

## BOTTLEBRUSH SQUIRRELTAIL & BIG SQUIRRELTAIL

*Elymus elymoides* (Raf.)

Swezey

&

*Elymus multisetus* M.E. Jones

Plant Symbol = ELEL5 & ELMU3

Contributed by: USDA NRCS Idaho State Office



Image courtesy of Mike Haddock  
Kansas State University  
Used with permission

### Alternate Names

For *E. hystrix*: *Elymus elymoides* (Raf.) Swezey var. *brevifolius* (J.G. Sm.) Barkworth; *Elymus elymoides* (Raf.) Swezey ssp. *californicus* (J.G. Sm.) Barkworth; *Elymus elymoides* (Raf.) Swezey ssp. *elymoides*; *Elymus elymoides* (Raf.) Swezey ssp. *hordeoides* (Suksdorf) Barkworth; *Sitanion hystrix* (Nutt.) J.G. Smith; *Elymus hystrix* L. var. *bigeloviana* (Fern.) Bowden and *Elymus hystrix* L. var. *hystrix*  
For *E. multisetus*: *Sitanion jubatum* J.G. Sm.

### United States Department of Agriculture-Natural Resources Conservation Service

Plant Materials <<http://plant-materials.nrcs.usda.gov/>>

Plant Fact Sheet/Guide Coordination Page <<http://plant-materials.nrcs.usda.gov/intranet/pfs.html>>

National Plant Data Center <<http://npdc.usda.gov>>

### Uses

**Reclamation/re-vegetation:** Squirreltail displays many qualities which make it a good choice for what has been described as “assisted succession.” It is a short-lived perennial grass which can act as an early-seral species by competing with and replacing annual weedy species following fire. It is thought that after squirreltail establishes, annual weedy species should decrease in frequency and longer-lived, native perennials may be more successfully reseeded and established.

Its ability to germinate in the late fall and very early spring at a wide range of temperatures add to its capability to compete with cheatgrass (*Bromus tectorum* L.). Studies also indicate that squirreltail is capable of establishing in medusahead wildrye (*Taeniatherum caput-medusae* (L.) Nevski) infested sites. This makes squirreltail one of the more competitive native grasses available for reseeding disturbed rangelands. It is also a self-fertilizing species which allows it to produce seed despite sparse stands following seeding.

Squirreltail is considered to be one of the most fire resistant native bunchgrasses. Older plants contain relatively low amounts of dead material when compared with other native bunchgrasses. This allows for hot, but quick burns which do not penetrate and damage the crown. However, during dry years plants can be damaged by severe burns. As an early-seral species, new plants often increase for two to three years following burns.

**Erosion control:** When in large, dense stands, squirreltail is very effective at controlling wind and water erosion, due to its persistent ground cover.

**Forage/wildlife:** Squirreltail is considered to be fair to desirable forage for cattle, horses and sheep in spring before seed head development and late summer to fall after seed shatter. The long, sharp awns of the florets and glumes can be injurious to grazing animals during mid to late spring into summer. Leaves green up in very early spring and are palatable through the fall, especially following rain. The tendency for some leaves to remain green through the winter makes squirreltail an important, though not especially nutritious, winter forage species. Table 1 shows crude protein levels for the spring, summer and winter.

**Table 1.** Crude protein levels by season

	% Crude protein
Spring	18.5
Summer	8.0
Winter	4.3

(Adapted from Monsen et al, 2004)

### Legal Status

Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g. threatened or endangered species, state noxious status, and wetland indicator values).

### Taxonomy

Though bottlebrush and big squirreltail are commonly referred to as *Sitanion hystrix* (Nutt.) J.G. Smith and *Sitanion jubatum* J.G. Smith, respectively, squirreltail is becoming more widely accepted through cytological and molecular evidence as belonging to the genus *Elymus*.

The squirreltail complex, *Elymus* section *Sitanion*, is composed of two species, *E. multisetus* (J.G. Sm.) M.E. Jones (big squirreltail) and *E. elymoides* (Raf.) Swezey (bottlebrush squirreltail), with *E. elymoides* being further divided into four subspecies: *elymoides*, *brevifolius* (J.G. Sm.) Barkworth, *californicus* (J.G. Sm.) Barkworth, and *hordeoides* (Suksd.) Barkworth. The following key will be useful in separating the various members of section *Sitanion* including subspecies.

