile lemma not swollen, with a soft, long-hairy tip...***Phalaris caroliniana***

Glumes broadly winged, with wings 0.2-1 mm wide...

Sterile florets solitary, or if paired, then the lower floret <0.7 mm long and the upper floret 1-3 mm long; fertile lemma to 3 mm long...***Phalaris minor***

Sterile florets paired, more or less equal in size, 0.5-4.5 mm long...

Panicles cylindrical, broken by gaps...***Phalaris angusta***

Panicles oval or egg-shaped, continuous...

Sterile florets 0.6-1.2 mm long, 1/5 the length of the fertile florets...***Phalaris brachystachys***

Sterile florets 1.5-4.5 mm long, 1/3 or more the length of the fertile florets...

Glumes 0.8-1.5 mm wide, with sharply pointed tips...***Phalaris caroliniana***

Glumes 2-2.5 mm wide, with rounded, short-awn-like tips...***Phalaris canariensis***

**APPENDIX I:**

**IDENTIFICATION KEY FOR  
WINTER ANNUAL POA SPECIES**

**POA**

Lemmas webbed with cobwebby hairs at base, smooth except rough basal fold; sheaths smooth...***Poa bolanderi***

Lemmas hairy...

Lemmas slightly webbed with cobwebby hairs at base, hairy on back, especially toward the base, not distinctly long-hairy on nerves and basal fold; sheaths rough; panicle open...***Poa howellii***

Lemmas hairy on nerves, sometimes between nerves as well...

Panicle narrow and contracted, usually broken by gaps; sheaths rough; lemmas webbed with cobwebby hairs at base, hairy between nerves below...***Poa bigelovii***

Panicle pyramid shaped or oblong, with branches spreading outward; sheaths smooth...

Lemmas webbed with cobwebby hairs at base, distinctly 3-nerved (intermediate nerves obscured)...***Poa chapmaniana***

Lemmas not webbed with cobwebby hairs at base, distinctly 5-nerved...***Poa annua***

APPENDIX J:

IDENTIFICATION KEY FOR  
WINTER ANNUAL *VULPIA* SPECIES

***VULPIA***

Lower glumes less than one-half the length of the upper glumes...***Vulpia myuros***

Lower glumes at least one-half the length of the upper glumes...

Lemmas less than 3.5 mm long, the lemma tips hairier than the bases...***Vulpia elliottea***

Lemmas 2.7 to 9.5 mm long, equally hairy throughout...

1 or 2 panicle branches per node; spikelets 4-7 flowered...***Vulpia octoflora***

Only 1 panicle branch per node; spikelets 1-8 flowered...

Panicle branches and spikelets spreading outwards or downward at maturity, branch axils swollen...***Vulpia microstachya***

Panicle branches narrow, erect or lying flat against main stalk at maturity, no swelling in branch axils...***Vulpia bromoides***

APPENDIX K

DIAGRAMS OF GRASS INFLORESCENCES  
USED IN IDENTIFICATION KEYS  
(for glossary of terms, see appendix M)

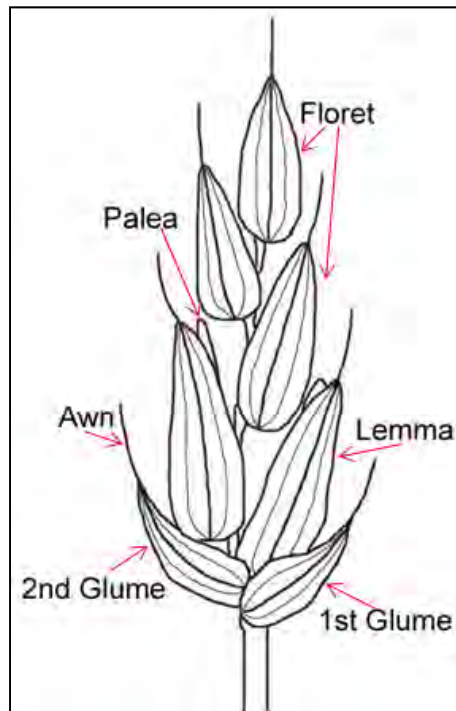


Figure K-1. Grass spikelet.

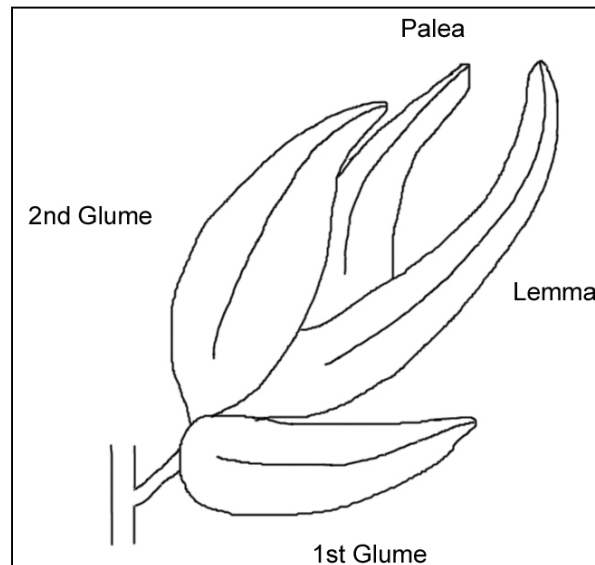


Figure K-2. Grass floret.

## APPENDIX L:

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## APPENDIX M:

### ABBREVIATIONS AND GLOSSARY

#### Abbreviations

| Term  | Spellout  |
|-------|---|
| AR    | Army Regulation   |
| CECW  | Directorate of Civil Works, U. S. Army Corps of Engineers       |
| CEMP  | Directorate of Military Programs, U. S. Army Corps of Engineers |
| CFR   | Code of the Federal Regulations                                 |
| CONUS | Continental United States                                       |
| DA    | Department of the Army  |
| EO    | Executive Order   |
| HQ    | Headquarters  |
| ITAM  | Integrated Training Area Management                             |
| PDF   | portable document file  |
| POC   | point of contact  |
| PWTB  | Public Works Technical Bulletin                                 |
| URL   | universal resource locator                                      |
| USACE | U.S. Army Corps of Engineers                                    |
| WBDG  | Whole Building Design Guide                                     |
| WWW   | World Wide Web  |

#### Glossary of Terms

**Auricle** - ear-like lobes at the base of leaf blades.

**Awn** - slender bristles found on glumes, lemmas, or paleas that form an extension from the midvein.

**Bract** - small, reduced leaves located on the upper portions of stems and the flowers.

**Floret** - the flower and the lemma and palea surrounding it.

**Glume** - the lowermost pair of bracts at the base of a floret.

**Inflorescence** - the flowering portion of a plant.

**Internode** - the area of a stem separating the stem joints.

**Lemma** - the spikelet bracts occurring above the glumes, the lower bract in a floret.

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**Palea** - the spikelet bracts occurring above the lemmas, the uppermost bract in a floret.

**Sheath** - the base of a leaf that is wrapped around the stem.

**Spikelet** - a unit of inflorescence in a grass, consisting of two glumes at the base and the florets above them.

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