Aberdeen Plant Materials Center

2003 Annual Technical Report

United States
Department of
Agriculture

**Natural Resources
Conservation Service**

Aberdeen, Idaho

March 2004

United States Department of Agriculture

NRCS Natural Resources Conservation Service

Plant Materials Center

ABERDEEN PLANT MATERIALS CENTER

USDA Natural Resources Conservation Service
Aberdeen, Idaho

MISSION

To develop and transfer effective state-of-the-art plant science technology to meet customer and resource needs.

Contents

INTRODUCTION

The Plant Materials Center at Aberdeen is part of a national plant materials program operated by the United States Department of Agriculture, Natural Resources Conservation Service. The purpose of the Plant Materials Center is to develop and communicate new technology for the use and management of plants. We also assemble, evaluate and release plant materials for conservation use and develop new techniques for establishment of conservation plants. The Aberdeen Plant Materials Center was established in 1939 and has been the primary breeder and releasing organization for 15 cultivars and a cooperator in the release of 12 additional cultivars. The Aberdeen Plant Materials Center serves portions of Nevada, Utah, California, Oregon and Idaho. This document is a compilation of progress reports for activities by the Aberdeen Plant Materials Center during FY 2003.

The following documents and presentations were developed during FY 2003 and may be obtained by contacting the Aberdeen Plant Materials Center:

DOCUMENTS

Stewart-Williams, K., L.St. John and D. Ogle 2002. 2002 Idaho Certified Seed Selection Guide for Some Varieties of Grasses, Forbs, and Shrubs. University of Idaho, College of Agricultural and Life Sciences, Moscow, ID. Progress Report 329. 2p.

St. John, L., J.C. Hoag, P. Blaker, D. Ogle 2003. Aberdeen Plant Materials Center - 2002 Annual Technical Report. USDA-NRCS Aberdeen Plant Materials Center, Aberdeen, ID. Mar. 2003. 310p.

St. John, L. and D. Ogle 2002. Trout Creek, Nevada Off-Center Advanced Test Site - Summary of Progress 1987 - 2002. USDA-NRCS Aberdeen Plant Materials Center, Aberdeen, ID. Oct. 18, 2002. 13p.

St. John, L. , Hoag, J.C. 2003. 2002 Aberdeen Plant Materials Center Progress Report of Activities. USDA-NRCS Aberdeen Plant Materials Center, Aberdeen, ID. Jan. 8, 2003. 4p.

St. John, L. 2002. 2002 Progress Report - 1998 Hybrid Poplar Initial Evaluation Planting. USDA-NRCS Aberdeen Plant Materials Center, Aberdeen, ID. October 9, 2002. 2p.

St. John, L. 2002. Appar and Native Blue Flax Comparison - 2002 Progress Report. USDA-NRCS Aberdeen Plant Materials Center, Aberdeen, Idaho. Nov. 6, 2002. 2p.

St. John, L. 2003. Conservation Plant Materials Tested at Trout Creek, Nevada. Aberdeen Plant Materials Center, Aberdeen, ID. June 16, 2003. 1p.

St. John, L. 2003. Fact Sheet - Goldar Bluebunch Wheatgrass. Aberdeen Plant Materials Center, Aberdeen, ID. Mar. 3, 2003. 2p.

St. John, L. 2003. Great Basin Native Plant Selection and Increase Project FY 2002 Annual Report. USDA-NRCS Aberdeen Plant Materials Center, Aberdeen, ID. Feb. 4, 2003. 2p.

St. John, L. 2003. Maintenance Tips for Your Windbreak or Ornamental Plantings. Aberdeen Plant Materials Center, Aberdeen, ID. August 19, 2003. 1p.

St. John, L. 2003. New Tools from the Plant Materials Toolkit. Aberdeen Plant Materials Center, Aberdeen, ID. June 16, 2003. 1p.

St. John, L. 2003. Perennial Grasses as Sugar Platform Stocks for Industrial Processing - 2003 Study Summary. Aberdeen Plant Materials Center, Aberdeen, ID. August 5, 2003. 1p.

St. John, L. 2003. Windbreak Maintenance Pointers. Aberdeen Plant Materials Center, Aberdeen, ID. May 29, 2003. 1p.

St. John, L and D. Ogle 2003. Grass Display Nursery Brochure. USDA-NRCS Aberdeen Plant Materials Center, Aberdeen, ID. Feb. 18, 2003. 8p.

St. John L. and P. Blaker 2002. New Native Plant Releases From the USDA-NRCS Aberdeen, ID Plant Materials Center. In: Hild, Ann L.; Shaw, Nancy L.; Meyer, Susan E.; Schupp, Eugene W.; Booth, Terrence,

comps. 2003. Seed and soil dynamics in shrubland ecosystems: proceedings; 2002 August 12-16; Laramie, WY., Ogden, UT. in press. 7p.

Rolson, Kortny 2002. Farmer trades row crops for flowers. The Idaho Statesman, Boise, ID. Oct. 2, 2002. 1p.

Ogle, D.G., T. Bush, L. St John, M. Stannard, and K.B. Jensen 2003. Orchardgrass Plant Guide. USDA-NRCS, Boise, Idaho. Feb. 2003. 3p.

Ogle, D.G., L. St. John, and C. Stange 2002. Tree Planting, Care and Management. USDA-NRCS, Boise, Idaho. ID-PM-TN No. 43 October 2002 revision. 30p.

Ogle, D.G., L. St John, L.K. Holzworth, S.R. Winslow, and T.A. Jones 2003. Basin Wildrye Plant Guide. USDA-NRCS, Boise, Idaho. Feb. 2003. 4p.

Ogle, D.G., L. St John, L.K. Holzworth, S.R. Winslow, and T.A. Jones 2003. Thickspike and Streambank Wheatgrass Plant Guide. USDA-NRCS, Boise, Idaho. Feb. 2003. 4p.

Ogle, D.G., L. St John, L.K. Holzworth, and S.R. Winslow 2003. Winterfat Plant Guide. USDA-NRCS, Boise, Idaho. Feb. 2003. 4p.

Ogle, D.G., L. St John, and T.A. Jones 2003. Bluebunch Wheatgrass Plant Guide. USDA-NRCS, Boise, Idaho. Feb. 2003. 4p.

Ogle, D.G., L. St John, and T.A. Jones 2003. Indian Ricegrass Plant Guide. USDA-NRCS, Boise, Idaho. Feb. 2003. 5p.

Ogle, D.G., L. St john, and K.B. Jensen 2003. Crested Wheatgrass Plant Guide. USDA-NRCS, Boise, Idaho. Feb. 2003. 6p.

Ogle, D.G., L. St John, and K.B. Jensen 2003. Intermediate Wheatgrass Plant Guide. USDA-NRCS, Boise, Idaho. Feb. 2003. 6p.

Ogle, D.G., L. St John, and K.B. Jensen 2003. Siberian Wheatgrass Plant Guide. USDA-NRCS, Boise, Idaho. Feb. 2003. 5p.

Ogle, D.G., L. St John, and J.S. Peterson 2003. Lewis Flax Plant Guide. USDA-NRCS, Boise, Idaho. Feb. 2003. 4p.

Ogle, D.G., L. St John, and J.S. Peterson 2003. Small Burnet Plant Guide. USDA-NRCS, Boise, Idaho. Feb. 2003. 3p.

Ogle, D.G., L. St John, and J.S. Peterson 2003. Venus Penstemon Plant Guide. USDA-NRCS, Boise, Idaho. Feb. 2003. 4p.

Ogle, D.G., L. St John, and J.K. Peterson 2003. Blue Flax Plant Guide. USDA-NRCS, Boise, Idaho. Feb. 2003. 4p.

Ogle, D.G., J. Scheetz, L.K. Holzworth, L. St John, and S.R. Winslow 2003. Western Wheatgrass Plant Guide. USDA-NRCS, Boise, Idaho. Feb. 2003. 4p.

Ogle, D.G., J. Henson, M. Stannard, L. St John, and T.A. Jones 2003. Idaho Fescue Plant Guide. USDA-NRCS, Boise, Idaho. Feb. 2003. 5p.

Ogle, D.G. and L. St John 2003. Fourwing Saltbush Plant Guide. USDA-NRCS, Boise, Idaho. Feb. 2003. 4p.

Ogle, D., 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, Bozeman, MT, and Spokane, WA. ID-TN24, Jan. 2003. 41p.

Ogle, D. G., L. St John, L.K. Holzworth, and K.B. Jensen 2003. Meadow Brome Plant Guide. USDA - NRCS, Boise, Idaho. Feb. 2003. 4p.

Ogle, D. and L. St. John 2003. Aberdeen Plant Materials Center Economic Impact 2002. USDA-NRCS Aberdeen Plant Materials Center, Aberdeen, ID. Feb. 18, 2003. 1p.

Hoag, JC and J Fripp 2003. Streambank Soil Bioengineering for Low Precipitation Areas. National Design, Construction, and Soil Mechanics Center, Ft. Worth TX as part of the National Riparian Design Manual, Ft. Worth, TX. 7/29/03. 17p.

Hoag, J.C., L. St. John and D.G. Ogle 2002. Reading Seed Packaging Labels and Calculating Seed Mixtures (PLS - What it is and How to use it). USDA-NRCS, Boise, Idaho. ID-PM-TN No 4 October 2002 revision. 15p.

Hoag, J.C. 2003. View From a Wetland, Number 8 (2002). USDA-NRCS Aberdeen Plant Materials Center, Aberdeen, ID. Number 8, Jan. 2003. 4p.

Blaker, P. and L. St. John 2002. Foundation Seed Production at Aberdeen Plant Materials Center. USDA-NRCS Aberdeen Plant Materials Center, Aberdeen, ID. October 7, 2002. 1p.

PRESENTATIONS

Date presented: 10/16/2002
Title: Riparian Ecology and Restoration Workshop
Presenter Hoag and Fripp **Location** Burns, OR

Date presented: 10/17/2002
Title: Riparian Ecology and restoration Field exercise
Presenter Hoag and Fripp **Location** Burns, OR

Date presented: 10/22/2002
Title: Riparian Ecology and Restoration Workshop
Presenter Hoag and Fripp **Location** Carson City, NV

Date presented: 10/23/2002
Title: Riparian Ecology and Restoration Field Exercise no. 1
Presenter Hoag and Fripp **Location** Carson River Carson City, NV

Date presented: 10/24/2002
Title: Riparian Ecology and Restoration Workshop field Exercise no. 2
Presenter Hoag and Fripp **Location** Carson River Carson City, NV

Date presented: 10/28/2002
Title: Gibbon River reconstruction meeting
Presenter Hoag and Clark **Location** Yellowstone National Park

Date presented: 11/5/2002
Title: Riparian ecology and restoration workshop, Alturas, CA
Presenter Hoag and Yard **Location** Alturas, CA

Date presented: 11/6/2002
Title: Riparian Ecology and Restoration field exercise, Alturas CA
Presenter Hoag and Yard **Location** Pit River, Alturas, CA

Date presented: 11/7/2002
Title: Road Management
Presenter Hoag and Yard **Location** Alturas, CA

Date presented: 1/16/2003
Title: Production of Native Seed Crops
Presenter L. St. John **Location** Ontario, OR

Date presented: 1/22/2003
Title: 2002 PMC Activities Update to Idaho Plant Materials Committee
Presenter St. John, L. **Location** Boise, ID

Date presented: 1/26/2003

Title: Aberdeen Plant Materials Center - Mission and Function
Presenter L.St. John **Location** Aberdeen High School

Date presented: 1/27/2003
Title: Great Basin Restoration Initiative - Aberdeen PMC Progress
Presenter St. John, L. **Location** Salt Lake City, UT

Date presented: 1/29/2003
Title: Utah Plant Materials Committee Meeting
Presenter St. John, L. **Location**

Date presented: 2/4/2003
Title: Wetland Plant Releases from the Aberdeen Plant Materials Center
Presenter Hoag **Location** Idaho State University, Pocatello, ID

Date presented: 3/3/2003
Title: Wetlands and Constructed Wetland Systems
Presenter Hoag **Location** Idaho State University,

Date presented: 3/27/2003
Title: Waterjet Stinger, a method to plant unrooted cuttings of willows and cottonwoods
Presenter Hoag **Location** SER meeting, Portland, OR

Date presented: 3/27/2003
Title: Propagation of Wetland Plant Species by Seed
Presenter Hoag **Location** SER Meeting, Portland, OR

Date presented: 4/2/2003
Title: Riparian Ecology and Restoration Workshop, Panguitch, UT
Presenter Hoag and Yard **Location** Panguitch, UT

Date presented: 4/2/2003
Title: New Native Plant Releases from the USDA-NRCS Aberdeen, ID Plant Materials Center
Presenter L. St. John **Location** Boise, ID

Date presented: 4/3/2003
Title: Riparian Ecology and Restoration field exercise, Panguitch, UT
Presenter Hoag and Yard **Location** Panguitch, UT

Date presented: 4/3/2003
Title: Overview of Aberdeen Plant Materials Center at Intermountain Native Plant Summit
Presenter L. St. John **Location** Boise, ID

Date presented: 4/8/2003
Title: Riparian Ecology and Restoration Workshop, Santa Maria, CA
Presenter Hoag and Fripp **Location** Santa Maria, CA

Date presented: 4/9/2003
Title: Riparian Ecology and Restoration field exercise, Santa Maria, CA
Presenter Hoag and Fripp **Location** Walker Site on the Alamo Pintado Creek,

Date presented: 4/10/2003

Title: Riparian Ecology and Restoration field exercise, Olesen Site, Santa Maria, CA

Presenter Hoag and Fripp **Location** Olesen Site, East Williamson Creek, Buelton,

Date presented: 4/18/2003

Title: Streambank Soil Bioengineering Basics

Presenter Hoag **Location** Island Park, Idaho

Date presented: 4/29/2003

Title: Riparian Ecology and Restoration Workshop, Elko, NV

Presenter Hoag and Fripp **Location** Elko, NV

Date presented: 4/30/2003

Title: Riparian Ecology and Restoration Workshop Field Exercise, Trout Creek, NV

Presenter Hoag and Fripp **Location** Trout Creek, NV

Date presented: 5/14/2003

Title: Plant Material Considerations for the Intermountain West and an Overview of PMC Activities

Presenter St. John, L. **Location** Boise, ID

Date presented: 5/20/2003

Title: Introduction to Aberdeen Plant Materials Center

Presenter Cornforth, Simonson, St. **Location** Aberdeen Plant Materials Center

Date presented: 5/21/2003

Title: Sharing Solutions for Successful Planting in the Northern Great Plains

Presenter Hoag **Location** Sheridan, WY

Date presented: 6/2/2003

Title: SVAP and how to conduct a stream assessment

Presenter Hoag and Krajewski **Location** Lewiston, ID

Date presented: 6/10/2003

Title: Report to Idaho, Nevada, Utah Interagency Plant Materials Committee

Presenter St. John, L. **Location** Reno, Nevada

Date presented: 6/10/2003

Title: Tri-state Interagency PM Committee Meeting

Presenter Hoag **Location** DRI, Reno, NV

Date presented: 6/19/2003

Title: Riparian inventory and assessment protocols

Presenter Hoag and Krajewski **Location** Twin Falls, ID

Date presented: 7/8/2003

Title: Fundamentals of Seed Production

Presenter Cornforth **Location** Aberdeen Plant Materials Center

Date presented: 7/8/2003
Title: Seed Quality, Seeding Rates, Seed Mixtures, Drill Calibration
Presenter St. John **Location** Aberdeen Plant Materials Center

Date presented: 7/8/2003
Title: PMC Functions and Responsibilities
Current PMC Projects
Presenter St. John **Location** Aberdeen Plant Materials Center

Date presented: 7/9/2003
Title: Demonstration- Rice hull mixing, drill calibration, seedbed preparation, weed barrier
Presenter St. John, Cornforth, **Location** Aberdeen Plant Materials Center

Date presented: 7/9/2003
Title: Wetland Plants and Uses
Presenter Hoag **Location** Aberdeen PMC, ID

Date presented: 7/10/2003
Title: Fairview Constructed Wetland System
Presenter Hoag **Location** Aberdeen PMC, ID

Date presented: 7/10/2003
Title: Coffee Point Off-Center Test Site
Presenter St. John **Location** Off-Center test site

