



## CRESTED WHEATGRASS COMPLEX

INCLUDING

### CRESTED WHEATGRASS

*Agropyron cristatum* (L.) Gaertn.

Plant Symbol = AGCR

#### Alternate Names

Common Names: Fairway wheatgrass, fairway crested wheatgrass

AND

### DESERT WHEATGRASS

*Agropyron desertorum* (Fisch. ex Link) Schult.

Plant Symbol = AGDE2

#### Alternate Names

Common Names: Standard crested wheatgrass  
Scientific Names: *Agropyron cristatum* (L.) Gaertn. var. *desertorum* (Fisch. ex Link) Dorn; *A. cristatum* ssp. *desertorum* (Fisch. ex Link) Á. Löve

#### Taxonomy

The crested wheatgrass complex broadly includes three generally recognized species: *A. cristatum* (referred to by agronomists as fairway-type crested wheatgrass), *A. desertorum* (standard-type crested wheatgrass), and *A. fragile* (Siberian wheatgrass). Different authors have historically treated these in various ways. For example, Barkworth et al. (2007) indicates two species in North America, a broadly interpreted *A. cristatum* with no subspecies, and *A. fragile*, with *A. desertorum* being included within *A. cristatum*. Cronquist et al. (1977) recognized three distinct species, *A. pectiniforme*, *A. cristatum*, and *A. sibiricum*. USDA NRCS (2022) currently separates crested wheatgrass into two species, *A. cristatum* and *A. desertorum*. *A. cristatum* is further divided into two subspecies, *A. c.* ssp. *cristatum* and *A. c.* ssp. *pectinatum*. Siberian wheatgrass is recognized as *A. fragile*. Flora of North America (Barkworth, 1993) notes the added confusion made by purposeful introductions and cultivar development:

According to Tsvelev (1976), the most widely distributed taxon outside the former Soviet Union is *A. cristatum* subsp. *pectinatum*. Within North America, the reticulate genetic history of crested wheatgrass and the absence of any native populations argue against attempting recognition of subspecies.



Figure 1. Desert wheatgrass. Photo by Derek Tilley.

Among the more commonly encountered variants of *A. cristatum* in North America are the cultivar 'Fairway', which was considered by Dillman (1946) and Dewey (1986) to belong to *A. cristatum* rather than *A. desertorum*, and its derivatives 'Parkway' and 'Ruff'. The name "fairway" is also widely used in agricultural circles to refer to any crested wheatgrass that looks like the cultivar Fairway. "Standard" crested wheatgrass, which Dewey (1986) and others placed in *A. desertorum*, originally referred to a particular seed lot (S.P.I. 19537) that the Montana Wheatgrowers' Association decided to use as a standard against which to compare the performance of other crested wheatgrass strains. The term is now applied by agronomists to all crested wheatgrasses that are less leafy and have more lanceolate spikes than Fairway crested wheatgrasses. To further complicate identification, interspecific hybrids *A. cristatum* x *A. desertorum* are commercially available and widely used in reclamation seedings.

Range managers and conservationists generally recognize two functional groupings, crested wheatgrass and Siberian wheatgrass. Therefore, this Plant Guide covers crested wheatgrass, including *A. cristatum* and *A. desertorum* as defined by USDA NRCS (2022). Siberian wheatgrass is treated more fully in a separate Plant Guide.

## Description

**General:** Grass Family (Poaceae). Crested wheatgrass in the broad sense is an introduced, cool season, perennial grass that is drought and cold resistant with an extensive root system. It has erect culms and grows from 12 to 36 inches (30 to 90 cm) tall.



Figure 2. Inflorescences of Fairway-type 'Ephraim' crested wheatgrass (*A. cristatum*). Photo by Mary Wolf.

*A. cristatum* (Fairway-type crested wheatgrass) spikes are 1 to 5 cm (0.4 to 2.0 in) long (Kew, 2024). The spikelets are more widely spreading with the glumes somewhat contoured, gradually tapering into awns 2 to 5 mm (0.08 to 0.2 in) long. Fairway-type crested wheatgrass has short-broad spikes that taper at the top, smaller seeds, is generally shorter statured, and has finer leaves and stems than standard-type crested wheatgrass.