1. glumes 3- to many-cleft; auricles mostly apparent, circa 1mm in length *E. multisetus*
1. glumes entire or 2-cleft; auricles mostly < 1mm *E. elymoides*
  2. spikelets usually 2 per node
    3. lowermost floret of one or both spikelets at each node sterile and reduced to a glume-like structure
      4. glumes 2-cleft; awns of glumes longer than those of the lemmas *ssp. elymoides*
      4. glumes entire; awns of lemma longer than those of the glumes *ssp. californicus*
    3. lowermost floret fertile and not reduced *ssp. brevifolius*
  2. spikelets 3 per node, the floret of the central spikelet fertile, those of the lateral spikelets sterile and rudimentary *ssp. hordeoides*

### Description

*General:* Squirreltail is a cool-season C-3 bunchgrass native to the western United States. Foliage can be

glabrous but is more often white hairy throughout. Plants are short, 10 to 45 cm (4 to 25 inches) tall, with culms erect to spreading. Leaf blades are flat to involute, 1 to 6 mm (0.04 to 0.24 inches) wide. The inflorescence is a spike from 2 to 17 cm (0.8 to 6.7 inches) long, not counting the awns. Internodes of the inflorescence are from 2 to 10 mm (0.08 to 0.40 inches) long with the rachis disarticulating regularly. At maturity the spike can be over 12 cm (4.7 inches) wide due to the widely spreading awns. Awns are scabrous and may grow from 2 to as much as 10 cm (0.8 to 3.9 inches) long, these often becoming purple with maturity.

Squirreltail is a self-pollinating allotetraploid and is known to hybridize with other species of *Elymus* as well as with members of *Hordeum* (barley) and *Pseudoroegneria* (bluebunch wheatgrass). Plants flower from late May to August.

*Distribution:* Squirreltail (in the broad sense) can be found throughout western North America from Canada to Mexico. For current distribution, please consult the Plant Profile page for this species on the PLANTS Web site.

*Habitat:* Bottlebrush and big squirreltail grow in a wide range of habitats, from shadscale communities to alpine tundra. *Elymus elymoides* ssp. *elymoides* is common at low to middle elevations in the western states. Subspecies *californicus* is native to mid-elevations up to alpine areas of Canada, California, Nevada and Utah. Subspecies *brevifolius* is found in a wide variety of habitats including desert and mountain plant communities, while subspecies *hordeoides* is restricted to the low lands of the Great Basin. *Elymus multisetus* occupies a similar range to ssp. *elymoides*, but is typically found in somewhat wetter, more mesic sites often in and near mountain foothills.

### Adaptation

In general, squirreltail is adapted to a wide range of ecological and topographical conditions. Plants can be found from 600 to 3,500 meters (2,000 to 11,500 feet) elevation in desert shrub to alpine plant communities. The different species-subspecies are adapted to sites receiving as little as 8 inches mean annual precipitation on upland sites or 5 to 9 inches in low lying areas that receive additional moisture. Big squirreltail is normally found in sites with 10 inches or more mean annual precipitation. Squirreltail grows well in medium to fine-textured soils, but also commonly occupies coarse-textured to gravelly soils. It tolerates low to moderately saline to alkaline run-in

or overflow sites with electrical conductivity (EC) generally less than 10.

### Establishment

For best results, seed should be planted to a depth of ¼ to ½ inches into a firm weed-free seedbed. For pure stands the recommended drill seeding rate is 7 lb pure live seed (PLS) per acre. Seed can be planted in early spring, but late dormant fall seeding is recommended for best annual weed suppression.

Squirreltail does not establish well into existing perennial shrub communities without mechanical treatment to reduce shrub density. Studies show four times the establishment success rate of squirreltail when planted after thinning big sagebrush (*Artemisia tridentata* Nuttall) as opposed to an untreated site. Similarly, it has been difficult to establish squirreltail in stands of crested wheatgrass (*Agropyron cristatum* [L.] Gaertner). It is recommended that crested wheatgrass and other perennial species competition be eliminated or severely reduced prior to seeding native seed mixtures that include squirreltail.