Date presented: 7/10/2003
Title: Riparian Considerations
Presenter Hoag **Location** Aberdeen PMC, ID

Date presented: 7/14/2003
Title: Plant Materials Center Grass Display Nursery
Presenter St. John **Location** Aberdeen Plant Materials Center

Date presented: 7/14/2003
Title: Constructed Wetland System at Fairview Wetland
Presenter Hoag and Inouye **Location** Aberdeen, ID

Date presented: 7/21/2003
Title: CWS principle and how to plant hydrologic ally
Presenter Hoag **Location** Ontario, OR

Date presented: 7/21/2003
Title: Constructed Wetland Systems and how to design a system
Presenter Hoag **Location** Ontario, ID

Date presented: 7/22/2003
Title: Constructed Wetland System in SW Idaho
Presenter Hoag **Location** Caldwell, ID

Date presented: 7/25/2003
Title: PMC Tour for Idaho BLM and Idaho Fish and Game Directors
Presenter St. John, Hoag, Cornforth, **Location** Aberdeen Plant Materials Center

Date presented: 7/29/2003
Title: Vegetative Considerations for Streambank Soil Bioengineering
Presenter Hoag **Location** Spokane, WA

Date presented: 8/5/2003
Title: Seed Collection, Processing, and Storage of Wetland Plants
Presenter Hoag **Location** Grand Coulee, WA Colville Indian Reservation

Date presented: 9/5/2003
Title: Riparian Dynamics and Vegetation Planting considerations when using soil bioengineering treatments
Presenter Hoag and Fripp **Location** Coeur d Alene, ID

Date presented: 9/10/2003
Title: Riparian Ecology and Restoration workshop, Grand Forks, ND
Presenter Hoag and Fripp **Location** Grand Forks, ND

Date presented: 9/11/2003
Title: Riparian Ecology and Restoration Field Exercise, Grand Forks, ND
Presenter Hoag and Fripp **Location** Grand Forks, ND

Note: *Trade names are used solely to provide specific information and should not be considered a recommendation or endorsement by the Natural Resources Conservation Service.*

Foundation Seed Production at Aberdeen Plant Materials Center

A major responsibility of the Aberdeen Plant Materials Center is the production of Foundation quality seed of the plant releases from the Center. Foundation seed is made available to the University of Idaho Agricultural Experiment Station, Idaho Crop Improvement Association, Utah Crop Improvement Association, other plant materials centers and cooperating agencies. Seed is distributed as provided for by allocation and exchange or other written agreements. Foundation seed of recent releases may also be provided to soil conservation districts for registered or certified seed production under District Seed Increase (DSI) programs.

The following table illustrates seed shipments from the Aberdeen Plant Materials Center for Fiscal year 1995 through 2003:

Cultivar	1995	1996	1997	1998	1999	2000	2001	2002	2003	TOTAL POUNDS
					POUNDS PLS					
Appar Lewis flax	65	455	150	950	115	320	300	470	65	2890
Bannock Thickspike wheatgrass	581	215	175	425	610	275	250	550	25	3106
Delar small burnet	350	0	0	550	0	451	150	75	0	1576
Ephraim crested wheatgrass	790	713	1000	100	50	260	455	696	0	4064
Fourwing Saltbush	-	-	-	-	-	-	-	25	5	30
Goldar Bluebunch wheatgrass	638	175	200	200	370	175	100	375	250	2483
Hycrest crested wheatgrass	100	1000	1550	0[1/]	0	0	0	0	0	2650
Magnar basin wildrye	202	0	250	180	901	517	1035	490	150	3725
Nezpar Indian ricegrass	0	0	325	350	100	900	150	75	340	2240
P-27 Siberian wheatgrass	110	250	1000	200	25	150	200	500	0	2435
Penstemon "Clearwater Selection"	1	0	0	1	0	1	10	1	10	24
Penstemon "Richfield Selection"	5	0	0	6	5	5	1	7	6	35
Paiute orchardgrass	550	400	250	0	250	101	450	200	0	2201
Regar meadowbrome	144	10	0	305	800	670	1061	207	50	3247
Rush intermediate wheatgrass	195	75	400	1820	1000	215	525	0	0	4230
Sodar streambank wheatgrass	311	0	100	250	100	860	500	500	200	2821
Tegmar dwarf intermed. wheatgrass	250	0	0	200	0	100	0	0	0	550
Northern Cold Desert Winterfat	-	-	-	-	-	-	-	8	3	11
TOTAL POUNDS	4292	3293	5400	5537	4326	5000	5187	4179	1104	38,318

1/ Foundation seed production of Hycrest crested wheatgrass was transferred to Meeker, Colorado Environmental Plant Center.

5/2/03

Aberdeen Plant Materials Center

2003 FIELD ANNUAL PLAN OF OPERATION

FISH AND GAME FARM

Field	Acres	Crop	Operation
21W	2.2	Alfalfa (2001)	Manage for hay production and wildlife benefits.
21E	2.2	Potatoes (2003)	University to plant potatoes. University will plant wildlife food plot for mitigation on University Farm.
21N	1.0	Bozoisky Cover crop	Maintain as needed for permanent cover.
22W	2.7	Bannock (2003)	Establish and manage for Foundation seed production.
22E	2.7	Goldar (2002)	Manage for Foundation seed production.
22E	-	Willow IEP (1984)	Maintain as needed.
23W	2.7	Goldar (1999)	Manage for Foundation seed production.
23M	-	Windbreak	Maintain and irrigate as needed.
23E	2.7	Wildlife Food Plot (2003)	Establish and maintain corn for wildlife use.
24W	2.7	Paiute (2001)	Manage for Foundation seed production.
24E	1.6	Durar Cover Crop	Maintain as needed.
25	5.4	Alfalfa (2003)	Establish and manage for hay production and wildlife benefits.
26W	1.7	Durar/Covar Cover Crop (1996)	Maintain as needed.
26E	1.7	Willow Increase Block (1994)	Irrigate according to irrigation plan and control weeds. Maintain Durar/Covar mix between rows for permanent cover.
27	5.4	Wildlife Food Plot (2003)	Establish and maintain wheat for wildlife use.
28W	5.4	Wildlife food plot (2003)	Establish and maintain corn for wildlife use.
29W	2.7	Willows (1994)	Irrigate and control weeds according to Wetland Project plan.
29E	2.7	Goldar (2000)	Manage for Foundation seed production.

Aberdeen Plant Materials Center

2003 FIELD ANNUAL PLAN OF OPERATION (continued)

FISH AND GAME FARM

Field	Acres	Crop	Operation
30W	-	Windbreak/Guard Row	Maintain and irrigate as needed.
30	5.4	Alfalfa (1995)	Manage for hay production and wildlife benefits.
31	5.4	Alfalfa (1995)	Manage for hay production and wildlife benefits.
32	6.2	Windbreak IEP (1982)	Maintain as needed.

Any hay grown will not be cut prior to June 15 and not after September 1. Hay will be irrigated after last cut to first fall frost to achieve regrowth prior to winter dormancy.

Irrigated, permanent grass cover seedings will not be mowed prior to July 1 and not after August 1 and will be irrigated a minimum of 3 times. Non-irrigated grass cover seedings will not be mowed. Early mowing or mowing of non-irrigated grass cover requires notification to and inspection by Fish and Game.

BREWINGTON FARM (U of I)

Field	Acres	Crop	Operation
409	4.25	Nezpar (2000)	Manage for Foundation seed production.

Aberdeen Plant Materials Center

2003 FIELD ANNUAL PLAN OF OPERATION

HOME FARM

Field	Acres	Crop	Operation
1	1.5	Bannock (2000)	Manage for Foundation Seed production.
2	2.3	Bannock (1999)	Manage for Foundation seed production.
3	1.8	Maple Grove Flax (2002)	Manage for Certified seed production.
4	1.4	Constructed Wetland Ponds (1992)	Manage per constructed Wetland project plan.
5	2.4	Magnar (2000)	Manage for Foundation seed production.
6	2.4	Potatoes (2003)	U of I will plant potatoes.
7	3.2	Regar (2003)	Establish and manage for Foundation seed production.
8	3.2	Ephraim (2003)	Establish and manage for Foundation seed production.
9	3.2	Fallow (2003)	Fallow as needed to control weeds.
10	3.2	Magnar (1995)	Manage for Foundation seed production.
11	1.1	Anatone Bluebunch (2002)	Manage for Foundation seed production.
11	0.2	9067402 Mutton grass (2002)	Manage for increase and potential release.
12	1.4	Fallow (2003)	Fallow as needed to control weeds.
13N	0.1	Penstemon (2003)	Establish and manage for Certified seed production.
13S	1.3	Fallow (2003)	Fallow as needed to control weeds.
14	1.2	Woody Display Nursery (1995)	Maintain display of woody conservation plants. Manage Durar/Covar cover crop.
	-	Penstemon (1996)	Manage for Certified seed production.
15	1.4	Field windbreak (2000)	Maintain Simon poplar field windbreak.
		USFS Flax test (2000)	Maintain and evaluate according to project Plan.
16	1.0	Fallow	Fallow as needed for weed control.
17	0.5	Hybrid Poplars (1998)	Manage and evaluate according to project plan.
18-19	0.9	Fourwing and winterfat (1999)	Manage for Certified seed production.

Aberdeen Plant Materials Center

2003 FIELD ANNUAL PLAN OF OPERATION (continued)

HOME FARM

Field	Acres	Crop	Operation
20	1.5	Grass Display Nursery (2002)	Manage for display.
Headquarters			Maintain buildings and grounds.

2003 Progress Report
1998 Hybrid Poplar Initial Evaluation Planting
Field 17, Aberdeen PMC
Loren St. John, Team Leader

The purpose of the Hybrid Poplar Initial Evaluation Planting is to evaluate accessions of hybrid poplar currently being grown in Oregon and Washington for adaptability to northern Utah and the Upper Snake River Plain of southeast Idaho. Hybrid poplar used for fiber, fuel and other lumber products is becoming a large agroforestry business in Oregon, Washington, and western Idaho. Presently there is no commercial production of hybrid poplar in southeast Idaho or northern Utah.

Five accessions of hybrid poplar considered as very productive and the most cold tolerant were obtained from Mount Jefferson Farms, Salem, Oregon. These accessions were planted in a complete randomized block design with 'Imperial', 'Siouxland', 'Robust', and 'Canam' as standards of comparison. The cuttings planted were dormant, 9 inches long and approximately 3/4 inch in diameter. The standards of comparison were collected at the PMC after spring growth had initiated.

Weed barrier material was installed in the clean-tilled field prior to planting. The cuttings were then hand planted through the weed barrier on May 28, 1998 so that only one bud was above the soil surface. Planting a cutting with only one bud above the soil surface increases the chance that the cutting will develop a single trunk which is desirable for wood production. Weed control needs were minimal because of the installation of weed barrier material. On June 1, 1999 forty-three plots were re-planted. The replacements were for those plots that did not establish during the first growing season. The evaluation planting is irrigated with a solid-set handline sprinkler system.

Between-row weed control was accomplished with mechanical cultivation between 1998 and 2000. The between-row area was seeded to a mixture of 'Durar' hard fescue and 'Bighorn' sheep fescue (3.5 pounds PLS per acre of each species) in June, 2001. The grass seeding is well established and controlling weeds.

In March, 2003 before buds began to break, the trees were pruned to remove all basal branches to encourage a single dominant trunk that is preferred for saw logs. No more than 50 percent of the branches on a single tree were removed. During the growing season sprouts and side branches below the prune line were removed periodically.

The plots were evaluated on September 19, 2003 and the data is summarized in Table 1. Accession no. 9076418 (OP-367) and 9076421 (52-225) continued to have the best survival. Accession no. 9076418 (OP-367) was the tallest (mean plant height 1069 cm – 421 inches) and also had the largest D.B.H. (mean 18.4 cm – 7.2 inches). This accession appears to be the best adapted to the soil and climate in the Snake River Plains of southeastern Idaho. Accession no. 9076418 (OP-367) and Siouxland had the best vigor ratings from the original planting. No pests were observed on the plants this year.

Of the plots re-planted in 1999, Robust continued to have the best survival and the tallest average height. Robust also had the largest mean D.B.H. (14.2 cm – 5.6 inches).

The planting will be evaluated next year and then will be harvested in 6 to 7 years to evaluate wood production.

Table 1.
2003 Evaluation Data
1998 Hybrid Poplar Initial Evaluation Planting

Accession Number	Number Survived	Percent Survival	Plant Height (cm) Minimum	Mean	Maximum	D.B.H. [1/] Mean (cm)	Vigor [2/]
9076418 (OP-367)	8	88.9	851	1069	1370	18.4	2.4
9076419 (184-411)	1	11.1	--	--	457	3.0	3.0
9076420 (50-197)	1	11.1	--	--	753	13.0	6.0
9076421 (52-225)	7	77.7	69	685	912	8.4	6.9
9076422 (15-29)	4	44.4	535	676	821	6.8	4.0
Canam	1	11.1	--	--	378	2.0	4.0
Robust	3	33.3	505	634	760	13.0	3.7
Siouxland	5	55.5	695	924	1095	13.4	2.6
Imperial	5	55.5	750	867	1065	14.2	3.2

Re-planted Hybrid Poplar 1999

Accession Number	Number Re-planted	Percent Survival	Plant Height (cm) Minimum	Avg.	Maximum	D.B.H. [1/] Mean (cm)	Vigor [2/]
9076418 (OP-367)	1	0	--	--	--	--	9.0
9076419 (184-411)	8	12	--	--	535	4.0	3.0
9076420 (50-197)	8	12	--	--	943	13.0	3.0
9076421 (52-225)	1	0	--	--	--	--	9.0
9076422 (15-29)	4	0	--	--	--	--	9.0
Canam	7	57	304	579	851	6.5	7.0
Robust	6	83	821	973	1126	14.2	3.7
Siouxland	4	75	635	424	1126	11.7	4.5
Imperial	4	25	--	--	699	12.0	3.0

[1/] D.B.H. is diameter at breast height (1.4 m from ground surface)
[2/] Rated 1 – 9, with 1 best, 9 worst

Perennial Grasses as Sugar Platform Stocks for Industrial Processing
2003 Study Summary
Cooperative Study with USDA-NRCS Forage Seed and Cereal Research Unit
Loren St. John, PMC Team Leader

During the 2003 growing season the PMC collected forage samples which were sent to the USDA-ARS Forage Seed and Cereal Research Unit in Corvallis, Oregon. The ARS is in the process of analyzing the samples for use as biofuel feed stocks.

The following table lists the accessions that were sampled from the Grass Display Nursery in Field 20 at the PMC Home Farm:

Sand Hollow squirreltail	*Elymus multisetus*
High Plains sandberg bluegrass	*Poa secunda*
Sodar streambank wheatgrass	*Elymus lanceolatus ssp. lanceolatus*
Bannock thickspike wheatgrass	*Elymus lanceolatus ssp. lanceolatus*
Whitmar beardless wheatgrass	*Pseudoroegneria spicata*
Goldar bluebunch wheatgrass	*Pseudoroegneria spicata*
Secar Snake River wheatgrass	*Elymus wawawaiensis*
Rosana western wheatgrass	*Pascopyrum smithii*
Sherman big bluegrass	*Poa secunda*
Pryor slender wheatgrass	*Elymus trachycaulus*
Magnar basin wildrye	*Leymus cinereus*
Shoshone beardless wildrye	*Leymus triticoides*
Bromar mountain brome	*Bromus marginatus*

Samples were collected on May 6 (vegetative stage), June 3 (boot stage), June 20 (flowering stage) and July 15 (seed fill stage). Four random samples were collected from each accession on each date, air-dried and shipped to the ARS Research Unit for biochemical analysis. The objective of the analysis is to identify the change in lignin, hemicellulose, cellulose, and sugars as a plant grows. The ARS is also conducting detailed greenhouse and growth chamber studies to verify the field sampling.

The PMC also provided to the ARS Research Unit standard seed packets of Magnar basin wildrye, Sodar streambank wheatgrass, Bannock thickspike wheatgrass, Goldar bluebunch wheatgrass, and Nezpar Indian ricegrass for the greenhouse studies.

Samples of field run seed (in dirt) of Magnar, Bannock, Godar and Nezpar were also provided to the ARS Research Unit for evaluation of seed processing procedures.

It is anticipated that the PMC will continue to cooperate with ARS to evaluate perennial grasses as sugar platform stocks for industrial processing.