Standard-type crested wheatgrass (*A. desertorum*) has longer spikes than Fairway-type, 2.5 to 8 cm (1.0 to 3.1 in) long (Kew, 2024). Spike shape varies from comb-like to oblong. Spikelets are flattened, closely overlapping, oriented at a slight angle on the rachis. The lemmas are linear-lanceolate narrowing to a short awn. Glumes are firm, awl-shaped and keeled. Leaves are flat, smooth below, slightly scabrous (coarse) above and vary in width from 2 to 6 mm (0.08 to 0.25 in).

Siberian wheatgrass (*Agropyron fragile*) is very similar to Fairway and standard crested wheatgrass, but has finer leaves and stems, narrower and awnless glumes and lemmas, and the spikelets are more ascending, which gives the spike a narrow, oblong, sub-cylindrical shape. Siberian wheatgrass is more drought tolerant and retains its greenness later into the summer (Ogle et al., 2014). See the Plant Guide for Siberian wheatgrass for more details.

The following diagnostic features may be useful in separating the three species; however, definitive identification, especially between *A. desertorum* and *A. cristatum*, can be challenging.

Table 1: Diagnostic features of three wheatgrass species, *Agropyron fragile*, *A. desertorum*, and *A. cristatum*

|                             | Siberian WG ( <i>A. fragile</i> )               | Desert WG ( <i>A. desertorum</i> )              | Crested WG ( <i>A. cristatum</i> ) |
|-----------------------------|---|---|------------------------------------|
| Character                   |   |   |                                    |
| Spike length                | 3- 15 cm  | 2.5-8 cm  | 1-5 cm                             |
| Spike width                 | 0.5- 1 cm                                       | 5-9 mm  | 10-20 mm                           |
| Spike shape                 | Linear  | Narrowly lanceolate to oblong or broadly linear | Oblong to broadly oblong           |
| Spikelets (below midlength) | Appressed or diverging at an angle of < 30°     | Diverging at an angle of 25-45°                 | Diverging at an angle of 45-90°    |
| Glumes                      | Appressed to lemmas                             | Appressed to lemmas                             | Not appressed to lemmas            |
| Lemma apex                  | Unawned, sometimes with a mucro up to 1 mm long | With an awn 1-4 mm long                         | With an awn up to 5 mm long        |

*Distribution:* *Agropyron cristatum* is native from central Europe and the eastern Mediterranean to Mongolia and China (Barkworth, 1993). It was introduced as a forage species from Eurasia in the early 1900s and has become naturalized throughout North America. *A. c. ssp. pectinatum* and *A. desertorum* are widespread and can be found throughout North America minus portions of the southeast and northeast (USDA NRCS, 2022). *A. c. ssp. cristatum* is limited in distribution to Colorado and New Mexico (USDA NRCS, 2022). For current distribution, please consult the Plant Profile page for this species on the PLANTS Web site.

*Habitat:* Crested wheatgrass is native to the steppe regions of Eurasia. It can be found in many arid and semi-arid plant communities, and it has become a dominant species in the northern Great Plains and in the sagebrush steppe ecosystem of the Intermountain West (Welsh et al., 2003). It has been estimated that crested and desert wheatgrass have been established on more than 10.5 million hectares (26 million acres) in the U.S. (Lesica & DeLuca, 1996).

### **Adaptation**

Crested wheatgrass is adapted for dryland seedings where annual precipitation averages 200 to 350 mm (8 to 14 in) and where the frost-free period is generally less than 140 days. Fairway-type varieties are recommended for use in areas averaging 250 mm (10 in) or more annual precipitation while standard-type varieties are typically used in areas receiving 230 mm (9 in) or more. Standard-type crested wheatgrass including the hybrid crosses 'Hycrest' and 'CD-II' are considered superior above 250 mm (9 in) annual precipitation in spring recovery and grazing readiness. On droughty sites with 200 to 250 mm (8 to 10 in) annual precipitation, Siberian wheatgrass may be the better choice, as it is known to surpass crested wheatgrass in rate of establishment, stand persistence, and total forage yield on more arid sites. Siberian wheatgrass has been seeded in areas with as little as 125 mm (5 in) of precipitation with some success.