### Management

Seeds germinate in the fall or spring. Plants green up early and remain green through the fall and into winter. Stands should be protected from heavy grazing, especially during flowering to ensure sufficient seed production to maintain the stand. New plantings should also be protected from grazing for at least two growing seasons. A direct seeded squirreltail stand in a big sagebrush/bluebunch wheatgrass community in south-central Idaho has survived for 30 years with recruitment from natural reseeding.

Wildland seed collection occurs from July to September before disarticulation of the spike. Best germination rates come from seed collected in stands with fifty percent of the seed heads having divergent awns and the other half having straight awns of a reddish color. This occurs approximately one week prior to disarticulation. One hour collecting for a single person averages a yield of about 1.6 oz of clean seed. Seed yields can vary widely depending on stand density and age.

### Pests and Potential Problems

Plants are known to be susceptible to rust.

### Seed Production

Plant seed in a 36-inch between-row spacing at a rate of 2.4 lbs PLS/acre for 30 PLS per foot of row. Fields should be weed free and have good field moisture to a depth of at least four inches. Soil should be kept

moist throughout the germination phase (about 14-28 days). Fifty percent of germination should occur within 15 to 30 days after planting. Broadleaf weeds can be controlled with low rates of bromoxynil at the three to five leaf stage. Always apply herbicides according to label directions. No fertilizer should be applied during the first year to discourage annual weed competition.

Soil moisture should be carefully maintained during early green-up, boot stage, milk stage of seed development and after harvest. No irrigation should be applied during flowering to encourage seed set. Fertilize established fields at 100 lb nitrogen and 40 lb phosphorus per acre in mid-September. Soil testing is recommended to ensure proper rates of fertilization.



Photo courtesy of L&H Seed Company  
Production field of Fish Creek Germplasm  
(*Elymus elymoides* ssp. *elymoides*)

Broadleaf weeds can be controlled with herbicides. Application should occur prior to boot stage. Between-row cultivation can be used to control other weeds for the life of the stand.

Seed is ready to harvest in about mid-July of the second growing season (see “management” section for timing). Harvest by windrowing followed by combining. Some report difficulty with mechanical harvesting due to the ready disarticulation of the rachis of mature seed heads. Swathing prior to maturity and curing in windrows will help reduce this problem. Flail-vac and seed stripping harvesting equipment have also been used with varying degrees of success.

Because of the large amount of inert material produced from awns and glumes, this is a very time-consuming species to clean. Thresh seed through a hammer mill to remove awns. Follow with a clipper or other separator. Purity should exceed 90% with greater than 85% viability. Big squirreltail, in

particular, has proven difficult to debeard without seed damage. Some seed companies have modified equipment that has resulted in improved seed viability.

Seed yields under irrigated conditions average approximately 200 lb/acre with 190,000 seeds/lb. Harvested seed should be dried to 12% or less moisture before storing. Storing seed in a cool dry environment will retain viability for several years.

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

Because of the broad array of subspecies of squirreltail and the genetic variation between species and subspecies, careful identification of the species and subspecies native to the planting site is recommended. Care should be taken to match the appropriate phenotype and genotype of the plant materials with those of the local plant communities to improve the chance of stand success and to prevent genetic contamination of existing populations.

Fish Creek Germplasm, 2003 (*E. elymoides* ssp. *elymoides*): This natural track, selected class germplasm was released by the USDA-ARS Forage and Range Research Laboratory in Logan, UT in cooperation with BLM, Utah Agricultural Experiment Station and USDA-NRCS. It was originally collected by T.A. Jones as accession T-1223 in Blaine County, Idaho in August 1995. The native site was described as a big sagebrush and Sandberg bluegrass (*Poa secunda* Presl.) community at approximately 1450 meters (4,760 feet) elevation. Estimated annual precipitation at the site is 35-38 cm (14-15 in). Fish Creek shows a 33% lighter awn mass as compared to Sand Hollow. The spike also disarticulates in a determinate fashion at the base of the spike, two traits which make Fish Creek easier to harvest and to clean than other releases. Fish Creek is adapted to and intended for use in the Snake River Plain. Second generation seed is maintained by the USDA-ARS Forage and Range Research Laboratory, Logan UT. G3 to G5 seed is available through the Utah Crop Improvement Association.