Great Basin Native Plant Selection and Increase Project
FY 2002 Annual Report

Project Title: Establishment and Maintenance of Certified Foundation (G1) Seed

Project Location: NRCS Aberdeen, ID Plant Materials Center

Principal Investigators: Loren St. John, Center Manager
Dan Ogle, NRCS Plant Materials Specialist, Boise, ID

Contact Information: Aberdeen Plant Materials Center, P.O. Box 296, Aberdeen, ID 83210. Email - LorenStjohn@id.usda.gov
Plant Materials Specialist, USDA-NRCS, 9173 West Barnes Drive, Suite C, Boise, ID 83709. Email - Dan.Ogle@id.usda.gov

Description of Project: To produce Certified Foundation (G1) seed of Maple Grove Lewis flax, Anatone bluebunch wheatgrass, Snake River Plains Germplasm fourwing saltbush and Northern Cold Desert Germplasm winterfat to facilitate commercial production. Evaluate procedures for production of rooted cuttings of fourwing saltbush. Establish demonstration planting near Boise, ID.

Status Report:

Seed Production

Maple Grove Flax - Seeded 1.8 acres field 3 on May 31, 2002. July 29 evaluation: Plant height 5 - 15 cm tall, good vigor. Plan to harvest summer, 2003.

Anatone bluebunch wheatgrass - Seeded 1.0 acres field 11 on May 31, 2002. July 29 evaluation: good, healthy full stand developing. Plant height 8 - 12 cm. Seedling vigor appears to be better than Goldar. Plan to harvest summer, 2003.

Snake River Plains Germplasm fourwing saltbush - Produced approximately 70 pounds (seed analysis pending). Shipped 25 pounds Certified seed from 2001 harvest. Provided 500 Certified cuttings to Washington grower (he reported 17 percent rooting success).

Northern Cold Desert Germplasm winterfat - Produced approximately 28 pounds (seed analysis pending). Shipped 8 pounds Certified seed from 2001 harvest.

Propagation Studies

Propagation of rooted fourwing saltbush from cuttings

Four cutting dates and percent rooting in ( ):

March 21, 2002	(0 %)
August 19, 2002	(50 %)
September 6, 2002	(4 %)
October 7, 2002	(14 %)

Timing of cutting harvest and morphology of cutting seem to be most important factor.

Greenhouse seedling establishment study: to evaluate fourwing saltbush seedling emergence based upon number of propagules planted per cell (5 versus 10 per cell) and to identify number of days to emergence, growth rates and transplant dates.

Seed planted September 30, 2002. Maximum emergence within 3 weeks. 5 seed plots averaged 10. 5 % emergence. 10 seed plots averaged 8.5 % emergence.

Seedlings transplanted to 40 inch ^{3} containers on November 11, 2002. Currently average 3 to 18 cm in height. Will continue to maintain plants to evaluate growth rates and maturity.

Special note: 75 percent of seedlings had red stems and 25 percent had white stems at transplant. Could this be an indication of sex? Will monitor.

Establishment of Demonstration Planting near Boise

Field visit with Mike Pellant and Nancy Shaw on October 24, 2002 to locate site. Planting site determined to be old demonstration nursery at Orchard test site (just inside north boundary).

BLM burned site in fall of 2002. PMC to apply Roundup spring, 2003 and proposed planting planned for fall, 2003. Need to identify accessions and prepare planting plan.

PLANT MATERIALS

2003

IDAHO EVALUATION SUMMARIES

FIELD, DSI and DEMONSTRATION PLANTINGS

IDAHO DIVISION I
PLANT MATERIALS PLANTINGS

FIELD OFFICE: BONNERS FERRY

ID99005 Paul Headings Regar meadow brome - Field Plantings (2). Materials ordered February 22, 1999. Field 1–pure stand of Regar. Field 2-mixed stand of Regar and alfalfa. Purpose – demonstration planting to document growth patterns, production, and forage quality. Site characteristics – MLRA E43b, silt loam soils, 5-10 percent slopes, north aspect, 2300 feet elevation, 24 inch precipitation zone, non-irrigated, T62N R1E NW ¼ Section 2. FY99 planted spring 1999. FY00 due to dry years 1999 and 2000 stand establishment was slow, but excellent stands in each field are establishing. Plantings average 3 tons per acre. FY01 Planting 1 - The "pure" stand of Regar Brome planting averaged 2 ton/acre. A forage analysis indicted the crude protein to be 8.75%. The forage grass for hay is fine leaves and stems. The hay feeds well to animals. In hot dry weather, the "windrows" have to be carefully harvested and cured to avoid damaging brittle leaves and stems. The crop can be "pulverized" easily. The average bale weight was 103 pounds. The owner applied 110 lbs. 40-0-0 to enhance production and will increase application rates up to 200 lbs/acre 40-0-0. There were no second cuttings since the field was planted three years ago due to poor to fair moisture conditions. Planting 2 - The Regar/Agate alfalfa mixture established well. The first cutting has grass present and makes great cattle feed. The second cutting has very little grass within the alfalfa due to slow recovery. This may be due to dry weather conditions. Also, this may be a good attribute for the producer who can sell hay with grass and no grass. FY01 Planting 1 - The "pure" stand of Regar has an excellent stand with 5 plants per square foot, good vigor, and 4000 pounds per acre production. Landowner applied 220 lbs. 40-0-0 in early spring. Planting 2 - Regar/alfalfa mixture has a good stand with 2 Regar/5 alfalfa plants per square foot, fair to good vigor, and 7000 pounds per acre production. FY02 and FY03 no evaluations.

ID99015 Merle Olsen Field Planting – Regar meadow brome/alfalfa. Materials ordered April 9, 1999. Site characteristics – Rubson silt loam soil, 5 percent slopes, south aspect, 1840 feet elevation, 24 inch precipitation zone, non-irrigated, T61N R1E Section 7. FY99 no evaluation. FY00 excellent mixed stand established. FY01 the Regar and alfalfa mixture performed well with good hay quality. This year's crop had reduced yields due to drought conditions. FY02 and FY03 no evaluations.

ID00016 Boundary Creek WRP – cropland area planted to permanent perennial species field planting. A mix of Alkar tall wheatgrass, Greenar intermediate wheatgrass, Ranger alfalfa, birdsfoot trefoil, red clover, Sherman big bluegrass, tufted hairgrass, orchardgrass, and timothy at critical area planting rates was dormant planted on 1000 acres in late fall 1999. A 42 feet air-seeder with fertilizer attachment planted mix with 2000 units per acre of nitrogen, phosphorus, potassium, and sulfur applied 1 inch below and to side of seed. FY00 excellent stand is establishing with some species as tall as 3-4 feet by early July. In October wild oats were present throughout stand. FY01 The permanent wildlife planting mixture established well utilizing the 42-foot air seeder. The drill was calibrated with the producer based upon 14.2 lbs. PLS/acre. A "flush" of wild oats occurred the first year. The stand was seeded the 1st week of November 1999. The "so called dormant planting" resulted in some sprouting of clovers due to a warmer than normal late fall. As a result, some mortality occurred in the clovers. An excellent stand of Alkar tall wheatgrass, Greenar intermediate wheatgrass, birdsfoot trefoil, Ranger alfalfa, Latar orchardgrass, timothy and clover exists. The Sherman big bluegrass is "spotty" due to becoming overpowered by the other species in the mix. There are some ridges in the field with quackgrass, which is good cover. The IDF&G is actively spot spraying the Canadian thistle. They plan to obtain a boom sprayer in order to treat the acreage more uniformly. FY02 The overall stand is good to excellent with the primary species including Alkar tall wheatgrass, Greenar intermediate wheatgrass, Latar orchardgrass and redtop. Some birdsfoot trefoil, clover, timothy, and alfalfa are present in scattered locations. Tufted hairgrass and Sherman big bluegrass were not found. FY03 no evaluation.

ID04002 Dave Wattenburger Field Planting. Delar small burnet ordered August 19, 2003. Planting planned for dormant planting in late October.

FIELD OFFICE: COUER D'ALENE

None

FIELD OFFICE: PLUMMER

None

FIELD OFFICE: SANDPOINT

ID96029 Lee Johnson wood fiber mulch, Niner sideoats grama, Alma blue grama, annual rye, Durar hard fescue, Durar hard fescue/clover, prairie junegrass, and alpine bluegrass field plantings - tree nursery ground cover trial. Site loam soil (low to mod. permeability/high erosion potential), 5-10% slopes on SE exposure. FY96 planted 5/31/96. 1. Wood mulch is doing excellent job of weed control and no rodent activity to date - mulch was about 10 inches deep when applied 2. Excellent stand of annual rye established, Durar hard fescue plants are very small and establishing beneath cover crop 3. Many young Durar hard fescue plants were establishing, but very few clover plants - soil may have been too loose when seeded and clover seed may be too deep 4. Excellent initial stand of sideoats and blue grama establishing - could not tell which species was doing the best 5. Very few prairie junegrass plants establishing - appears some germination is occurring this fall 6. A lot of alpine bluegrass seedlings - appears germination did not occur until fall. FY97 and FY98 no evaluations. FY99 Treatment 1: Control no cover and normal weed control - 0 percent desirable cover with 50-80 weeds. Treatment 2: Cedar bark mulch 6-8 inches thick – 100 percent desirable cover in rows with 5 percent weeds invading mulch and some evidence of rodents in mulch. Trees near cedar mulch are more chlorotic than other treatments. Treatment 3: Durar hard fescue and annual ryegrass – 50-70 percent desirable cover with up to 20 percent weeds. Fescue blends provide more biomass than other seedings and good cover – almost 100 percent cover if mowed. Treatment 4: Durar hard fescue and Berseem annual clover – 60-80 percent desirable cover and up to 15 percent weeds. Treatment 5: blue grama and sideoats grama – 20-50 percent desirable cover with 30-80 percent weeds. Clearly the worst treatment in trial. Treatment 6: Prairie junegrass – 60-80 percent desirable cover and 10-15 percent weeds. A good alternative since this is a low growing cover. Treatment 7: Alpine bluegrass – 50-80 percent cover with 5-10 percent weeds. Less biomass produced than fescue or prairie junegrass. The alpine bluegrass produced more of a thick sod with seedheads 6-8 inches tall. This would be a better choice for nurseries that are concerned with the shading effect of taller grasses on lower branches. It also covers the ground better once established, especially in shady areas. One potential problem is its ability to spread, including into the tree rows. FY00, FY01, FY02 and FY03 no evaluations.

ID00004 Paul Jayo Regar meadow brome field planting – irrigated/non-irrigated and hay/grazing trial. Seed ordered January 21, 2000 for delivery in early April. Site is 30-acre field with Hoodoo silt loam soil, 0-1 percent slopes, 32-inch rainfall zone, and 2485 feet elevation. FY00 planting was delayed due to dry spring weather. Cooperator plans to plant fall 2000. FY01, FY02 and FY03 no evaluations.

IDAHO DIVISION II
PLANT MATERIALS PLANTINGS

FIELD OFFICE: GRANGEVILLE

ID02002 Teresa Seloske Forest Field Planting. Lind Douglas fir (30 plants) and Yakima Douglas fir (13 plants) ordered July 16, 2001. Plants delivered to FO April 3, 2002 by WAPMC. FY02 Planting completed April 6, 2002. Lind Douglas fir 10 percent survival with poor vigor. Yakima Douglas fir 15 percent survival with fair vigor. Survival effected by extremely dry conditions. FY03 very hot dry summer resulted in failure of this planting. **Cancel**

FIELD OFFICE: LEWISTON

ID82001 Galin Buchanon Starthistle control field planting. Covar sheep fescue planted in early 1980's. FY01 good to excellent stand with 2 plants per foot squared average, excellent vigor, fair spread for bunch grass. Plants are 10 inches tall with seedheads averaging 14 inches tall and 6-inch diameter plants. Overall Covar is providing good starthistle control. Starthistle is present in plot, but not reproducing seed. Where Covar has 4 plants per foot squared, starthistle is not present. Covar is moving slowly downslope into starthistle dominated area. **Next field evaluation will be FY04.**

ID86007 Hellsgate field planting - adaptation. FY92 Rush 50%, Oahe 70%, Luna 60%, Ephraim 20%, Magnar 30%, Secar 10%, Alkar 70% and P27 50% survival. FY93 in very heavy cheatgrass infested area Nordan 10% Rush 40%, Oahe 20%, Luna 24%, Rosana 30%, Magnar 15%, Secar 20% and P27 10% survival. Rush and Luna appear to be the best species. FY94 Rush int. wheatgrass is the most vigorous followed closely by Luna pubescent wheatgrass. Magnar plants are the largest. Rodents have utilized all Secar plants and a few plants of Ephraim, Nordan, P-27, Sherman, and Rosana. The accessions that have failed include Goldar, Paiute, Delar, Appar, Bandera, Nezpar and Tualatin. Cheatgrass continues to dominate site. FY95 50% survival of Rush and Rosana; 30% survival Oahe, Luna, Magnar; 20% survival Secar; 10% survival Ephraim, P27 and Sherman. Failed species include Tualatin, Nezpar, Bandera, Appar, Durar, Delar, Paiute, and T2950-Goldar. Intermediate types are doing the best. Rush and Rosana have spread the most. Alkar has extensive die-out. Cheatgrass continues to dominate site. FY96, and FY97 no evaluations. FY98 survival/comments: Oahe 50% erratic 10-12 feet spread in some areas to dead in others; Magnar 70% some seedlings and plants are very vigorous with few weeds between plants; Rush 75% spreading vegetatively 12-14 feet wide and uniform; Rosana 60% spreading vegetatively 20-30 feet wide and spotty with many weeds; Luna 70% spreading vegetatively up to 12 feet wide and a few bare areas; and Secar 10% widely scattered plants with good vigor. 1 to 3 plants of Nordan, Ephraim, and P-27 found. All other plots are dead. FY99 and FY00 pubescent and intermediate wheatgrasses performing the best with Rush intermediate a particular standout. Rosana western wheatgrass is the most aggressive spreader. FY01 and FY02 no evaluation. **Next field evaluation will be FY04.**

ID95028 Dau Bannock thickspike wheatgrass and Rush intermediate wheatgrass field planting. Seed ordered 4/3/95. FY95, FY96, FY97, FY98 and FY99 no evaluations. FY00 40 plants per foot squared of Rush intermediate wheatgrass. Bannock thickspike wheatgrass failed. FY01 40 seedheads per foot squared, 4.5 feet tall, 3000 pounds per acre, estimate 500 pounds per acre seed production and stand is weed free. **Next field evaluation will be FY04.**

ID96009 Dau Rush intermediate wheatgrass, Luna pubescent wheatgrass, and Bozoisky Russian wildrye field planting (3 individual plantings) for star thistle control. Seed ordered 12/8/95. FY96, FY97, FY98 and FY99 no evaluations. FY00 excellent stand with 40 reproductive stems per square foot. Excellent vigor, ability to spread, erosion control, and forage production producing 3000 pounds per acre. Producer is very pleased with performance and plans to establish additional plantings. FY01 and FY02 no evaluation. **Next field evaluation will be FY04.**

ID98007A Mike Miller willow planting. Aberdeen willows (Laurel, White, Streamco, Coyote, Geyer) and Meeker willows (Coyote, Yellow 3 accessions, Scouler, Whiplash 2 accessions, Booth 3 accessions, Drummond 3 accessions, Geyer 2 accessions) and Pullman shrubs (Dogwood 3 accessions). Materials ordered 2/9/98. FY98 survival Meeker willows 832 10/10, 823 10/10, 820 9/10, 826 9/10, 826 9/10, 847 7/10, 834 7/10, 827 10/10, 835 6/10, 825 10/10, 828 7/10, 822 0/10, 829 5/10, 819 ?/10. Survival of Pullman dogwoods 740 3/5, 733 5/5, 739 5/5. FY99 no evaluation. FY00 80 percent survival of 820 Pacific willow (local standard). 20 percent survival of 827 Booth willow, 828 Drummond willow, 822 Geyer willow, 829 Drummond willow and 834 Yellow willow. 10 percent survival of 832 Geyer willow. 823 Coyote willow, 826 Booth willow, 847 Drummond willow, 825 Yellow willow, 819 Yellow willow, 739 dogwood, 733 dogwood, 740 dogwood, and 835 Yellow willow failed. Competition, insects and browse damage

are factors affecting survival. FY01 survival 822 Geyer 10%, 828 Drummond failed, 825 Yellow 10%, 829 Drummond 10%, 820 Pacific 80% (all died back to base – sprouting about 3 feet high this years growth), 823 Sandbar failed, 832 Geyer 20%, 826 Booth 10%, 847 Drummond failed, and 827 Booth 50%. **Next field evaluation will be FY04.**