### **Uses**

*Grazing/rangeland:* Crested wheatgrass is commonly seeded in the arid sections of the western United States. Crested wheatgrass is usually recommended for forage production. It is palatable to all classes of livestock and wildlife. It is a preferred feed for cattle, sheep, horses, and elk in spring and also in the fall, if additional growth occurs from late season rainfall. It is considered a desirable feed for deer and antelope during spring and fall, but it is not considered a desirable feed for cattle, sheep, horses, deer, antelope, and elk in the summer. In spring, the protein levels can be as high as 18 percent and decrease to about 4 percent when dormant. Digestible carbohydrates remain high throughout the active growth period. Crested wheatgrass is commonly utilized for winter forage by cattle and horses, but protein supplements are required to ensure good animal health (Mayland, 1986). Crested wheatgrass is noted for its ability to withstand very heavy grazing pressure (65 to 70 percent utilization) once stands are established. It produces excellent forage yields in the areas where it is best adapted. Crested wheatgrass stands generally produce from 1.5 to 2 times more forage than native grass stands. Crested wheatgrass is generally not recommended for use in areas with more than 350 mm (14 in) of annual precipitation because better alternative forage species are available.

*Erosion control/reclamation:* Crested wheatgrass is well adapted for stabilization of disturbed soils in semi-arid sites (Hull, 1974). It establishes quickly and competes well against other aggressive introduced plants during the establishment period. Crested wheatgrass competes better against introduced winter annual species such as cheatgrass (*Bromus tectorum*) and medusahead (*Taeniatherum caput-medusae*) than most native species because it germinates earlier and grows more rapidly at colder temperatures.

Drought tolerance, fibrous root systems, and excellent seedling vigor make crested wheatgrass suited for soil stabilization and reclamation in areas receiving 230 mm (9 in) or more annual precipitation. These grasses can be used in urban areas where irrigation water is limited to provide ground cover, weed control and to stabilize ditch banks, dikes, pipelines, power lines, and roadsides. In areas above 350 mm (14 in) annual precipitation, 'Roadcrest' and 'Ephraim' may exhibit their rhizomatous traits and make excellent low maintenance turf when broadcast seeded to establish lawns.

*Wildlife:* Birds and small rodents eat crested wheatgrass seeds. Deer, antelope, and elk graze it, especially in spring and fall. Upland birds and songbirds utilize stands for nesting. However, where crested wheatgrass is planted as a monoculture, the resulting plant structure and habitat diversity are lower than that found in a diverse seeded or native plant community (McAdoo et al., 1989).

### **Status**

Threatened or Endangered: *No.*

Wetland Indicator: *Upland.*

Please consult the PLANTS Web site (<http://plants.usda.gov/>) and your state's Department of Natural Resources for this plant's current status (e.g., threatened or endangered species, state noxious status, and wetland indicator values).

### **Planting Guidelines**

Crested wheatgrass should be seeded with a drill at a depth of 13 mm (½ in) or less on medium to fine textured soils and 25 mm (1 in) or less on coarse textured soils. The recommended single species seeding rate is 5.6 kg/ha (5 lb/ac) Pure Live Seed (PLS) or 215 PLS/m<sup>2</sup> (20 PLS/ft<sup>2</sup>). If used as a component of a mix, adjust the seeding rate to the percent of mix desired. For mine lands and other harsh critical areas, the seeding rate should be doubled. Mulching and light irrigation are beneficial for stand establishment on highly disturbed, droughty areas.

The best seeding results are obtained from seeding in very early spring on heavy to medium textured soils and as dormant seeding in late fall (most commonly preferred seeding period) on medium to light textured soils. Late summer (August to mid-September) seedings are not recommended unless irrigation is available.

Crested wheatgrass should not be seeded with native species unless it is a very small proportion of a mix because it has a tendency to dominate mature stands (Heinrichs & Bolton, 1950; Schuman et al., 1982). When seeded at low rates with native species, adequate mixed stands including bluebunch wheatgrass (*Pseudoroegneria spicata*), Snake River wheatgrass (*Elymus wawawaiensis*), and Sandberg bluegrass (*Poa secunda*) have been achieved (Schuman et al., 1982; Nafus et al., 2022). In a seedling interference study in the greenhouse, Gunnell et al. (2010) suggested that native species with rapid germination and seedling growth, such as bottlebrush squirreltail (*Elymus elymoides*), experience less interference from crested wheatgrass and are more likely to establish in its presence. Shrub seedling growth experiences more interference from crested wheatgrass, but shrub seedlings that do establish persist because they occupy a different niche.