Toe Jam Creek Germplasm, 2003 (*E. elymoides* ssp. *californicus*): This natural track, selected class germplasm was released by the USDA-ARS Forage and Range Research Laboratory in Logan, UT in cooperation with BLM, Utah Agricultural Experiment Station and USDA-NRCS. The original collection for Toe Jam Creek was made in Elko County, Nevada west of Tuscarora by J. Garrison of NRCS. Elevation at the site is 1829 meters (6,000 feet), and average precipitation is estimated at 31cm

(12 in.). Toe Jam Creek is intended for use in the lower Snake River Plain and the northern Great Basin. Similar to Fish Creek, Toe Jam Creek exhibits a lower awn mass than Sand Hollow making them presumably easier to remove without damaging the caryopsis. G3 seed is maintained by the USDA-ARS Forage and Range Research Laboratory, Logan UT. Seed through G6 is available through the Utah Crop Improvement Association.

Sand Hollow Germplasm, 1996 (*E. multisetus*): The Sand Hollow collection site is considerably drier than those typical for big squirreltail. It was originally collected in 1984 in Gem County, Idaho by Greg Painter of NRCS in a bluebunch wheatgrass, Sandberg bluegrass and tapertip hawksbeard (*Crepis acuminata* Nutt.) community. The collection site is at 830 meters (2,720 feet) elevation and receives an average of 28 centimeters (11.0 inches) annual precipitation. Sand Hollow is considered to be adapted to the mountain foothills of the Snake River Plain region of Idaho and in adjacent regions of Oregon, Nevada and Utah. It was released as a selected class germplasm for high seed production, higher-than-average seed weight and late heading date. G2 seed is maintained by the USDA-ARS Forage and Range Research Laboratory, Logan UT. Seed from G3 and G4 generations are available for seed certification through the Utah Crop Improvement Association.

Tusas Germplasm, 2001 (*Elymus elymoides* ssp. *brevifolius*): Tusas Germplasm bottlebrush squirreltail was released by the NRCS and New Mexico State University Agricultural Science Center at Los Lunas, New Mexico. This natural track, selected class release is a composite of eight accessions from throughout New Mexico. Collection site elevations ranged from 1,460 meters (4,800 feet) to 2,800 meters (9,200 feet). From the initial 131 collections, eight were selected for vigor, late flowering and higher seed yield. An equal number of seedlings from each accession were taken to form the composite, Tusas. It is intended for use in the southwestern United States for erosion control, wildlife food and cover, revegetation of disturbed sites and restoration of weed infested rangelands. Breeder and G2 seed are maintained by the NRCS NM Plant Materials Center. Seed is available through the New Mexico Crop Improvement Association.

Pueblo Germplasm and Wapiti Germplasm, 2005 (*Elymus elymoides* ssp. *brevifolius*): Pueblo and Wapiti Germplasm are natural track, selected class releases, each originating from a single source. Pueblo was originally collected in 1976 southwest of

Pueblo, Colorado in Pueblo County at an elevation of 7,200 feet in shallow, gravelly soils. The original collection of Wapiti was made in 1981 along the Gooseberry Creek drainage in Rio Blanco County, Colorado. The original collection site was in a stony loam soil at 7,800 feet elevation. Eight bottlebrush squirreltail accessions were evaluated by the Upper Colorado Environmental Plant Center (UCEPC) from 1983 to 1987 and compared for forage production, seed production percent stand, leaf height, vigor, leaf abundance and stem height. Of these, two accessions were chosen for further development, Pueblo and Wapiti. Both are intended for use in erosion control and forage production for livestock and wildlife as well as a variety of conservation applications. These releases should be considered as potentially adapted within the natural range of the species. The UCEPC will maintain G1 and G2 seed. G2 seed will be available to growers. Growers may produce one generation (G3) beyond G2 for Pueblo and Wapiti Germplasm seed. Seed used for certified seed production must be obtained from UCEPC.

Contact your local Natural Resources Conservation Service (formerly Soil Conservation Service) office for more information. Look in the phone book under "United States Government". The Natural Resources Conservation Service will be listed under the subheading "Department of Agriculture."

#### References

Arredondo, J.T., T.A. Jones and D.A. Johnson. 1998. Seedling growth of Intermountain perennial and weedy annual grasses. *Journal of Range Management*. 51: 584-589.

