

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
BRIDGER, MONTANA

and

MONTANA AGRICULTURAL EXPERIMENT STATIONS
MONTANA STATE UNIVERSITY
BOZEMAN, MONTANA

and

DEER LODGE VALLEY CONSERVATION DISTRICT
DEER LODGE, MONTANA

and

MONTANA DEPARTMENT OF JUSTICE
NATURAL RESOURCE DAMAGE PROGRAM
UPPER CLARK FORK RIVER BASIN RESTORATION FUND
HELENA, MONTANA

and

DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION
RECLAMATION AND DEVELOPMENT GRANT PROGRAM
HELENA, MONTANA

and

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESTORATION AND DEVELOPMENT
MINE WASTE TECHNOLOGY PROGRAM
CINCINNATI, OHIO

NOTICE OF RELEASE OF WASHOE BASIN WILDRYE
SELECTED CLASS OF NATURAL GERMPLASM

The Natural Resources Conservation Service-Bridger Plant Materials Center, Montana Agricultural Experiment Stations-Montana State University, Deer Lodge Valley Conservation District, Montana Department of Justice-Natural Resource Damage Program, Department of Natural Resources and Conservation-Reclamation and Development Grant Program, and the U.S. Environmental Protection Agency-Mine Waste Technology Program announce the release of a selected ecotype of basin wildrye (*Leymus cinereus* [Scribn. & Merr.] A. Löve).

As a selected release this plant will be referred to as Washoe Germplasm basin wildrye. It has been assigned the NRCS accession number 9081627. Washoe Germplasm is released as a selected class of certified seed (natural track).

This alternative release procedure is justified based on the critical need for acid and heavy metal tolerant plant materials to revegetate degraded minelands in western Montana. The two existing cultivars, 'Trailhead' and 'Magnar', were not selected for their tolerance to low pH and heavy metal contaminated soils. Washoe Germplasm basin wildrye, collected near the Anaconda Washoe smelter stack, has demonstrated superior vigor and survival when grown in contaminated soil. In addition, the potential for immediate and long-term demand is high.

Collection Site Information: Washoe Germplasm was originally collected in Deer Lodge County, Montana (Township 4 North, Range 11 West, NW 1/4 of Section 14), on October 27, 1998, by Leslie Marty. The collection site is within the Anaconda Smelter Superfund Site, approximately 1.25 mi (2 km) southwest of Washoe smelter stack at an elevation of 6,132 ft (1,869 m). The latitude/longitude is North 46°06'03" West 112°56'01". Seed was collected from greater than 50 plants on a south-facing, ~15 percent slope on gravelly, sandy loam textured soil. Aerial emissions from past copper smelting operations have resulted in elevated levels of heavy metal and sulfur compounds in the soil at the collection site. Laboratory analyses of the two soil samples taken at the collection site are presented in table 1. The chemical variation in the two samples is typical of the extreme heterogeneity of mine impacted lands. Precipitation in the area averages 12 to 14 in (305 to 356 mm) annually, with most of the precipitation occurring during the spring and summer months. The average annual maximum and minimum temperatures for Anaconda are 52°F (11°C) and 33°F (0.6°C), respectively.

Table 1. Laboratory analyses of two soil samples taken at the Washoe Germplasm collection site.

Sample No.	pH <i>S.U.</i>	As <i>mg/kg</i>	Cd <i>mg/kg</i>	Cu <i>mg/kg</i>	Pb <i>mg/kg</i>	Zn <i>mg/kg</i>	Conductivity <i>mmhos/cm</i>	Texture
Coll.-site-3A	4.6	610	7	790	210	280	0.55	loam
Coll.-site-3B	5.6	370	7	550	100	280	0.83	sand
ξ	5.1	490	7	670	155	280	.69	
Phytotoxic Criteria [†]	<5.0	136-315	5.1-20	236-750	94-250	196-240	>4.0	

[†] Phytotoxic levels accepted by the EPA (CDM Federal 1997).