Stands may require weed control measures during establishment, but herbicide applications should not be made until grass seedlings have reached the four to six leaf stage. Mow when weeds are beginning to bloom to reduce weed seed development. Under favorable conditions, crested wheatgrass provides good competition against weeds. Grasshoppers and other insects may also damage new stands and use of pesticides may be required.

### **Management**

New stands of crested wheatgrass should not be grazed until they are firmly established and have started to produce seed heads. Six inches of new growth should be attained in spring before grazing is allowed in established stands. Three inches of stubble should remain at the end of the grazing season to maintain the long-term health of the plant. In addition, leaving three inches or more stubble going into the winter will result in a 10 to 14 day earlier growth period or "green-up" the following spring. Crested wheatgrass is a low maintenance plant requiring little additional treatment or care. However, spring/fall deferment or grazing rotations are recommended to maintain plant health and to maximize forage production potential.

Crested wheatgrass is best suited to grazing use rather than hay production. Light, infrequent applications of nitrogen 28 kg/ha (25 lb/ac) and light irrigation will increase total biomass production and lengthen the growing period. Regrowth of crested wheatgrass is generally poor. Crested wheatgrass begins to produce forage in the spring about 10 days after bluegrass species and about two weeks earlier than most native wheatgrasses. It makes good spring growth, little summer growth and good fall growth if moisture is available. Livestock and wildlife will graze crested wheatgrass throughout the spring growing season until it becomes too coarse, and again in fall if regrowth occurs. Established stands can withstand very heavy grazing.

### **Pests and Potential Problems**

There are no serious disease problems in crested wheatgrass; however, it is a host of black grass bugs (*Irbisia* and *Labops* spp.), which prefer wheatgrasses. Heavily infested plants have reduced green leaf area and appear frosted, yellow or straw colored. Damage can reduce forage yield, plant height and seedhead production. Widespread insecticidal control for forage grasses is usually not practical or economically feasible. Heavy fall/spring grazing and burning dead grass may reduce successful egg hatch in the spring. Planting mixtures of different grass species can reduce widespread damage by black grass bugs (Hodgson, 2008).

### **Environmental Concerns**

Overuse of crested wheatgrass has led to the conversion of millions of acres of native range to crested wheatgrass monoculture with limited ecosystem function (Lesica & DeLuca, 1996). It is not only persistent upon the rangeland, but it can spread quickly by seed to invade surrounding native vegetation (Hull & Klomp, 1966). When sown in mixtures with native species, it frequently becomes the dominant species (Heinrichs & Bolton, 1950; Schuman et al., 1982). It produces large quantities of seed and can dominate soil seed banks (Marlette & Anderson, 1986). Crested wheatgrass has been shown to replace shrub habitat needed for native passerine birds (Wiens & Rotenberry, 1985). Monocultures of crested wheatgrass can result in higher soil bulk density (Dormaar et al., 1995).



Some have suggested that crested wheatgrass can act as a bridge between disturbance and restoration of native species (Cox & Anderson, 2004). However, other studies have shown that it is very difficult to move from a crested wheatgrass monoculture to a diverse native plant community. Hulet et al. (2010) and McAdoo et al. (2017) found that when mechanical or chemical control was used to reduce the amount of crested wheatgrass in a stand, the effectiveness of the treatment diminished after a few years. In these situations, crested wheatgrass recovery led to a decline in native species. Both studies found that reducing crested wheatgrass in a stand can lead to weed invasion if native species do not establish well.

Crested wheatgrass has been extensively used in greenstrips (fuel breaks) because of its ease of establishment, persistence, competitiveness with weeds, and palatability to livestock. However, if not managed actively with timely mowing or grazing, crested wheatgrass can produce significant amounts of fuel with low moisture content later in the summer, making it a less effective fuel break than species that stay green longer (Maestas et al., 2016).

### **Control**

Please contact your local agricultural extension specialist or county weed specialist to learn what works best in your area and how to use it safely. Always read label and safety instructions for each control method. Trade names and control measures appear in this document only to provide specific information. USDA NRCS does not guarantee or warranty the products and control methods named, and other products may be equally effective.