ID98007B Ed and Maxine Larson willow and dogwood planting. FY99 and FY00 no evaluations. FY01 Superior accessions are Laurel willow, which is now 15-18 feet tall with good density and being utilized for cuttings to plant on other areas of the property; Sandbar willow 9024823, which is 4-5 feet tall, spreading and competing well with other vegetation. Accessions that failed include 9024825 Booth willow, 9024826 Booth willow, 9024827 Booth willow, Streambank willow, Aberdeen Geyer willow, Aberdeen Coyote willow, and 9023740 redosier dogwood. **Next field evaluation will be FY04.**

ID98007C Modie Park willow planting. FY99 100% survival – Booths826, Booths827, and Pacific820; 70% survival sandbar823 and Dummond829; 60% survival dogwood; 33% survival Booth825; 30% survival Geyer822 and Drummond828; 20% survival Geyer832; 14% survival Dummond847; 10% survival yellow835; 0% survival-failed yellow819 and yellow834. Site is heavily overgrown with blackberries, cattails, rush and quackgrass. West side of creek was mowed resulting in severe willow damage. Most promising willows were yellow 9024835, sandbar 9024823, Drummond 9024829 and Booth 9024826/9024827. Geyer 9024832 has glaucus stems and undersides of leaves and may be Drummond. **Next field evaluation will be FY04.**

ID98007E Victor Thulon willow planting. Aberdeen willows (Laurel, White, Streamco, Coyote, Geyer) and Meeker willows (Coyote, Yellow 3 accessions, Scouler, Whiplash 2 accessions, Booth 3 accessions, Drummond 3 accessions, Geyer 2 accessions) and Pullman shrubs (Dogwood 3 accessions). Materials ordered 2/9/98. FY99 no evaluation. FY00 site is heavily infested with reed canarygrass. Meeker willows: 40% survival 827 Booth willow; 30 percent survival 835 Yellow willow and 834 Yellow willow; 20% survival 825 Booth willow; and 10 percent survival 832 Geyer willow and 822 Geyer willow. Aberdeen willows: 80 percent survival Laurel willow and White willow; 40 percent survival Streamco willow; and 30 percent survival Coyote willow. All other materials failed. FY01 Aberdeen willow survival Laurel 70% (best overall), White 70%, Streamco 30%, Coyote 30%. Meeker willow survival 835 Yellow 30%, 832 Geyer 10%, 825 Booth 10%, 827 Booth 40%, 822 Geyer 10%, and 834 Yellow 30%. **Next field evaluation will be FY04.**

ID98016 Fred Kaufman Hycrest crested wheatgrass, and Vavilov Siberian wheatgrass field planting. FY98 and FY99 no evaluations. FY00 excellent stands of Hycrest and Vavilov established. FY02 excellent stand with excellent vigor for each cultivar. Hycrest crested wheatgrass suppressing cheatgrass better than Vavilov Siberian wheatgrass. **Next field evaluation will be FY04.**

FIELD OFFICE: MOSCOW
None

FIELD OFFICE: NEZPERCE
None

FIELD OFFICE: OROFINO
ID99010 Ray Geidl field planting. Species include Coyote willow, Geyer 435 willow, Geyer 448 willow, Geyer 483 willow, Geyer 491 willow, Snowberry, Elderberry, Dogwood 733, Dogwood 740, and Chokecherry. FY99 and FY00 and FY01 no evaluations. FY02 Plantings are located in area with heavy reed canarygrass competition. Good survival for all willow and dogwood accessions with 4 of 5 cuttings for each still surviving, fair vigor for each, 40 inch height for all willows and 20 inches height for all dogwoods. Snowberry, Elderberry and chokecherry failed. FY03 no evaluation.

IDAHO DIVISION III
PLANT MATERIALS PLANTINGS

FIELD OFFICE: CALDWELL

ID98021 Bill Baird Vavilov Siberian wheatgrass, Bozoisky Russian wildrye, tall wheatgrass field planting - saline bottom. Seed ordered May 14, 1998. Planting scheduled for Nov. 1998. FY99-FY03 cooperator has not planted site due to droughty conditions and he wants to give seeding best opportunity possible when he plants. **Cancel**

ID98022 Bill Baird Rush intermediate wheatgrass and orchardgrass field planting - irrigated pasture. Seed ordered May 14, 1998. Planting scheduled for mid May through mid June. FY98 irrigated pasture planted in mid May with poor stand establishing. Bill plans to replant in spring of 1999. FY99 good stand density establishing with 5 plants per foot squared and fair vigor. Plants reached 6-8 inch height this establishment year. Nitrogen, phosphorus, potassium, and sulfur were applied. This is a very course-gravelly soil requiring irrigation every 4-5 days. FY00 and FY01 no evaluations. FY02 very course-gravelly soils that require frequent 3-4 day irrigation. Stand has good density with about 6 plants per square foot, good vigor in spite of droughty infertile soils. Individual plants are increasing in size and are competitive with weedy species. Cooperator is please with performance.

ID99006 Jacy Gibbs-cooperator will complete evaluations for demo plots. Site characteristics: very warm dry summers, Cencove fine sandy loam soil, 0-2 percent slopes, about 2200 feet elevation, 8-10 inch precipitation, T3N R5W NE1/4 Section 10. Seed ordered February 24, 1999. Aberdeen accessions: Bannock thickspike wheatgrass, Sodar streambank wheatgrass, Goldar bluebunch wheatgrass, Appar blue flax, Magnar basin wildrye, Nezpar Indian ricegrass, Richfield Selection firecracker penstemon, Clearwater Selection alpine penstemon, Snake River Plain fourwing saltbush. Bridger accessions: Trailhead basin wildrye, Rimrock Indian ricegrass, M1 Nevada bluegrass, PI434231 plains bluegrass, 9005460 alpine bluegrass, 9078408 High Plains Sandberg bluegrass, Shoshone beardless wildrye, 9019219 bottlebrush squirreltail, Critana thickspike wheatgrass, Wytana fourwing saltbush. Meeker accessions: Summit Louisiana sagewort, Timp Utah sweetvetch, Bandera Rocky Mountain penstemon, 9040187-bottlebrush squirreltail, 9040189 bottlebrush squirreltail, 9043501 Salina wildrye, Maybell antelope bitterbrush. Pullman accessions Secar Snake River wheatgrass, Covar sheep fescue, Canbar Canby bluegrass, Sherman big bluegrass, Whitmar beardless wheatgrass, and Schwendimar thickspike wheatgrass. FY99 no evaluation. FY00 Nezpar has excellent seedling vigor, easy to transplant, remains green, and is an attractive landscape plant. Schwendimar is best thickspike wheatgrass, remains green longer, best regrowth, responds well after mowing, good dryland and limit irrigation. Goldar and Whitman stands are very poor due to cheatgrass competition. Basin wildrye, Sherman, Secar mix good weed competition. Basin wildrye, Sherman, Covar, Secar are all good landscape plants. Using Covar along one side of property for firebreak – it will be excellent. Penstemon species are very slow growing, remain green and will be good landscape plants. Appar can be a nuisance and is not very shade tolerant. Maybell is slow growing. Timp is a preferred species by rabbits resulting in difficulty establishing stand. Summary of best plants – Grasses: Secar Snake River wheatgrass, Magnar basin wildrye, Sherman big bluegrass, Nezpar Indian ricegrass, Covar sheep fescue, sand dropseed, Bannock thickspike wheatgrass, and Schwendimar thickspike wheatgrass. Forbs: western yarrow, Drummond phlox, white evening primrose, scarlet globemallow, silky lupine, Louisiana sagewort, Rocky Mountain iris, and Appar blue flax. Shrubs: native fourwing saltbush, native basin big sagebrush, Maybell bitterbrush, curlleaf mountain mahogany, Saskatoon serviceberry, Woods rose, almond, and Drummond willow. Trees: Idaho hybrid poplar, and Rocky Mountain juniper. FY01, FY02 and FY03 no evaluations. **Cancel**

ID02001 CB River Springs Ranch WRP field planting. Vavilov Siberian wheatgrass, Bannock thickspike wheatgrass, Magnar basin wildrye, Northern Cold Desert winterfat, and Snake River Plain fourwing saltbush. Seed ordered 3/26/01 for shipment in early March 2002. Site characteristics: Felthom fine sandy loam soil, 3-12 percent slopes, NE aspect, 2100 feet elevation, 11 inch rainfall, cheatgrass community to be sprayed 2-3 times (spring and fall 2001) prior to early spring (2002) interseeder planting. FY02 this year's precipitation is below average. Field was sprayed for cheatgrass control in May 2001 and March 2002. Field was planted on April 9, 2002 using a grass seeding drill and a rain of 0.3 inches occurred immediately following planting. No appreciable rain fell during the rest of the year. A field check on May 16 showed excellent seed germination. Field was sprayed for broadleaf control in June 2002. Field check on November 19, 2002 - was unable to determine success of planting. FY03 no evaluation.

FIELD OFFICE: EMMETT

ID02023 Little Farms Rush intermediate wheatgrass, Vavilov Siberian wheatgrass, Covar sheep fescue, and Sodar streambank wheatgrass critical area planting. Seed ordered December 14, 1998 for delivery about August 1, 1999. FY02 seed transferred to Little Farms. FY03 no evaluation.

FIELD OFFICE: MARSING/GRANDVIEW

ID04001 Matt and Jean Barney demonstration plots. Bannock thickspike wheatgrass, Sodar streambank wheatgrass, Magnar basin wildrye, Nezpar Indian ricegrass, Snake River Plains fourwing saltbush, Northern Cold Desert winterfat, Vavilov Siberian wheatgrass, Critana thickspike wheatgrass, Rimrock Indian ricegrass, 9019219 bottlebrush squirreltail, PI434231 plains bluegrass, 9005460 alkali bluegrass, High Plains Sandberg bluegrass, 9063520 Ruby Valley pointvetch, 9005617 strawberry clover, 9016134 Gardner saltbush, Trailhead basin wildrye, Bozoisky Russian wildrye, Secar Snake River wheatgrass, Schwendimar thickspike wheatgrass and Sherman big bluegrass ordered April 17, 2003. Seeding planned of October - November 2003. **Site Characteristics:** Owyhee County, MLRA B11, Soil Map Unit 100 fine sandy loam, weak salinity, 1-7% slope, south aspect, 3300 feet elevation, 8-10 inch precipitation zone, non-irrigated, NE 1/4 Section 29 T4S R1W. Plots were planted late fall of 2003.

FIELD OFFICE: MERIDIAN

ID02004 Brad Little Field Planting – BASF Plateau Herbicide Study – Seeding Trial.
Herbicide Treatment 1 – Burn + Herbicide (control – 2 ounce – 4 ounce rates). Herbicide Treatment 2 – Non-burn + Herbicide (control - 2 ounce – 4 ounce – 6 ounce – 8 ounce – 10 ounce – 12 ounce rates). Seeding Treatments – Alfalfa and Snake River Plains Germplasm fourwing saltbush will be mixed with each of the following rangeland forage grass species: Rush intermediate wheatgrass, Luna pubescent wheatgrass, Hycrest crested wheatgrass, CD-II crested wheatgrass, Vavilov Siberian wheatgrass, P27 Siberian wheatgrass, Bozoisky Select Russian wildrye, Mankota Russian wildrye, and Covar sheep fescue. Each treatment (herbicide rate – seed mix) will cover 0.12 acres in 48x110 feet plots. Seed ordered September 18, 2001 for shipment by October 12, 2001. Herbicide treatments and seeding planned for November 2001 during dormant growth period. Site characteristics – MLRA B10, silt loam to sandy loam soil, 2-6 percent slopes, east southeast aspect, 2900-3000 feet elevation, 11-12 inch precipitation zone, non-irrigated, T5N R1N SW1/4 of SW1/4 of Section 5. Site sprayed November 2, 2001. Planting conducted in December 2001. FY02 there was no plants established on August 16, 2002 due to lack of spring and summer moisture for germination. As of evaluation date only 5 inches of moisture for entire year. FY03 wet spring, but extremely hot summer (record setting). No grass establishment. Observations on herbicide treatments: 2 ounce rate very similar to control (no herbicide treatment) with very little cheatgrass or six-weeks fescue control; 4-12 ounce rates resulted in good cheatgrass control; 8-12 ounce rates controlled Sandberg bluegrass, but it appears that there was little control of six-weeks fescue. Trial will be evaluated for at least one more year.

FIELD OFFICE: MOUNTAIN HOME

ID00017 Ted Hoffman-Idaho Department of Lands Species and Planting Method Demonstration for cheatgrass-medusahead wildrye control – rangeland rehabilitation. Three planting methods including conventional tillage with grain drill with sweeps, Idaho Fish and Game interseeder, and Idaho Department of Lands or BLM rangeland seeder will be demonstrated. Ten species – species mixes including Luna pubescent wheatgrass, Rush intermediate wheatgrass, Hycrest crested wheatgrass, Nordan crested wheatgrass, Vavilov Siberian wheatgrass, Bozoisky Russian wildrye, Bozoisky/Vavilov mix, Cereal Rye, Secar Snake River wheatgrass/Bannock thickspike wheatgrass/fourwing saltbush mix, and Secar Snake River wheatgrass/Bannock thickspike wheatgrass/Immigrant forage kochia mix will be cross planted over planting methods. Site characteristics include MLRA B11, Chilcott-Elijah silt loam soil, 0-12 percent slopes, south exposure, 3480 feet elevation, 10-12 inch rainfall zone, non-irrigated, T2S R6E SE1/4 of SE1/4 of Section 16. FY01 planting completed November 2001. The conventional tillage section was not completed and was replaced with a no-till operation. Little to no emergence occurred in 2001 due to extreme drought conditions. The evaluation in 2002 will determine if planting was a success or failure. FY02 more grass observed this year, however, drought has removed any hope of obtaining an adequate seeding. **Cancel**

ID03004 Pat Bennett field planting. Topar pubescent wheatgrass, Regar meadow brome, and Garrison creeping foxtail seeding mixture. Seed ordered October 24, 2002. Seeding planned for November 2002. Site is in MLRA 10A on Houk silty clay loam soil with 0-1 percent slope, 16 inch precipitation zone, 5000 feet elevation, and non-irrigated. NW1/4 Section 33 T1S R11E. D6 caterpillar was used to scalp site, breach existing embankments, and construct earthen plugs prior to planting. Seed was broadcast planted in December 2002 onto dry seedbed. Good winter moisture (snow cover) by late December. FY03 no evaluation.

FIELD OFFICE: PAYETTE
None

FIELD OFFICE: WEISER
ID91029 Grafe Bannock and Critana thickspike wheatgrass field planting. Site is a sandy loam soil, non-irrigated, 12-14 inch ppt, 2500 feet elevation, and 4-8% slopes on west exposure. FY92 estimate 20% stand. FY93 survival is 90% for both species. The existing plants are healthy and holding their own with competition. Neither species is as vigorous as Oahe on same sites. FY94 survival is 95% for each species, good stands, and excellent vigor. This trial continues to improve, the stands are spreading and filling in open ground. Both species appear well adapted to site even considering the extended drought conditions. Total forage production is less than adjacent intermediate wheatgrass, but is more palatable. Plants are producing seed this year. The stands are starting to provide competition for annual weeds, grasses and cereal rye. I am now starting to see the value of these plants on some of our most droughty and limiting sites. FY95 Good stands for both Bannock and Critana (95% survival). Both species continue to improve over time. Cereal rye is not affecting growth. Neither thickspike wheatgrass is producing as well as Oahe intermediate wheatgrass. Both species would fit well with similar palatability grasses in mixture (suggest Goldar or Secar bluebunch wheatgrass). FY96 good stands of both with 6 plants/ft2 of each and excellent vigor. Growth of both species is still very good and weed competition is light. Total production continues to be less than adjacent intermediate wheatgrass. FY97 good stands (5 plants per foot), survival, and vigor for both Bannock and Critana. Growth and vigor for both does not reflect the excellent moisture year we had and stands are maintaining or declining slightly. FY98 no evaluation. FY99 good stands of both species with 90 percent survival and good vigor. Producing between 500 and 1000 pounds per acre in an extremely dry April through November year. Bannock is slightly taller at 18 inches than Critana at 16 inches. Heavy grasshopper damage this year. Cheatgrass invasion is slight. FY00 no evaluation. FY01 stands of both Bannock and Critana were rated poor, with 1 plant per square foot, fair vigor and 200 pounds of production per acre. Two years of drought has heavily impacted this planting and cheatgrass is invading. **Next evaluation scheduled for FY04**.