Description: Washoe Germplasm basin wildrye has the same general botanical and phenological attributes as the species. Basin wildrye is a tall, coarse, robust, perennial bunchgrass native to the intermountain region of the western United States. It is a long-lived, cool season grass with coarse fibrous roots and a few short rhizomes that bind the soil. Basin wildrye clumps may reach 3 ft (0.9 m) in diameter and grow 3 to 10 ft (0.9 to 3 m) tall. The leaf blades are long, wide, and flat with long, pointed auricles. The reproductive stems are dense, stout, and strongly erect. Seed heads are 6 to 10 in (15 to 25 cm) long. Growing points are 10 to 12 in (25 to 30 cm) above the crown. Washoe Germplasm has an average of 175,994 seeds/lb (79,830 seeds/kg).

Method of Selection: In 1995, an Initial Evaluation Planting (Site 1) was installed near Anaconda, Montana. Site 1, located in an area affected by aerial fallout from past smelter emissions, was sparsely vegetated, and had an average pH of 5.5. Composite soil samples (0 to 10 in, 0 to 25 cm) indicated cadmium, copper, and zinc levels that exceed the EPA standards for phytotoxicity (CDM Federal 1997). Site 1 tested 69 accessions of 45 grass species in a randomized complete block design replicated three times. *Leymus cinereus* Magnar and Trailhead were tested in this study. In 1999, the planting was evaluated for plant height, vigor, and percent survival. Results indicated that Magnar and Trailhead ranked eighth and ninth, respectively, in overall performance.

The superior performance of basin wildrye in the Initial Evaluation Planting prompted the collection of Washoe Germplasm and two other basin wildrye accessions (9081624 and 9081625) located within the Anaconda Smelter Superfund Site. These accessions along with Magnar and Trailhead were then tested in a greenhouse Comparative Evaluation Planting conducted from December 1, 2000, to March 1, 2001. The soil media utilized in the study was collected 2 mi (3.2 km) southeast of Anaconda and transported to the Bridger Plant Materials Center. Laboratory analyses of four soil samples indicated an average pH of 4.6. Acid extractable levels of arsenic and zinc exceed the EPA's upper range for phytotoxicity. Cadmium, copper, and lead levels exceed EPA's lower range for toxicity (table 2). Soil texture varied from sandy loam to sandy clay loam and organic matter ranged from 1 to 3 percent.

Table 2. Acid extractable heavy metal levels and pH of the four soil samples of the greenhouse Comparative Evaluation Planting growing media.

Sample No.	pH <i>S.U.</i>	As <i>mg/kg</i>	Cd <i>mg/kg</i>	Cu <i>mg/kg</i>	Pb <i>mg/kg</i>	Zn <i>mg/kg</i>
GHCEP-1-11-15-00	4.5	436	10	643	197	432
GHCEP-2-11-15-00	4.5	445	10	596	228	399
GHCEP-3-11-15-00	4.6	422	11	582	201	378
GHCEP-4-11-15-00	4.6	403	9	633	208	408
$\bar{x} \pm s_x$	4.55, 0.01	427, 14	10, 0.5	614, 24.5	208, 9.5	404, 15.75
Phytotoxic Criteria	< 5.0	136-315	5.1-20	236-750	94-250	196-240

[†] Phytotoxic levels accepted by the EPA (CDM Federal 1997).

The study tested a total of 71 entries (19 forbs and 52 grasses) in a randomized complete block design replicated 20 times. A single replication consisted of 71 entries planted in 10 in³ (16.4 dm³) containers arranged randomly within a tray. The 20 trays were then randomized and placed adjacent to each other in the Bridger Plant Materials Center greenhouse. The greenhouse was maintained at 75°F day/65°F night (24°C/18°C) temperatures. High-pressure sodium lights provided a 16-hour photoperiod. The trays were hand-irrigated approximately every other day or as needed to provide adequate water for plant growth.

Evaluations were made only on the first emerging seedling. All subsequent germinates were culled. Height was measured approximately every 3 to 5 days over the 90-day study period. At

90 days, a final evaluation was conducted recording height and vigor data. Height was measured in centimeters to the top of foliage. Vigor was rated on a scale of 1 to 5 (1 = best) based on visual observations.