### **Seed and Plant Production**

Seed production of crested wheatgrasses has been very successful under cultivated conditions. Row spacings of 0.6 to 1.0 m (24 to 36 in) under irrigation and 1.0 m (36 in) under dryland conditions with >350 mm (14 in) annual precipitation are recommended. The recommended seeding rate for seed production in 1.0 m (36 in) row spacing is 3.1 kg/ha (2.8 lb/ac) (Cornforth et al., 2001). Early spring or late fall seedings are preferred under dryland conditions. Early spring seedings are recommended under irrigated conditions. When irrigated, spring seedings consistently yield more seed during the first year of seed production. To obtain maximum seed production under irrigation, fall plantings are not recommended.

Control weeds during stand establishment and for long term management by clipping, hand roguing or light rates of herbicide (2,4-D or bromoxynil according to label) after the five-leaf stage. Fertilizer is generally not recommended during establishment. If soil test nitrogen and phosphorus are low, an application of 11 to 17 kg nitrogen per hectare (10 to 15 lb/ac) and 22 to 34 kg phosphorus per hectare (20 to 30 lb/ac) may be applied prior to planting. Fertilize for full seed production following the establishment year in early fall or use a split application in early fall and again in early spring (Cornforth et al., 2001). Very early spring application of nitrogen may be beneficial on sandy soils to promote vegetative growth. When irrigating, bring soils to field capacity to supply adequate moisture for germination and establishment. Do not stress plants during re-growth and tillering in the fall, late boot stage, and during pollination. Avoid sprinkler irrigation during flowering. Following stand establishment, fertilize and irrigate soon after seed harvest in fall to stimulate seed head primordia development for the subsequent crop.

Seed fields are productive for 4 to 5 years. Average production of 170 to 225 kg/ha (150 to 200 lb/ac) can be expected under dryland conditions in areas with >355 mm (14 in) average annual precipitation. Average production of 670 to 780 kg/ha (600 to 700 lb/ac) can be expected under irrigated conditions (Cornforth et al., 2001). The seed heads do not readily shatter, but some shatter can be expected. Harvesting is best completed by direct combining when the top of the seed head begins to shatter or by windrowing at hard dough stage and combining with pickup attachment 5 to 7 days later. Seed is generally harvested from mid-July to mid-August.

### **Cultivars, Improved, and Selected Materials (and area of origin)**

Foundation and Registered seed are available through the appropriate state Crop Improvement Association or commercial sources to grow certified seed.

#### *Crested Wheatgrasses*

'Douglas' was developed by USDA ARS in Logan, Utah and released in 1994 in cooperation with the Utah Agricultural Experiment Station and NRCS. The breeding populations were derived from accessions originating in the former USSR, Iran, and Turkey. One accession was characterized with very broad leaves and was used as the female parent in all crosses. Douglas has larger seed than other crested wheatgrasses and has excellent seedling vigor. It produces less forage than other cultivars but is leafier and remains green longer into the growing season suggesting improved forage preference and improved fire resistance. Douglas requires 330 to 355 mm (13 to 14 in) or more annual precipitation. It is not recommended for turf applications but may work very well in roadside applications. Certified seed is available. ARS in Logan, Utah maintains breeder and foundation seed.

'Ephraim' was developed by the Forest Service Shrub Laboratory in Provo, Utah and Utah Division of Wildlife Resources developed from an accession originating in Turkey. It was released in 1983 by the developing agencies in cooperation with NRCS and Agricultural Experiment Stations in Arizona, Idaho, and Utah. Ephraim is weakly rhizomatous, with rhizomes being expressed at higher precipitation zones above 355 mm (14 in). It is well adapted to disturbed areas, roadsides, and mine spoils. It has been used successfully as a low maintenance turf. It is not well adapted to silty soils. It is a good seed producer. Certified seed is available. Aberdeen PMC maintains breeder and foundation seed.

'Parkway' was developed by the University of Saskatchewan and Agriculture and Agri-Food Canada and released in 1969. It is recommended for hay and pasture. It is a good seed producer and has good lodging resistance. It is not recommended for turf applications. Certified seed is available. Agriculture and Agri-Food Canada Research Station, Swift Current, Saskatoon, Saskatchewan, maintains breeder and foundation seed.