Clausnitzer, D.W., M.M. Borman and D.E. Johnson. 1999. Competition between *Elymus elymoides* and *Taeniatherum caput-medusae*. *Weed Science*. 47: 720-728.

Cornforth, B., L. St. John and D G. Ogle. 2001. Technical Note 14: Seed production standards for conservation plants in the intermountain West. USDA-NRCS. Boise, ID. ID-TN 14, Dec. 2001.

Cronquist, A., A.H. Holmgren, N.H. Holmgren and J.L. Reveal. 1977. *Intermountain Flora: Vascular Plants of the Intermountain West*, U.S.A. The New York Botanical Garden.

Doescher P.S. 2001. Technical Note: Early harvest of squirreltail seed. *Journal of Range Management*. 54: 197-199.

Jones, T.A. 1998. Viewpoint: The present status and future prospects of squirreltail research. *Journal of Range Management*. 51: 326-331.

Larson, S. R., T.A. Jones, C.L. McCracken and K.B. Jensen. 2003. Amplified fragment length polymorphism in *Elymus elymoides*, *Elymus multisetus*, and other *Elymus* taxa. *Canadian Journal of Botany*. 81: 789-804.

Monsen, S.B., R. Stevens and N.L. Shaw. 2004. Restoring western ranges and wildlands. USDA Forest Service, Rocky Mountain Research Station. General Technical Report RMRS-GTR-136. 884 p.

Ogle, D.G., L. St. John, M. Stannard and L. Holzworth. 2003. Technical Note 24: Grass, grass-like, forb, legume, and woody species for the intermountain west. USDA-NRCS, Boise, ID. ID-TN 24. 41p.

USDA NRCS. 2006. The PLANTS Database (<http://plants.usda.gov>). [National Plant Data Center](http://plants.usda.gov) (accessed 08March2006), Baton Rouge, LA 70874-4490 USA.

Welsh, S. L., N. D. Atwood, S. Goodrich and L. C. Higgins. 1993. *A Utah Flora*. Brigham Young University Press. Provo, Utah.

Wilson, F.D. 1963. Revision of *Sitanion* (Triticeae, Gramineae). *Brittonia*. 15: 303-323.

Winslow, Susan R. 2002. Propagation protocol for production of *Elymus elymoides* seeds; Bridger Plant Materials Center, Bridger, Montana. In: Native Plant Network. URL: <http://www.nativeplantnetwork.org> (accessed 15 March, 2005). Moscow (ID): University of Idaho, College of Natural Resources, Forest Research Nursery.

#### Prepared By:

*Derek J. Tilley*, Range Conservationist (Plants)  
USDA NRCS Plant Materials Center, Aberdeen, ID

*Dan Ogle*, Plant Materials Specialist  
USDA NRCS Idaho State Office, Boise, ID

*Loren St. John*, Manager  
USDA NRCS Plant Materials Center, Aberdeen, ID

*Larry Holzworth*, Plant Materials Specialist  
USDA NRCS Montana State Office, Bozeman, MT

*Thomas A. Jones*  
USDA-ARS Forage and Range Research Laboratory,  
Logan, UT

*Susan R. Winslow*, Agronomist  
USDA NRCS Plant Materials Center, Bridger, MT

**Species Coordinator:**

*Dan Ogle*, Plant Materials Specialist  
USDA NRCS Idaho State Office, Boise, ID

Edited: 24Feb06djt; 24Feb06lsj; 24Feb06dgo;  
23Mar05srw; 8Apr05taj; 05May05lkh. 23mar06 jsp

For more information about this and other plants, please contact your local NRCS field office or Conservation District, and visit the PLANTS Web site <<http://plants.usda.gov>> or the Plant Materials Program Web site <<http://Plant-Materials.nrcs.usda.gov>>

*The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, sex, religion, age, disability, political beliefs, sexual orientation, and marital or family status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at 202-720-2600 (voice and TDD).*

*To file a complaint of discrimination write USDA, Director, Office of Civil Rights, Room 326-W, Whitten Building, 14th and Independence Avenue, SW, Washington, DC 20250-9410 or call 202-720-5964 (voice or TDD). USDA is an equal opportunity provider and employer.*

*Read about Civil Rights at the Natural Resources Conservation Service.*