ID94025 Eckhardt Ephraim crested wheatgrass, Magnar basin wildrye, Mankota Russian wildrye, Trailhead basin wildrye, P27 Siberian wheatgrass, Manska pubescent wheatgrass, Reliant intermediate wheatgrass, Bannock thickspike wheatgrass, Schwendimar thickspike wheatgrass, Greenar intermediate wheatgrass, Sherman big bluegrass, Secar Snake River wheatgrass, Goldar bluebunch wheatgrass, Bozoisky Russian wildrye, Hycrest crested wheatgrass, Rush intermediate wheatgrass demo plots. Site is clay loam soil, non-irrigated, 10-12 inch ppt, 3000 feet elevation, and 5% slopes on NE exposure. Seed ordered July 1994. FY94 and FY95 due to drought conditions, seeding planned for spring 96. FY96 planted April 9, 1996 by hand planting and raking plots to control bulbous bluegrass competition. June 19, 1996 evaluation for establishment: Mankota poor, Manska good, Sherman very poor, Greenar good, Trailhead fair, Reliant good, Bozoisky good, Bannock good. July 8, 1996 establishment: Mankota fair, Manska good, Sherman poor, Greenar good, Trailhead fair, Reliant good, Bozoisky good, Bannock good, Goldar good, Rush excellent, Secar fair. Rush has the best stand establishment to date with Goldar next. FY97 no evaluation. FY98 first set of plots; Reliant is out producing all other plots, Greenar is second in production, Sherman hand planted plot is third in production, Sherman broadcast plot failed, T6633-P is fourth in production. Second set of plots; Bozoisky performed the best with Mankota second, and trailhead the poorest. The wildryes, thickspike wheatgrasses and intermediate wheatgrasses have shown adaptation to this area and could play a roll in revegetating local rangelands. FY99 plots were grazed this spring and grazing preference was evaluated. Plots: Greenar and Reliant were grazed the heaviest, followed by Mankota and Bozoisky Russian wildrye. This was uniform for all replications. Thickspike wheatgrasses and all other varieties had slight utilization. Basin wildryes were not utilized. Grazing preference for the larger plantings: Bozoisky Russian wildrye was used the heaviest, followed by Goldar bluebunch wheatgrass, and Rush intermediate wheatgrass used the least. Cattle are grazing Fourwing saltbush. The producer is very happy with results from these plots and uses the information to make his planting decisions. Cattle in mid May grazed FY00 the small plot species. Grazing preference was for Goldar, Bozoisky, and the intermediate wheatgrasses. The intermediate wheatgrasses are spreading into adjacent plots. Moderate use was made on Magnar and Trailhead. Sherman was used only slightly. Fourwing saltbush was utilized and continues to get taller (20 inches tall). In the large acre sized plots adjacent to a Hycrest planting, grazing preference (mid May) in order are: 1) Goldar, 2) Bozoisky, 3) Rush, and 4) Secar. Use of Goldar was similar too slightly heavier than the Hycrest. FY01 all plots are grazed this year. Utilization was heaviest on Greenar intermediate wheatgrass and Reliant intermediate wheatgrass plots. The larger plantings showed grazing preference was highest for Bozoisky Russian wildrye, then Goldar bluebunch wheatgrass, followed by Rush intermediate wheatgrass. FY03 plots were grazed this fall at time of evaluation.

ID94026 Weber Goldar bluebunch wheatgrass, Rush intermediate wheatgrass, Luna pubescent wheatgrass, Secar Snake River wheatgrass, Greenar intermediate wheatgrass, Schwendimar thickspike wheatgrass, Bozoisky Russian wildrye, Bannock thickspike wheatgrass, Delar small burnet, Firecracker and Alpine penstemon, Sherman big bluegrass, Wytana fourwing saltbush, and Rincon fourwing saltbush demo plots. Site is stony clay loam soil, non-irrigated, 16 inch ppt, 3200 feet elevation, 0-2% slopes. Seed ordered July 1994. FY94, FY95, and FY96 due to drought conditions, seeding not planted. FY97 seeded May 16, 1997 with good rains following planting. Weed competition is high. In general initial establishment was good for wheatgrasses, fair for wildryes and poor for forbs. FY98 rainfall was 150 percent of average this year resulting in a flush of weeds. All plots except forbs were sprayed for broadleaf weed control and were shredded to reduce overstory competition. The most successful plants include: GRASSES Rush is by far the superior plot from standpoint of vigor, total growth, and total production. Luna is rated second and Reliant is rated third. Other grasses are only marginally successful to non-existent due to possibly saturated soils and weed competition during the establishment year. FORBS Delar is doing very well and appears very hardy and adapted to wet soil conditions. Penstemons and Lupine did not establish. SHRUBS Rincon is taller (10-15 inches) than Wytana (4-6 inches). FY98 no evaluations. FY99 Weeds and saturated soils are a problem on this site. Most successful plants – grasses: Rush intermediate wheatgrass followed by Luna pubescent wheatgrass, and Reliant intermediate wheatgrass, with others only marginally successful; Forbs: Delar small burnet is performing very well and no other forbs established; Shrubs: Rincon fourwing saltbush is superior to Wytana fourwing saltbush on this site. FY00 no evaluation. FY01 following two years of extreme drought Greenar intermediate wheatgrass was the most productive and vigorous followed by Reliant intermediate wheatgrass and Luna pubescent wheatgrass. Rush intermediate wheatgrass, Mankota Russian wildrye, and Manska pubescent wheatgrass did not grow much this year. Magnar basin wildrye was superior to Trailhead basin wildrye in production and survivability. Thickspike wheatgrass and Russian wildrye accessions grew very slowly. Delar small burnet plants are not handling drought well and are dying. Rincon fourwing saltbush is better than Wytana fourwing saltbush with some plants to 18 inches in height. Weeds are infesting site. FY02 was a very dry growing season. Intermediate wheatgrasses - Greenar is producing more forage than any other species, Greenar is not spreading as fast as Rush or Reliant which is probably an advantage on this droughty site, Luna is the best pubescent wheatgrass, but not producing as much as Greenar. Basin wildryes - Magnar and Trailhead are nearly identical in production with Magnar slightly higher with more vigor than trailhead. Russian wildrye - Bozoisky is by far the best performer of the R. wildryes. Small burnet - Delar is no longer present. Fourwing Saltbush - Rincon is a little better than Wytana, but they lack vigor. Thickspike wheatgrass - all accessions are barely surviving. **Next evaluation scheduled for FY04**.

ID96024 Sutton Rush intermediate wheatgrass, Luna pubescent wheatgrass, and Oahe intermediate wheatgrass field planting. Site is loam soil, non-irrigated, 15-17-inch ppt, 3320 feet elevation, 1-4% slope on south exposure. Seed ordered March 14, 1996. FY96 planted in May into good seedbed with good weed control. Good stand establishing with about 3 plants per foot squared, each species was planted with alfalfa in alternate rows and alternating sections. FY97 good stands with excellent vigor of each cultivar. The Oahe/alfalfa stand was cut for hay and produced 1.5 tons/acre. Because of topography the Rush/alfalfa and Luna/alfalfa were not cut for hay. The entire field was grazed; grazing was uniform across all trials so preferences could not be determined. Producer is very happy with all three from standpoint of production potential when seeded with alfalfa. FY98 good stands and vigor for each species with about 7 plants per square foot. Yield for all species was about 5000 pounds per acre or about 3 AUMs per acre. Cattle are selecting Luna as first choice, then go to Rush before Oahe. The Rush was more mature than Luna when steers were put in pasture which may account for selection choices. FY99 good stands and vigor of all three species. Entire 84 acre seeding provided 135 AUMs or 1.6 AUMs/ac. Due to later season of use; cattle prefer Luna and Oahe to Rush. Rush initiates growth earlier and is more mature when cattle are turned into pasture, which probably accounts for this preference. FY00 similar report to last year. FY01 good stands and vigor for all species. Grazing preference continues to be for Oahe, followed by Luna, and the Rush. Production is about the same for all species although reduced this year due to two years of extreme drought. FY02 good stand, and vigor with greatly reduced production this drought year for all accessions. Produced 0.5-0.7 AUM/Acre for each accession, less than 50% of the normal precipitation year. Grazing is slowing spread of these species. **Next evaluation scheduled for FY04**.

ID97023 Schwenkfelder Rush intermediate wheatgrass District Seed Increase. Site is silty clay loam soil, 14-16 inch ppt, irrigated, 2700 feet elevation, 0-2% slopes, and north exposure, T15N R2W SW1/4 NE1/4 Section 16. Seed ordered March 24, 1997. FY97 spring planted May 29, 1997 into excellent firm seedbed. By July 3, 1997 adequate rain had occurred for good germination so no irrigation was required. There were still a few seedlings emerging on this date. Cooperator plans to spray for broadleaf weeds and will fertilize this fall to prepare for seed production. FY98 excellent stand and vigor with plants averaging 60 to 72 inches in height on June 23 with seedheads up to 15 inches

long. Harvested in mid August with 550 to 600 pounds per acre estimated yield. Baled forage yield was 7000 to 8000 pounds per acre. The hay is fed to range cattle early in the feeding season and utilize it readily. FY99 produced 300 lbs/ac seed this year. Producer is very happy with production and utilizes residue to feed beef cows. Hay yield was about 3 tons per acre. Producer fertilized with 43-lbs/ac nitrogen and 104-lbs/ac phosphorus in late October 1999. FY00 no evaluation. FY01 producer decided to graze this field this year due to drought and reduced seedhead production. Vigor was reduced because of drought. FY02 producer choose to irrigate (twice) this field and harvest (July 10th) for hay. Production was 7500 pounds per acre (3.76 tons/acre). Field was irrigated again and used for fall grazing. **Next evaluation scheduled for FY04**.

ID98019 Royce Schwenkfelder Bannock thickspike wheatgrass Field Planting. Seed ordered March 16, 1998 for April delivery. FY98 because of spring rains, this seeding did not go in until mid June. Seedbed preparation was excellent, but only 20 percent of plants emerged due to soil crusting. Additional seed was obtained and this seeding will be replanted. FY99 - FY03 producer has not planted due to severe drought conditions the past three years.

ID00001 Ed Pollard Field Planting – Native mix Secar Snake River wheatgrass, Bannock thickspike wheatgrass, Magnar basin wildrye, winterfat, fourwing saltbush, Wyoming big sagebrush. Site is Baldock silt loam soil, 10-12 inch precipitation, 2180 feet elevation, 1-percent slope, SW exposure, T10 and 11N R4W Sections 3 and 34. Seed ordered (Bannock and Magnar) on 10-6-99. FY00 seeded October 27, 1999 into very dry soft seedbed. It rained .2 inches the night of seeding and weather was been mild until early December. Winterfat still had fluff on seed so it was broadcast ahead of drill. Half of sagebrush and all of fourwing saltbush seed were mixed with grass and drilled – the other half of sagebrush will be broadcast later this winter onto snow. FY00 unable to get good evaluation this year due to droughty conditions. FY01 this is the second year of extreme drought conditions that are severely impacting plant development. Competition from annual weeds is heavy. Not enough plants to give a good evaluation. FY02 all species are adapted to site, but are severely impacted by third year of drought. There is heavy competition from weeds (cheatgrass, foxtail barley, and thistle) and producer is conducting a weed control program. Shrubs are present in limited amounts, but not very obvious. Grasses are suppressed and it will take a long time for them to dominate site. FY03 all species have very poor establishment due to drought conditions and excessive weed competition. New seeding mixes are being developed to replant site. **Cancel**

ID02010 Hugh Pangman - New Meadows Riparian Planting. 9067541 Peachleaf willow - Baker source and Golden willow. 50 cuttings ordered February 11, 2002 for shipment in early May 2002. To be planted with waterjet stinger. FY02 willows were planted through cobbly site using a backhoe to watertable located at 5-6 feet depth. 95 survival of each species. Peachleaf willows are 18-20 inches tall and Golden willows are 24 inches tall. Golden willows are more vigorous with more stem growth. FY03 Peachleaf willow 95 percent survival with 36-48 inch height. Golden willow local cuttings also have 95 percent survival with 48 inch plus height. Producer is please with this planting.

ID02011 Tom Vogel - Paddock Riparian Planting. 9067546 Peachleaf willow - Burns source and local coyote willow. 50 cuttings ordered February 11, 2002 for shipment in late March 2002. To be planted with waterjet stinger. FY02 willows were planted on April 3, 2002 using the waterjet stinger. Stream was dry for most of July and August. Peachleaf willows have about 75 percent survival with some leader growth up to 36 inches. Coyote willow has about 60% survival. FY03 no evaluation.

ID02014 Mink Land and Livestock Riparian Planting. 9067549 Peachleaf willow - Prairie City source and local source coyote willow, 2002 for shipment in late March 2002. To be planted with waterjet stinger. FY02 Peachleaf willow survival 50% and Coyote willow survival 10%. Planting depth (soils were very dry for most of season) was probably too shallow and plant perhaps should have been completed sooner. FY03 Peachleaf willow 80 percent survival with 48 to 96 inch height. Coyote willow local cuttings have 65 percent survival with 24 to 36 inch heights.

ID02017 Jim Eckhardt Field Planting - Plateau Herbicide Trial (4 oz, 8 oz, 12 oz, Control 4 oz, 8 oz, 12 oz). Seed ordered March 20, 2002 for shipment in early October. Species include: Magnar basin wildrye, Trailhead basin wildrye, Bozoisky Russian wildrye, Mankota Russian, Bannock thickspike wheatgrass, Critana thickspike wheatgrass, Goldar bluebunch wheatgrass, High Plains Sandberg bluegrass, Vavilov Siberian wheatgrass, CD-II crested wheatgrass and Hycrest crested wheatgrass. Site Characteristics: MLRA B10, Deshler-Devon silty clay loam soil, 2-5 percent slope, south aspect, 2600 feet elevation, 12 inch rainfall zone, T11N R6W NE 1/4 NW1/4 Section 1. FY02 Plateau was applied (4, 8 and 12 ounce rates) March 27, 2002 by Joe Vollmer. Did not control salsify, fiddleneck or sunflower. Planted November 4, 2002 under dry/cold conditions with a rangeland drill at 12-inch spacing. FY03 three planted

species established this year: 1) Vavilov Siberian wheatgrass had the best stand and was the most vigorous. It did not grow in the untreated control plot – established well in the 4 and 8 ounce treatments – did not establish in the 12 ounce treatment; 2) CD-II crested wheatgrass was not as vigorous as Vavilov and had fewer plants established. It had no establishment in the no treatment - some establishment in the 4 ounce treatment – good establishment in the 8 ounce treatment – no establishment in the 12 ounce treatment; 3) Hycrest crested wheatgrass was the least vigorous of the establishing species with 30-35 percent fewer plants than Vavilov and CD-II. It had no establishment in the untreated plot - spotty establishment in the 4 and 8 ounce plots – no establishment in the 12 ounce plots. At this evaluation the 8 ounce treatment appears to be the best rate for Plateau herbicide.