'RoadCrest' was developed by USDA ARS in Logan, Utah and released in 1998. It is long-lived, has a short stature, and is significantly more rhizomatous than Ephraim, the only other somewhat rhizomatous crested wheatgrass cultivar. Roadcrest is recommended for use for erosion control along roadsides or similar low-maintenance turf application areas in 250 to 500 mm (10 to 20 inch) annual rainfall areas. Certified seed is available. ARS in Logan, Utah maintains breeder and foundation seed.

'Ruff' was developed by USDA ARS, Lincoln, Nebraska and released in 1974 by ARS and the Nebraska Agricultural Extension Service. It is recommended for a short season, spring forage crop. It can be used as a low maintenance turf on roadsides, parks, and playgrounds in low rainfall areas of the central Great Plains. Common seed is available, but certified seed is not available.

#### *Desert wheatgrasses*

'Nordan' was developed by the USDA ARS at the Northern Great Plains Research Laboratory, Mandan, North Dakota, and ND Agricultural Experiment Station. It was officially released in 1953. Plants are uniform, erect, with heavy, awnless seeds. The seed heads are dense and compressed. Nordan has good seedling vigor and seed quality, and long-term forage yields are equal to the newer varieties. It is very palatable in spring and fall, but less so in summer. Certified seed is available. ARS at the Great Plains Research Laboratory maintains breeder and foundation seed.

'Summit' was introduced from the Western Siberian Experiment Station, Omsk, former USSR. The University of Saskatchewan and Agriculture and Agri-Food Canada in Saskatoon released it in 1953. Summit is considered very similar to 'Nordan'. Summit has not persisted in the seed market because of production issues (Robins & Jensen, 2020). Agri-Food Canada, Saskatoon, Saskatchewan, maintains breeder and foundation seed. Certified seed is available.

#### *Agropyron cristatum* × *Agropyron desertorum* hybrids

'CD-II' was released by the USDA ARS in Logan, Utah in 1996. CD-II is a selection of 'Hycrest' and was released to ensure the genetic purity of the cross. It has increased growth characteristics under cold temperatures. Characteristics and performance are the same as Hycrest. Certified seed is available. USDA ARS Logan, Utah maintains breeder and foundation seed.

'ForageCrest' was developed by the USDA ARS in Logan, Utah by crossing crested wheatgrass cultivars 'Hycrest' and 'PI 406442'. It was released in 2016. It was bred to have improved seedling establishment, plant persistence, and forage production over earlier cultivars. ForageCrest can emerge from deeper planting depths, up to 76 mm (3 in). It is adapted to areas of the Intermountain West, Great Basin, and Northern Great Plains receiving less than 300 mm (12 in) annual precipitation. USDA ARS Logan, Utah maintains breeder and foundation seed.

'Hycrest' was developed by the USDA ARS in Logan, Utah by crossing Fairway and desert wheatgrasses. ARS, NRCS, and Utah Agricultural Experiment Station released Hycrest in 1984. It is easier to establish than either of its parents and is more productive during the establishment period than either parent. Long-term productivity exceeds Fairway and is equal to that of desert wheatgrass. The leaves and stems of Hycrest are coarser and it has more stems than Fairway. Good stands have been established in the 200 mm (8 in) or greater precipitation zones. It is best adapted to 1,520 to 2,740 m (5,000 to 9,000 ft) elevation zones, but good stands are common to 760 m (2,500 ft). It does well on shallow to deep, coarse to fine textured, moderately well to well drained soils. Under slightly saline conditions, vigor and production are reduced. It is not adapted to excessively saline areas. Certified seed is available. ARS, Logan, Utah, maintains breeder and foundation seed.

'Hycrest II' was released by the USDA ARS and the Utah Agricultural Experiment Station in 2008. It was selected for improved seedling establishment under harsh dryland conditions and is intended for use on arid and semiarid rangelands. It is

intended to replace Hycrest for reseeding sites on heavier soils receiving less than 380 mm (15 in) annual precipitation. ARS, Logan, Utah maintains breeder and foundation seed.

Cultivars should be selected based on the local climate, resistance to local pests, and intended use. Consult with your local land grant university, local extension or local USDA NRCS office for recommendations on adapted cultivars for use in your area.

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