The performance results were ranked from 1 to 71 (best to worst) based on comparative height, vigor, and percent survival. Percent survival was calculated by dividing the number of replications that survived to day 90 by the number of replications that germinated. To assess overall performance, the rank of the height, vigor, and percent survival parameters were summed and the resultant score used as a performance measure.

Results from the study indicated that Magnar had the tallest average height (2.0 in, 5.2 cm) compared to Washoe Germplasm (1.9 in, 4.8 cm), Trailhead (1.7 in, 4.3 cm), 9081625 (1.7 in, 4.2 cm), and 9081624 (1.6 in, 4.1 cm). The most vigorous entry was Washoe Germplasm with an average vigor rating of 3.85 compared to Magnar (3.95), 9081624 (4.00), 9081625 (4.00), and Trailhead (4.19). Survival rates were highest for Washoe Germplasm and 9081625 at 95 percent compared to Magnar (90%), 9081624 (85%), and Trailhead (81%).

The overall performance scores (calculated by summing each entry's rank in height, vigor, and percent survival) over the entire study ranged from 7 to 157 with an average value of 83.3. The overall performance of the five accessions of basin wildrye are shown in table 3, arranged from best to worst (lowest score = best performance). These scores ranged from 38 to 60 with an average value of 48. This overall evaluation system identified Washoe Germplasm as the best basin wildrye performer. Washoe Germplasm, with a score of 38, performed slightly better than Magnar (40) and considerably better than 9081625 (48), 9081624 (54), and Trailhead (60).

Table 3. Overall performance based on height, vigor, and percent survival rank.

Accession	Id.	Height Rank	Vigor Rank	% Surv. Rank	Score (<i>Ht. + Vg. + %Surv.</i>)
Washoe Germplasm	30	20	16	2	38
Magnar	31	17	20	3	40
9081625	29	25	21	2	48
9081624	28	27	21	6	54
Trailhead	32	23	28	9	60

Ecological Considerations and Evaluation: Washoe Germplasm basin wildrye is a selection of naturally occurring germplasm that has undergone minimal purposeful selection. Basin wildrye is native to western North America and adapted to a wide range of soils. It can reproduce from seed or tillers. Washoe Germplasm was rated “OK to release” when evaluated through the “Worksheet for Documenting an Environmental Evaluation of NRCS Plant Releases.”

Conservation Use: The potential uses for Washoe Germplasm basin wildrye include erosion control, wildlife food/cover, and restoration of minelands affected by acid and heavy metal soil contamination. Basin wildrye's drought tolerance and extensive fibrous root system make it an excellent plant for soil stabilization, especially on erosive hillsides in areas that receive 8 to 20 in (203 to 508 mm) of annual precipitation. It is a high forage producer, palatable to all classes of livestock and wildlife, and provides good winter forage. The tall, upright stature of this

bunchgrass is ideal for providing wind protection and cover for small animals and birds. It is not generally recommended for spring or summer forage because it has an elevated growing point that is easily damaged by grazing.

Anticipated Area of Adaptation: Washoe Germplasm performs well in loamy to sandy soils in the foothills of the Anaconda Smelter Superfund Site in 12- to 14-in (304.8- to 355.6-mm) average annual precipitation zones. It is expected to perform well at sites with similar soil, climate, and topographical conditions as in much of the foothills of the Northern Rocky Mountains. It may perform well in other regions where basin wildrye is adapted. Basin wildrye is commonly found in the plains, foothills, and montane zones, 2,000 to 9,000 ft (610 to 2,743 m) from British Columbia and Alberta to New Mexico with average annual precipitation of 8 to 20 in (203 to 508 mm).

Availability of Plant Materials: The USDA-NRCS, Bridger Plant Materials Center maintains foundation-quality (G₁) seed of Washoe Germplasm basin wildrye. Seed will be distributed through the Seed Stocks Program, Department of Plant Sciences, P.O. Box 173150, Montana State University, Bozeman, MT 59717-3150.

References:

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Signatures for release of:

Washoe Germplasm basin wildrye (*Leymus cinereus*)

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