IDAHO DIVISION IV
PLANT MATERIALS PLANTINGS

FIELD OFFICE: BURLEY

ID94003 Bronson Bozoisky Russian wildrye, Mankota Russian wildrye, Trailhead basin wildrye, Magnar basin wildrye, Goldar bluebunch wheatgrass (firebreaks and winter grazing). Site is sandy loam soil (weakly saline), 9-10" ppt, partially irrigated, 4800 feet elevation, 0-2% slopes. Species seeded in fall of 1994 with good seedbed. FY95 good stands of Mankota, Magnar and Trailhead; fair stands of Bozoisky and Goldar. All seedings are establishing well except in weedy areas. No seed production during establishment year. FY96 good stand of Goldar, fair stand of Mankota and Magnar, and very poor stand of Trailhead and Bozoisky. All plants that are present look good and are producing seed. There are weeds present including cheatgrass, tumble mustard, Russian thistle, broom snakeweed and sagebrush. FY97 Goldar full stand, Trailhead has improved and is spreading, Magnar is very thin, and both Russian wildryes are adapted with thin stands. FY98 good stands of Bozoisky and Goldar and fair stands of Mankota, Trailhead and Magnar. Stands are grazed in winter. FY99 Good stand and vigor of all species. All species are in same pasture and the Bozoisky is grazed closer than the other species. FY00 fair to good stand of all species. Cooperator is very pleased with all species and prefers them over crested wheatgrass varieties. Site was grazed in spring. Cooperator states that livestock make good use of Bozoisky and Mankota in spring, Trailhead in winter, and Magnar in fall and winter. Magnar stays greener than Trailhead. FY01 this site is suffering from two years of drought. Mankota Russian wildrye has 36-inch height, fair to good stand and good vigor. Bozoisky has 20-inch height, fair stand with fair vigor. Magnar has 30-inch height and Trailhead has 20-inch height and both have fair to poor stands with fair to good vigor. Goldar has 24-inch height, fair to poor stand with good vigor. FY02 Survival/Plant Height - Mankota 75%/26 inch, Magnar 80%/40 inch, Trailhead 80%/36 inch, Bozoisky 75%/30 inch, Goldar 30%/26 inch. Magnar and Trailhead are only lightly grazed and are showing very little effect from grazing. Bozoisky and Mankota stands are heavily grazed and stand are beginning to decline. Goldar stand is also heavily grazed and stand has declined significantly. Producer comments indicate that Goldar is always the first species to be grazed in this pasture followed by the Russian wildrye. FY03 no evaluation.

ID96012 Poulton Garrison field planting for plug nursery. Seed ordered 12/8/96. FY96 no evaluations. FY97 field has full stand with 2 plus plants/ft2. Plants have height of 36 inches and no weeds. Stand is gravity irrigated and was fertilized with 80 pounds of N in early June. FY98 excellent stand that has improved significantly in the last year. The stand was hayed this year. FY99 good to excellent stand. The stand was 36 inches tall when swathed for hay and had 6 inches of regrowth in early September. Cooperator is very pleased with this grass. Elk are utilizing planting. FY00 planting was cut for hay and elk are utilizing it heavily due to drought conditions. FY01 due to drought conditions, this planting was hayed earlier than normal and has been heavily grazed. Production was below normal. Stand is solid with no bare spots or invading species. FY02 same comments as last year. FY03 no evaluation.

ID96028 East Cassia SCD Hycrest crested wheatgrass, Sodar streambank wheatgrass, Bannock thickspike wheatgrass, and Appar blue flax field planting and Hycrest II (CD-II) crested wheatgrass, Sodar, Bannock, and Appar field planting. FY96 planting planned for fall of 1996. FY97 no evaluation. FY98 fair stand of all species except Appar, which failed. FY99 poor stands of Hycrest, CDII, and Flax. Bannock and Sodar failed. Crested wheatgrass can be rowed in very heavy stands of cheatgrass. FY00 fair stand of Hycrest and CD-II, poor stand of Bannock, and Sodar and Appar failed. Both Hycrest and CD-II are thickening up and starting to crowd out cheatgrass. Some Bannock is present, but Sodar and Appar were not observed. FY01 no evaluation. FY02 planting has been mowed resulting in poor opportunity to evaluate planting. FY03 no evaluation.

ID97005 Hawker Field planting for medusahead wildrye control. Sherman big bluegrass, Covar sheep fescue and Garnet (905308) mountain brome. Site is very stony loam soil, non-irrigated, 14 inch ppt, 5800 feet elevation, 4% slope on south exposure. Seed ordered 10/17/96. FY97 new seeding and difficult to determine establishment. FY98 good stand of Sherman and Covar establishing and fair stand of mountain brome establishing. FY99 due to severe grasshopper population, it is impossible to determine stand composition. FY00 due to drought planted species were not found – evaluate in spring 2001.FY01 site was heavily grazed early this year and no regrowth occurred. FY02 cattle have been in field most of the summer and field is overgrazed. Planting evaluation could not be performed. FY03 no evaluation.

ID97006 Gary Jones Field planting of Garrison creeping foxtail. Site is silt loam soil, irrigated, 5000 feet elevation, and 0-3% slope on south exposure. Seed ordered 10/17/96. FY97 new seeding and very difficult to determine establishment. FY98 poor stand establishing with .5 plants per foot2. FY99 good stand with about 4 plants per square foot and 4000 pounds per acre production. Fertilizer would benefit stand and reduce weeds. FY00 good stand with excellent vigor. Planting was hayed this year. FY01 this is a good planting. It was cut earlier than usual for hay due to shortage of irrigation water. Yield was down this year, but cooperator was satisfied with yield given the droughty conditions. FY02 landowner is enthused about Garrison production/performance and plans to plant additional field to this species. FY03 no evaluation.

ID00009A Warren Yadon willow field planting. 9067561 Lemmon willow (12), 9067548 Drummond willow (12), 9067436 Yellow willow (12), 9067375 Peachleaf willow (15), and 9067376 Peachleaf willow (14) were ordered on March 1, 2000 for shipment April 10, 2000. FY00 willow evaluations will be performed next year. FY01 this planting is overgrown with woods rose, stinging nettle and weeds. Cuttings are alive, but very difficult to evaluate this late in the year. Recommend evaluating earlier next year. FY02 12 Drummond and 6 Yellow willows were alternately planted with 2 Yellow willows 6-8 feet tall still surviving. 6 Yellow willows planted into the face of a 4-5 feet cutbank on the west side of stream, all have survived and are 2-4 feet tall with limited branching. 14 Peachleaf 376 were planted with 4 6-8 feet tall plants surviving. 15 Peachleaf 375 were planted with 12 2-10 feet tall plants surviving. 12 Lemmon willows were planted, but could not be located. FY03 no evaluation.

FIELD OFFICE: GOODING/FAIRFIELD

ID98018A Bill Simon Farms Rush intermediate wheatgrass District Seed Increase. Seed ordered March 16, 1998 for mid April delivery. FY98 Rush seeded in April 1998 into twin rows on 30-inch centers. The 55 acre field was formerly in alfalfa (1996 and prior) and fallowed in 1997. Excellent stand established by the fall of 1998 with plants fully bunched and vigorous. Stand was sprayed with formula 40 2, 4-D in late June or early July. Producer did not fertilize stands in the fall. FY99 approximately 25 percent of production was lost to shatter due to strong winds prior to harvest. The 55-acre field produced approximately 180 lbs/acre. On droughtier hilltops and ridges producer noted that seed production was lacking and suggested that wider row spacing would be desirable. FY00 Rush stand remain strong and Bill Simon feels it is the best grass on the Prairie. The dry year took its toll on seed production, however. Harvested the third week of August 2000 and the 55-acre field produced 91 pounds/acre clean seed. The 55-acre field was in alfalfa prior to seeding to Rush, and this field has more weeds. FY01 spring frost damaged reproductive stems - no seed production. FY02 unfavorable moisture year - 50 pounds per acre seed production. FY03 no evaluation.

ID98018B Bill Simon Farms Rush intermediate wheatgrass District Seed Increase. Seed ordered March 16, 1998 for mid April delivery. FY98 rush seeded in April 1998 into twin rows on 30-inch centers. The 85-acre field was formerly in small grain. Excellent stand was established by the fall of 1998 with plants fully bunched and vigorous. Stands were sprayed with formula 40 2, 4-D in late June or early July. Producer did not fertilize stands in the fall. FY99 approximately 25 percent of production was lost to shatter due to strong winds prior to harvest. The 85-acre field produced approximately 110 lbs/acre. On droughtier hilltops and ridges producer noted that seed production was lacking and suggested that wider row spacing would be desirable. FY00 Rush stands remain strong and Bill Simon feels it is the best grass on the Prairie. The dry year took its toll on seed production, however. Harvested the third week of August 2000, the 85-acre field produced 81 pounds/acre clean seed. Weeds in the 85-acre field are not a problem, since prior to seeding to Rush the field was in 2 years of wheat, and prior to that 5 years of Regar meadow brome, providing a clean field. FY01 unfavorable moisture year - 40 pounds per acre seed production. FY02 unfavorable moisture year - 23 pounds per acre seed production. FY03 no evaluation.

ID98020 Bill Simon Bannock thickspike wheatgrass District Seed Increase. Seed ordered April 10, 1998 for mid April delivery. FY98 Bannock seeded on 12-inch centers. Evaluation in November 1998 indicated a slow start with weak plants at the end of the first full growing season. Weeds do not appear to be a problem, but soils are somewhat gravelly and it appears to be a difficult site to establish a stand. Field was fertilized with about 20 units of nitrogen in the fall. FY99 plants remain narrow and spindly, but fertilizer did contribute to improved plant health. Harvest of approximately 80 lbs/acre was completed early while plants were still green, but seed was mature and beginning to shatter. FY00 this is the first-to-ripen grass in Bill's portfolio, interfering with his alfalfa hay harvest on the Prairie. This year the Bannock was harvested the first week of August, and produced 110 pounds/acre clean seed, which is higher than last year's yield despite the dry year. The field was fertilized with 40 units of ammonium sulfate about May 1, 2000, and later sprayed with Formula 40 2,4-D. Cheatgrass is increasing in the field and will need to be controlled in 2001. FY01

unfavorable moisture year - 100 pounds per acre seed production. FY02 unfavorable moisture year - 65 pounds per acre seed production. FY03 no evaluation.

ID99007 Spring Cove Ranch – Butler Field Planting Laurel willow. Island-constructed wetland, silt loam soil, 0-2 percent slopes, 3100 feet elevation, T5S R12E SW1/4 Section 21. FY99 20 Laurel willows were at water edge on islands. Tree tubes (1.5 feet tall) were utilized to protect cutting from muskrats. All cutting are flourishing with about 5 to 6 feet of growth the first growing season. FY00 Laurel willows are thriving on the islands, protected by their tree tubes. Plants are vigorous and are now beginning to obtain fuller, multi-branched shape. FY01 planting doing very well - tree tubes removed. FY02 planting doing very well - beaver/muskrat are not damaging trees to date. Providing excellent bank erosion protection. FY03 no evaluation.

ID00005 Camas SCD (Koonce) formerly ID86010 Koonce multiple species demo plots. FY99 field evaluation determined these plots to be contaminated and planting was destroyed, site cleaned-up and fallowed during 1999, and was replanted in the spring of 2000. Plots replanted May 1, 2000. Plots will be irrigated the first growing season. FY00 plots were irrigated until mid June, and then discontinued. Most of the wheatgrasses sprouted in the central and northern portions of the plot, but remained small at evaluation time due to dry season. Plot remains relatively weed-free except the southernmost 15 feet of the plot (sheep fescue area) which is a solid stand of globe mallow. The fescue is sprouted underneath the large mallow leaves. This is a particularly difficult weed to control once established. Special attention needs to be directed here in spring 2001.
FY01 the plots have been subjected to two seasons of unfavorable plant growth (dry springs) and one of the lowest winter snowpacks recorded on the Camas Prairie. Still, all varieties exhibit some level of success except for the following varieties which could not be found for observation: Durar hard fescue, Nezpar Indian ricegrass, 9043501 Salina wildrye, and Thurber's needlegrass. These varieties did not establish at all or remain yet as dormant seed due to drought. Some of the absent species may have germinated but died unnoticed due to drought. Weed competition most likely is not a factor of establishment difficulties in the plot. Possible exceptions may be in the Covar sheep fescue area that had significant amounts of common mallow in 2000 but is now under control due to spot spraying. Scouringrush is invading in the Bighorn sheep fescue and Magnar basin wildrye areas and may be a factor there. The entire demo plot was spot-sprayed in 2001 twice (last of June and first of August) with 2, 4-D/Banvel. At the time of this evaluation the plot did not contain weed problems significant to grass establishment.
The wheatgrasses are performing the best. The highest performing wheatgrasses include Rush and Reliant intermediate wheatgrasses, Manska and Luna pubescent wheatgrasses, CDII and Nordan crested wheatgrasses, Bannock thickspike wheatgrass, and Pryor slender wheatgrass. Weak wheatgrass performance was observed with Arriba western, Whitmar beardless wildrye, San Luis slender wheatgrass, Critana thickspike wheatgrass, Ephraim crested wheatgrass, Douglas crested wheatgrass, and P27 Siberian wheatgrass. Bozoisky and Mankota Russian wildrye performed moderately, but the other wildryes either did poorly (Volga Mammoth and Magnar) or did not establish (Salina and Trailhead). Manchar and Liso smooth bromes have done well considering the drought with moderate performances, but Garnet and Bromar mountain bromes and Regar meadow brome did not fare so well and have overall weak ratings. The fescues, needlegrasses, orchardgrasses, ricegrasses, timothy, and foxtail are currently performing weakly or did not establish. Sherman big bluegrass had low establishment density but the existing plants have good vigor with many seedheads produced.
FY02 drought continues. Excellent plots include: Rush, Greenar, Reliant, Topar, Manska, Luna, Bozoisky, CD-II, Hycrest, and Nordan. Good plots include: Rosana, Manchar, Regar, Alkar, Jose, Liso, Oahe, Tegmar, 238, Goldar, P-7, Mankota, Secar, Pryor, Bannock, Schwendimar, Sodar, Sherman, Vavilov, and Magnar. Fair plots include: Latar, Garrison, Arriba, Climax, Covar, Volga, Whitmar, San Luis, Critana, Ephraim, Douglas, P-27, Rimrock, High Plains, and Trailhead. Poor plots include: Paiute, Garnet, Bromar, Durar, 902484, and 9040137. Failed plots include: Salina and Nezpar.
FY03 no evaluation.

ID00006 Bill Simon Bannock thickspike wheatgrass District Seed Increase. Seed ordered February 10, 2000 for mid April delivery. FY00 this new Bannock seeding in spring 2000 was installed adjacent and south of existing Bannock field under file ID98020. Bannock was drilled at 3 pounds per acre PLS on 24-inch centers. The field was helicopter sprayed with 2, 4-D the third week of June. Where helicopter missed, Russian thistle prevailed this year but should diminish next year. At evaluation time on November 1, 2000, the stand was well on its way to establishment considering the dry year. FY01 unfavorable moisture year - 200 pounds per acre seed production. FY02 unfavorable moisture year - 110 pounds per acre seed production. FY03 no evaluation.

ID01007 Spring Cove Ranch – Butler demonstration plantings of Magnar basin wildrye, Snake River Plain fourwing saltbush, and Northern Cold Desert winterfat. Seed ordered March 16, 2001. Site characteristics: Planting 1. Vertisol soil, 11-inch rainfall, irrigated, 3300 feet elevation, south of Pioneer Reservoir. Planting 2. Sodic soil, 12-inch rainfall, irrigated, 3500 feet elevation, near Clover Creek – Hill City Road – southern base of Bennett Mountain foothills. FY01 and FY02 seed not planted due to extreme drought. FY03 no evaluation.

ID01011 Bill Simon District Seed Increase High Plains Sandberg bluegrass test plots. Seed ordered in September 2001. FY02 seed not planted due to drought. FY03 no evaluation.

ID02015 Bob Josaitis Field Planting. 905439 switchgrass (Bridger PMC) and Blackwell switchgrass (Manhattan PMC) were ordered March 15, 2002 for shipment about April 1, 2002. Purpose: portion of seed mix for wildlife nesting cover. Site Characteristics: MLRA 11a, Harsand fine sandy loam soil, 0-2 percent slope, 3700 feet elevation, 11 inches precipitation, full irrigation, T6S R15E Section 4. FY02 seed not planted due to drought. FY03 no evaluation.

FIELD OFFICE: JEROME

ID99012 Tom Davis Critical Area Planting on pond embankment/dike. Hycrest crested wheatgrass and Vavilov Siberian wheatgrass seed ordered March 30, 1999. Planting planned for early April 1999. FY99 spring planting failed due to lack of rainfall. Cooperator planted (broadcast and harrowed) in November 1999 under dry conditions. FY00 good stand in areas where sprinkler semi-irrigates - poor to fair stand establishing in dry areas due to extremely droughty conditions. 2 plants per square foot, good vigor, 12-inch height. Expect stand to improve with better rainfall this fall-winter. FY01 good stand with 3 plants per foot square, and good vigor. FY02 good stand with 4 plants per square foot. FY03 no evaluation.

ID99014 Tom Davis irrigation pivot corner field planting. Vavilov Siberian wheatgrass ordered March 30, 1999 with delivery about September 1, 1999. Planting planned for late October 1999. FY00 planted (broadcast and harrowed) in November under dry conditions. Good stand in areas where sprinkler semi-irrigates - poor to fair stand establishing in dry areas due to extremely droughty conditions. 2 plants per square foot, good vigor, 12-inch height. Expect stand to improve with better rainfall this fall-winter. FY01 good stand with 3 plants per foot squared and good vigor. FY02 fair stand with 2 plants per square foot. FY03 no evaluation.

FIELD OFFICE: RUPERT

ID02016 Cooperator Unknown critical area planting - roadside. Seed ordered March 6, 2002 (100 pounds Topar). FY02 and FY03 no evaluations.

FIELD OFFICE: SHOSHONE/HAILEY

ID01003 Cooperator unknown willow field planting. 10 cuttings each of 9067548 Drummond willow, 9067435 Geyer willow, 9067491 Geyer willow, 9067437 Booth willow, 9067469 Booth willow, and 9067478 Booth willow. FY01 no evaluation. FY02 and FY03 no evaluations.

FIELD OFFICE: TWIN FALLS

ID00007 Twin Falls SWCD/Twin Falls Highway District Drought tolerant landscape-weed control demonstration plantings. Seed ordered March 1, 2000 for late March delivery. Planting 1: Vavilov Siberian wheatgrass, Bozoisky Russian wildrye, and Ladak alfalfa. Planting 2: Hycrest crested wheatgrass, Bozoisky Russian wildrye, and Ladak alfalfa. Planting 3: Secar Snake River wheatgrass, Critana thickspike wheatgrass, Trailhead basin wildrye, Rimrock Indian ricegrass, and Wytana fourwing saltbush. Planting 4: Secar Snake River wheatgrass, Bannock thickspike wheatgrass, Magnar basin wildrye, Nezpar Indian ricegrass, and Snake River Plain fourwing saltbush. Site characteristics: MLRA B11A, Portneuf silt loam soil, 0-2 percent slopes, north exposure, 3800 feet elevation, 10-12 inch precipitation, irrigated for establishment only, T11S R18E SW1/4 of SW1/4 of Section 13. FY00 due to very dry spring the planting was delayed until better planting conditions occur. FY01 site was planted in mid to late April and sprinkler irrigated in May to assist with plant establishment. Site was also mowed several times during growing season for weed control. Because of mowing, species identification was not possible – estimated initial stand establishment for all plantings are fair with good plant vigor. FY02 introduced plantings are well established - native plantings failed. Introduced seed of Vavilov Siberian wheatgrass (15 lb) and Bozoisky Russian wildrye (5 lb) was ordered on September 15, 2002 to replant failed portion. Planting completed for October 25, 2002 (dormant planting). FY03 field observation determined that little establishment has occurred this year due to drought conditions.

ID02008 Hot Creek Riparian Planting. 9067541 Peachleaf willow - Baker source, 9067549 Peachleaf willow - Prairie City source, and 9067560 Peachleaf willow - Deer Creek source. Cuttings ordered February 11, 2002 for shipment April 1, 2002. FY02 - 9067541 12 percent survival with poor vigor - 9067549 24percent survival with poor vigor - 9067560 56 percent survival with poor vigor. Survival impacted by continuously saturated soils. Success primarily related to different site conditions. FY03 no evaluation.

ID02009 Shoshone Creek Riparian Planting. 9067541 Peachleaf willow - Baker source, 9067549 Peachleaf willow - Prairie City source, and 9067560 Peachleaf willow - Deer Creek source. Cuttings ordered February 11, 2002 for shipment April 1, 2002. FY02 - 9067549 60 percent survival with good vigor - 9067541 76 percent survival with good to excellent vigor - 9067560 50 percent survival with fair vigor, native Planeleaf willow 100 percent survival with excellent vigor. Death loss can primarily be related to livestock damage when cattle were place in field for 5 days. FY03 no evaluation.

ID03001 Walt Coiner Field Planting. Seed was ordered on September 17, 2002. Purpose: Field Planting - windbreak interspace perennial cover/weed control study - irrigated-semi irrigated-dryland trials. Approximately 1 acre per species - broadcast seeding rates - Aberdeen PMC broadcast planters were used for seeding - dormant fall planting completed November 4 and 5, 2002. **Irrigated species:** Durar hard fescue; Sherman big bluegrass; Foothills Canada bluegrass, and Talon Canada bluegrass. **Semi Irrigated species**: Covar sheep fescue; Sodar streambank wheatgrass; Paiute orchardgrass; Ephraim crested wheatgrass; Sherman big bluegrass; Roadcrest crested wheatgrass; Rosana western wheatgrass; and Quatro sheep fescue. **Dryland species:** Vavilov Siberian wheatgrass and Bozoisky Russian wildrye. FY03 - Initial evaluation August 20th. Below is preliminary data per this evaluation:

Irrigated Perennial Cover (full irrigation)				
Species	Stand	Plants/ft2	Vigor	Adapted (Yes/No)
Sherman big bluegrass	good-exc.	6-8	excellent	yes-good
Talon Canada bluegrass	good-exc.	4-6	excellent	yes-good
Foothills C. bluegrass	excellent	5-7	excellent	yes-good
Durar hard fescue	fair-good	3-4	excellent	yes-good
Semi-Irrigated Perennial Cover				
Covar sheep fescue	poor-fair	2	fair-good	no-needs full irr.
Quatro sheep fescue	poor	<1	fair	no-needs full irr.
Newhy hybrid wheatgrass	poor	<1	fair	no-needs full irr.
Roadcrest c. wheatgrass	good	3-5	good	yes-good
Ephraim c. wheatgrass	excellent	8-10	good-exc.	yes-exc.
Sodar s. wheatgrass	good	2-3	fair	yes-fair
Paiute orchardgrass	fair-good	1	fair-good	yes-needs full irr. for establishment
Dryland Perennial Cover				
Vavilov S. wheatgrass	good	4-5	good	yes-good
Bozoisky R. wildrye	poor	<1	fair	unknown
Sherman big bluegrass	v. poor	<1	v. poor	no-needs est. irr.
Rosana w. wheatgrass	fair	<1	good	no-needs est. irr.

IDAHO DIVISION V
PLANT MATERIALS PLANTINGS

FIELD OFFICE: AMERICAN FALLS/ABERDEEN
None

FIELD OFFICE: BLACKFOOT
ID02006 Paul Ricks Demonstration Planting. Seed ordered February 11, 2002 for shipment to Aberdeen PMC by March 4, 2002. FY02 Planting completed in May 2002. August 27, 2002 initial evaluation indicated at least some establishment of all seed plots.

Fully Irrigated Plots FY03 good to excellent stands – Forager alfalfa, Rampage alfalfa, Alice clover, Rowdy alfalfa, Mara perennial rye, Fawn tall fescue, Latar orchardgrass, Johnstone tall fescue, Potomac orchardgrass, Teton tall fescue, Bavidana orchardgrass, Povet tall fescue, Paiute orchardgrass, Barcel tall fescue, Regar meadow brome, Barcarella tall fescue, Rebound meadow brome, T33 tall fescue, Paddock meadow brome, Bartura meadow fescue, Hakari mountain brome, 9005438 switchgrass, Blackwell switchgrass, 9005439 switchgrass, and Bozoisky Russian wildrye. Poor to fair stands – Jumbo Ladina clover, Lutana cicer milkvetch, Ranger alfalfa, Endura Kura clover, Bull Birdsfoot trefoil, Climax timothy, Barliza timothy and Mutimedia sunflower.

Partially Irrigated Plots FY03 good to excellent stands – Forager alfalfa, Rampage alfalfa, Rowdy alfalfa, Travois alfalfa, Ladac alfalfa, Bromar mountain brome, Luna pubescent wheatgrass, Garnet mountain brome, Reliant intermediate wheatgrass, Newhy hybrid wheatgrass, Rush intermediate wheatgrass, Greenar intermediate wheatgrass, Bozoisky Russian wildrye, Tegmar intermediate wheatgrass, Latar tall wheatgrass. Poor to fair stands – Eski sainfoin, Remont sainfoin, Delar small burnet, Appar blue flax, Timp Utah sweetvetch, 9057902 western yarrow, Ruby Valley pointvetch, Covar sheep fescue, Arriba western wheatgrass, Rosana western wheatgrass, Paiute orchardgrass, Bannock thickspike wheatgrass, Douglas crested wheatgrass, Critana thickspike wheatgrass, Manchar smooth brome, Schwendimar thickspike wheatgrass, Lodorm green needlegrass, Sherman big bluegrass, Foothill Canada bluegrass, SL hybrid wheatgrass, RS Hoffman wheatgrass, San Luis slender wheatgrass, Pryor slender wheatgrass, Alkar tall wheatgrass, Mandan Canada wildrye, Magnar basin wildrye, Joseph Idaho fescue, Trailhead basin wildrye, Mankota Russian wildrye, Goldar bluebunch wheatgrass, and Syn A Russian wildrye.

Dryland Plots FY03 good to excellent stands – Rampage alfalfa, Rowdy alfalfa, Luna pubescent wheatgrass, Hycrest crested wheatgrass, Critana thickspike wheatgrass, CD-II crested wheatgrass, Mankota Russian wildrye, and Bozoisky Russian wildrye. Poor to f air stands – Forager alfalfa, Whitmar beardless wheatgrass, Immigrant forage kochia, Rimrock Indian ricegrass, Travois alfalfa, Nezpar Indian ricegrass, Ladak alfalfa, P27 Siberian wheatgrass, Secar Snake River wheatgrass, Vavilov Siberian wheatgrass, Covar sheep fescue, Durar hard fescue, Arriba western wheatgrass, Rosana western wheatgrass, Nordan crested wheatgrass, Sodar streambank wheatgrass, Ephraim crested wheatgrass, Bannock thickspike wheatgrass, Schwendimar thickspike wheatgrass, Magnar basin wildrye, High Plains Sandberg bluegrass, Trailhead basin wildrye, 9019219 bottlebrush squirreltail, Goldar bluebunch wheatgrass, Open Range winterfat, and Wytana fourwing saltbush.

FIELD OFFICE: FORT HALL
ID03002 Shoshone-Bannock Tribe Demonstration Planting. Nezpar Indian ricegrass, Goldar bluebunch wheatgrass, Magnar basin wildrye, Sodar streambank wheatgrass, Bannock thickspike wheatgrass, Rimrock Indian ricegrass, Trailhead basin wildrye, Critana thickspike wheatgrass, Shoshone creeping wildrye, High Plains Sandberg bluegrass, Secar Snake River wheatgrass, Sherman big bluegrass, Schwendimar thickspike wheatgrass, Joseph Idaho fescue, Nezpurs Idaho fescue Winchester germplasm Idaho fescue, Needle and Thread grass. Seed ordered September 30, 2002. Planting completed early November 2002. FY03 no evaluation.

ID03005 Shoshone-Bannock High School field planting. Common Camas bulbs. Bulbs ordered January 14, 2003. Site - MLRA B11b, 10-12 inch precipitation, sub-irrigated wet to semiwet bottomlands, non-irrigated. FY03 no evaluation.

FIELD OFFICE: MALAD

ID02007 Don Buehler Riparian Planting. 9076375 Peachleaf willow - Caribou source, 9076376 Peachleaf willow - Pocatello source, and coyote willow. Cuttings to be shipped April 1, 2002. FY02 - 9076375 92 percent survival with poor to good vigor and 4-6 inch height - 9076376 90 percent survival with poor to good survival and 4-5 inch height. Landowner watered cuttings weekly to assist with establishment and carry them through the drought. FY03 no survival due to severe drought and rodent damage. **Cancel**

ID03006 Monte Price Poplar Demonstration. Robusta polar, Carolina poplar, Siouxland poplar, Simon poplar, OP-367 poplar and 52-225 poplar. Cuttings to be shipped April 1, 2003. FY03 planting completed April 18, 2003 – 2.5 feet planting depth. Survival September 22, 2003 – all plantings failed due to severe drought and rodent damage. **Cancel**

FIELD OFFICE: MONTPELIER
None

FIELD OFFICE: POCATELLO
None

FIELD OFFICE: PRESTON
ID95036 Franklin County Bannock thickspike wheatgrass and Sodar streambank wheatgrass critical area planting. Site is landfill, Wheelon/Collonston soil, non-irrigated, 14-15 inch ppt, 5000 feet elevation, 12-20% slopes on north exposure. Seed ordered 5/5/95. FY95 seed planted 5/17/95 in good clean seedbed. Fall evaluation indicated good stand establishing for both species. FY96 good stands of both species with 3 plants/ft2 and spreading. Species are providing good erosion control. FY97 and FY98 no evaluations. FY99 good stand of each specie with 3-4 plants per square foot, good vigor, good ability to spread, and good erosion control under these conditions. Weed infestation of planting is very low. FY00 Bannock and Sodar stands are good with good vigor and 4 plants per square foot. FY01, FY02 and FY03 no evaluations.

FIELD OFFICE: SODA SPRINGS
None

IDAHO DIVISION VI
PLANT MATERIALS PLANTINGS

FIELD OFFICE: ARCO

ID03003 Hill-Freeman Snake River Plain fourwing saltbush field planting. Seed ordered October 18, 2002. FY03 one half pound of Snake River Plains fourwing saltbush was included in a five acre marginal pastureland seeding adjacent to Warm Springs Creek on Barton Flat (South Custer County). The entire seeding area of 13.3 acres included a three and a half acre stand of decadent crested wheatgrass. A seed mix of Vavilov Siberian wheatgrass (1.2 lbs/ac), Bannock thickspike wheatgrass (2.0 lbs/ac), Bozoisky Russian wildrye (1.2 lbs/ac), Rincon fourwing saltbush (0.25 lbs/ac), and Bighorn skunkbush sumac (0.25 lbs/ac) was broadcast over the seeding area. The area was then rolled to obtain seed to soil contact on a firm weed free seedbed.

FIELD OFFICE: DRIGGS

ID91006 Fair Grounds Multiple Species Demo Plots. FY92 planted spring 1992 excellent survival on all species except trefoil, mountain brome and cicer milkvetch which will have to be replanted. FY93 Remont, Bromar, Lutana planted spring of 1993. Remont is not tolerant of frequent irrigation. Bozoisky exhibits poor seedling vigor, Goldar has poor plant vigor, Canbar not recommended for pure stands, Magnar not adapted to shallow soils, Newhy lacks seedling vigor, Manchar exhibits poor summer regrowth, Whitmar is not tolerant of excessive moisture, and Garrison adapted to wet soils. Magnar, Bromar, Rush, and Lutana are all doing poorly. Ordered Rush, P27, Magnar, Canbar, and Bozoisky on 3/17/94 to be included in plots. FY94 all plots good to excellent stand except Lutana, Remont and Delar. These plots are all irrigated so evaluations for drought, flood, salt and acid tolerance not possible. This planting does provide excellent trials for irrigated varieties in high mountain valleys. FY95 best performers are Hycrest, Critana, Alkar, Tegmar, Luna, Greenar, Topar, Rush, Regar, Manchar, Latar, Paiute, Sodar, Newhy, Durar, Sherman, Canby and Delar. Complete evaluations are available on request. FY96 not evaluated. FY97 Durar and Delar good to excellent stands with high vigor; Regar, Amur, Manchar, Latar, Paiute good stands with excellent vigor; Rush fair stand with fair vigor; Sodar, Goldar, Cascade, Appar poor stands with fair vigor; Hycrest, Critana, Alkar, Tegmar, Luna, Greenar, Topar, Lutana, Garrison, Whitmar, Secar, P27, Bromar, Magnar, Bozoisky, Canbar, Sherman, Kalo, very poor to failed stands. All plots are subject to turfgrass encroachment. February 9, 1998 ordered Hycrest, CD-II (Hycrest II), Sherman, Newhy, Critana, Bannock, Garrison, and Bozoisky for plots. FY98 species with good to excellent stands include Amur, Rush, Manchar, Latar, Durar, Cascade, and Delar. Species with poor to fair stands include Alkar, Luna, Topar, P27, Bromar, Paiute, Magnar, Appar, and Bozoisky. Failed stands include Hycrest, Critana, Tegmar, Greenar, Secar, Whitmar, Garrison, Lutana, Regar, Sodar, Newhy, Kalo, Sherman, Canbar, and Goldar. FY99 - FY03 no evaluations.

ID99018 SCD field planting – leafy spurge competition study. Species include Rush intermediate wheatgrass, Luna pubescent wheatgrass, Regar meadow brome, Bromar mountain brome, Durar hard fescue, Bozoisky Russian wildrye, and Climax timothy. Seed ordered April 28, 1999 for shipment about May 17, 1999. FY99 Roundup was applies on June 10th to leafy spurge plots with up to 200 stems per 9.6 square foot hoop. Grass was drilled into plots on July 1, 1999 using a Brillion drill. Evaluation of germination and establishment will be performed in the spring of 2000. Replicated plots will be installed in May of 2000. FY00 - FY03 no evaluation.

ID02019 Lowel Curtis field planting. Species include Garrison creeping foxtail, Regar meadow brome and Johnstone tall fescue. Seed ordered April 8, 2002. FY02 and FY03 no evaluations.

FIELD OFFICE: IDAHO FALLS

ID94020 Winterfeld Magnar basin wildrye and Trailhead basin wildrye vegetative terraces field planting. Seed ordered 3/94. FY94 planted 5/94. Good initial stand establishment with good vigor. FY95 excellent stand establishment with over 3 plants/ft2. Plants average 24" height. Grouse are using basin wildrye for nesting cover. Working well for erosion control. FY96 excellent stands with excellent vigor Trailhead and good vigor Magnar. Excellent wildlife use by game birds, deer, owls, and coyotes. Both species are very good for snow catchment and field windbreaks. FY97 100% survival, Trailhead spreading a little faster than Magnar. Plant height about 96 inches for each. Cooperator notes that Trailhead is more drought tolerant and Magnar is more robust. FY98 100 percent survival for both species. Cut for seed this year with 140 pounds of clean seed per acre. FY99 excellent stands: Magnar 96 inches tall with little to no spread; Trailhead 84 inches tall with good spread via seed shatter. FY00 excellent stands with excellent vigor for both Magnar and Trailhead. Magnar is more robust with 96 inches height. Trailhead is spreading rapidly, is more drought tolerant,

and approximately 84 inches tall. FY01 excellent stand and vigor with 96 inch height. Seed production was approximately 100 pounds per acre. Straw yield was 1.6 tons per acre. FY02 Trailhead plowed out. Magnar excellent stand with excellent vigor, 72 inch height, and 4000 pounds per acre production. FY03 no seed crop due to insect damage.

ID95046 Winterfeld Venus penstemon and Firecracker penstemon District Seed Increase. Seed sent 8/95. FY95 planted fall 1995. FY96 poor stand establishing for Alpine and no emergence for Firecracker, no seed production. FY97 Alpine slow establisher and susceptible to frost, no seed production. FY98 fair stand of both Firecracker and Alpine penstemon (1 plant per foot 2). Stands for both species are getting better each year. FY99 fair stands in unfavorable moisture year and no seed production. FY00 Firecracker penstemon died due to drought and short-lived character. Alpine penstemon has good stand with good vigor and stands 24 inches tall. Seed production was unknown at evaluation date. FY01 firecracker penstemon came back, excellent stands and vigor for both species. Seed production estimated at 600 pound per acre bulk. FY02 - Venus - fair stand with excellent vigor, 24 inch height, and 100 pounds per acre bulk production. Firecracker - fair stand with excellent vigor, but slower establishment, 24 inch height, and 100 pounds per acre bulk production. FY03 Firecracker penstemon stand is going out – no production. Venus penstemon produced 80 pounds of seed.

ID99016 Winterfeld Goldar bluebunch wheatgrass District Seed Increase. Seed ordered April 15, 1999. Site characteristics – Tetonia silt loam soil, 1- percent slopes, north aspect, 5400 feet elevation, 18 inch precipitation zone, non-irrigated, T2N R43E NW1/4 Section 26. FY99 planted spring 1999 with good stand establishing. FY00 excellent stand and vigor. Seed production unknown at evaluation date. Good regrowth in spite of very droughty conditions. FY01 excellent stand and vigor. 150 pounds per acre cleaned seed production (some problem with silver top). 900 pounds of straw per acre. FY02 - excellent stand with excellent vigor, 36 inch plant height and 100 pounds per acre cleaned production. Regrowth is excellent and field experiences a lot of wildlife use (elk). FY03 excellent stand produced 100 pounds per acre in unfavorable moisture year.

ID01006 Winterfeld Ephraim crested wheatgrass District Seed Increase. Seed ordered March 13, 2001. Site characteristics - Tetonia silt loam soil, 2 percent slopes, south aspect, 5600 feet elevation, 18 inch precipitation, non-irrigated, T2N R43E SE1/4 Section 8. FY01 plan to plant spring 2002 due to drought this year. FY02 - planted the spring of 2002. Establishing stand is excellent with excellent vigor and 10 inch plant height. FY03 planting failed. **Cancel**

ID01012 Winterfeld Regar meadow brome – Foundation. FY01 good stand establishing with fair vigor due to drought conditions. FY02 - excellent stand with excellent vigor and 36 inch height. Drought year production 55 pounds per acre cleaned. FY03 excellent stand produced 125 pounds per acre under severe drought conditions.

ID01013 Winterfeld Sodar streambank wheatgrass – Foundation. FY01 excellent stand establishing with excellent vigor under severe drought conditions. FY02 - excellent stand with excellent vigor and 24 inch height. Drought year production 38 pounds per acre cleaned. FY03 excellent stand produced 35 pounds per acre under severe drought conditions.

ID03007 Winterfeld San Juan penstemon - Demonstration planting. Seed ordered February 10, 2003. Seed shipped February 18, 2003. FY03 planted fall of 2003.

FIELD OFFICE: REXBURG

ID89015 Wagoner Luna pubescent wheatgrass, P-27 Siberian wheatgrass, Sodar streambank wheatgrass, Greenar intermediate wheatgrass, Delar small burnet, Trevois alfalfa field planting on rangeland. Site is gravelly loam soil with a pan at 5-6 inches, non-irrigated, 12-inch ppt, 6300 feet elevation, and 3% slopes on NE exposure. FY89 ripped rangeland in spring and seeded mix in fall of 1990. FY91 excellent stand establishing with production about 1400 lbs/ac. FY92 clipping data: No Treatment - 318 lbs/ac., chisel only treatment (native species) - 495 lbs/ac., chisel/disc/seed treatment - 1110 lbs/ac. Clipped 7/9/92. FY93 Clipped plots resulted in production of 1200-2000 lbs/ac. FY94 production of about 800 lbs/ac in extremely droughty year. Non treated rangeland producing about 100 lbs/ac this year. FY95 excellent stand Luna and Greenar, Good stand P-27, Sodar and Travois and Poor stand of Delar. Stand produced 1400+ lbs/acre this year. High antelope use of stand was noted. Stand was grazed 3 weeks in spring and 4 weeks in fall with good management. FY96 excellent stand of Trevois and good stands of Luna, P27, Sodar, and Greenar. Very poor stand of Delar. Considered 90% stand overall. Produced 1000 lbs/ac in very poor moisture year.

Stand is doing great under good management. FY03 Disc-Seed treatment – near fence good stand of natives – primarily crested wheatgrass in seeding with 5-6 percent sagebrush and 600 pounds per acre production in very dry year. Ripped-Disc-No Seed treatment – sagebrush very heavy with forage producing about 200 pounds per acre and brush producing about 200 pounds per acre in very dry year. Ripped-Disc-Seed treatment – excellent stand of primarily Bozoisky wildrye, Nordan crested wheatgrass, P27 Siberian wheatgrass and some Trevois alfalfa. Very little intermediate wheatgrass left in stand. Production is about 1000 pounds per acre in very dry year. **Next evaluation 2008.**

ID90025 Wagoner Rush intermediate wheatgrass field planting on rangeland. Site is gravelly loam soil with a pan at 5-6 inches, non-irrigated, 12-inch ppt, 6300 feet elevation, and 3% slopes on NE exposure. FY89 ripped rangeland. FY90 planted April 1990. FY91 excellent stand establishing with no weeds. Production is 1400 lbs/ac. FY92 stand excellent with 1200 lbs/ac production. FY93 excellent stand producing 2000+ lbs/ac. Grazing value - appears to be a highly preferred/selected species according to cooperator. FY94 excellent stand producing 800 lbs/ac in very droughty year. FY95 excellent stand producing 1800+ lbs/acre. Rush is the most productive species in all range trials. FY96 excellent stand with 5-10 plants/ft2 producing 1000-lbs/ac and good vigor in very low rainfall year. FY03 good to excellent stand with 3 plants per square foot and good to excellent vigor. Producing 700 pounds per acre in very dry year – produces about 1400 pounds per acre in average to favorable years. Sagebrush invasion is about 1-5 percent of plant community. No weeds in stand. **Next evaluation 2008.**

ID90035 Wagoner Bozoisky Russian wildrye field planting on rangeland. Site is gravelly loam soil, non-irrigated, 12-inch ppt, 6200 feet elevation, and 2% slopes on NE exposure. FY90 planted April. FY91 good stand establishing. FY92 excellent stand producing 1100 lbs/ac. FY93 90% + stand and up to 4' tall, estimated production 1200-1400 lbs/ac. FY94 good stand producing about 600 lbs/ac in very droughty year and only 50% of plants produced seedheads this year. FY95 good stand producing 1200+ lbs/acre. This species is doing very well and is well adapted to site. FY96 good stand with 4-5 plants/ft2 and 1200-lbs/ac production in very low summer rainfall year. FY03 good stand of P27 Siberian wheatgrass and Bozoisky Russian wildrye with 3 plants per square foot and good to excellent vigor. Stand is producing about 800 pounds per acre in a very dry year. Estimate 1400-1600 pounds per acre in an average to favorable moisture year. **Next evaluation 2008.**

ID91033 Madison SCD Multiple species demo plots. Located behind Rexburg FO. FY91 planted in spring. FY92 planting establishing well. Shrubs under fiber mulch are out performing those that are not. FY93 plants were doing well but had to be moved because of enlargement of parking lot. Will know survival in 94. FY94 Grass plots were removed because of parking lot enlargement. Austrees are 4 years old and about 20 feet tall and 2 year old poplars are 10-12 feet tall. FY95 Arctic willows failed transplant, all others are doing very well. Austrees are 25 to 30 feet tall (five years Old). Grass will be planted in spring of 1996. FY96 Austrees 30+ feet tall, Poplars 20+ feet tall and Larch is eight feet tall (4 years old). FY97 lost one poplar to disease all others doing well. FY03 most of this planting has been destroyed for parking lot. **Cancel**

ID92013 Webster Regar meadow brome, Bozoisky Russian wildrye, Luna pubescent wheatgrass, Critana thickspike wheatgrass field planting on rangeland. Site is gravelly silt loam soil, non-irrigated, 14-inch ppt, 6000 feet elevation, and 4% slopes on SE exposure. FY92 site sprayed for weed control, but too dry to seed. FY93 seeding not completed. FY94 very poor moisture conditions, planting not installed. FY95 good stand of all species establishing with good spring moisture. FY96 good stand of all species with 2-4 plants/ft2 and good vigor on all except Regar has fair vigor. Stand had low production and is still establishing. FY97 good stands for all species with 60% stands and good vigor - they have been slow to establish on this tough site. FY99 Bozoisky and Luna good stands, Regar and Critana fair stands. FY03 good to excellent stand of Bozoisky Russian wildrye and Regar meadow brome with 3 plants per square foot (70% Bozoisky – 30% Regar), good vigor and about 1500 pounds per acre production in a very dry year. Good to excellent stand of Bozoisky Russian wildrye and Trevois alfalfa with 3 plants per square foot (70% Bozoisky – 30% Trevois), good vigor and about 1500 pounds per acre production in a very dry year. Fair to good stand of Critana thickspike wheatgrass with 9 plants per square foot, poor vigor and about 400 pounds per acre production in a very dry year. Good to excellent stand of Luna pubescent wheatgrass with 5 plants per square foot, good vigor and about 1500 pounds per acre production in a very dry year. Bozoisky is heavily grazed (80-90 percent utilization) by cattle and elk and stands are maintaining very well. **Next evaluation 2008**.

ID93001 Clark SCD Multiple species demo plots. Site is located near Clark County Senior Center. FY93 trees were planted and ground prepared by chiseling to plant grass in the spring of 94. FY94 trees and shrubs planted with fabric

material have a 98-100% survival. Grass plots were not installed due to drought conditions. FY95 all trees have survived and doing great. Poplars are 6-8 feet tall second year. Grass plots were planted in spring of 1995 and are establishing well. FY96 poplars 10-15 feet tall, juniper 4-5 feet tall, grass plots are establishing well. FY97 excellent growth for both trees and shrubs. FY99 grass plots are well established. A 1600 feet windbreak with drip system has been added to area (species include row 1: poplars, row 2 mixed shrubs of Siberian peashrub, chokecherry, and Nanking cherry, and row 3 Rocky Mountain juniper. Survival the first year was 98 percent. FY03 This planting was not maintained and plots have failed. **Cancel**

ID94017 Lerwill Multiple willows adaptation demo. Colorado accessions. Cuttings ordered 3/94. Cuttings shipped 4/94. FY94 no evaluation. Some cuttings of each species have survived. The PMC accessions have much better growth than native species. Some loss due to spraying herbicide to control thistles. FY96 willows that survived are doing well. FY97 40 percent survival with surviving willows growing well. They survived spring flooding. FY98 vigor is good with plants now 8 to 10 feet tall and 10 feet crown width. FY03 this planting has been affected by grazing cattle – 6 willows still survive. **Cancel**

ID98009 Lerwill Aberdeen PMC - Laurel willow field planting. Materials ordered 2/9/98. FY98 - FY02 no evaluations. FY03 this planting has been affected by grazing cattle – 6 willows still survive. **Cancel**

ID00011 Richard Beesley Poplar field planting of accessions (15-29; 50-197; OP-367; 184-411; 52-225). Materials shipped from Oregon to Aberdeen PMC April 1998 and transferred to Rexburg same date. FY98 Poplar accessions planted in April were subjected to several hard frosts, and very hot dry summer. Survival was poor at 30 percent. 100 cuttings each of OP367 Hybrid poplar and 52-225 Hybrid poplar were ordered March 1, 2000 from Aberdeen for shipment on about March 7, 2000. FY00 - FY02 no evaluation. FY03 planting failed. **Cancel**

FIELD OFFICE: RIGBY/TERRETON

ID96019a Mud Lake Willows and cottonwood demo planting Laurel, Coyote, White, Robusta poplar, Siouxland poplar, and Carolina poplar. Cuttings ordered 2/20/96. Planted May 8, 1996 using fabric mulch material and drip irrigation. FY96 Water application, started July 5th with willows receiving 7 gallons/week and poplars receiving 12 gallons/week. Flood irrigation by Park officials resulted in over-irrigation and drip system was cut back. 100% survival of all species except coyote which had 70% survival. Good vigor for all species except Carolina poplar which had fair vigor. Growth: Carolina 3.2 feet; Siouxland 5.7 feet; Robust 5.5 feet; Laurel 2.7 feet; White 3.7 feet; Coyote 4.0 feet. FY97 Irrigation: 3 gallons/tree from May through September. Survival/Vigor/Height: Carolina poplar 75%/good/10.5 feet; Siouxland poplar 100%/excellent/14 feet; Robust poplar 100%/fair/7 feet; Laurel willow 100%/excellent/7.5 feet; White willow 100%/excellent/9 feet; Coyote willow 67%/fair/ 4.5 feet. FY98 Survival/ Vigor/Height: Carolina poplar 75%/good/15 feet; Siouxland poplar 100%/excellent/ 20 feet; Robust poplar 100%/fair/12 feet; Laurel willow 100%/excellent/10.5 feet; White willow 100%/good/14 feet; Coyote willow 70%/good/6.5 feet. FY99 Carolina poplar 75% survival with good vigor and 21.2 feet height. Siouxland poplar 100% survival with excellent vigor and 26.4 feet height. Robust poplar 100% survival with poor vigor (yellow leaves) and 16.6 feet height – seedlings are vigorous with good color and suspect Aberdeen stock may have disease. Laurel willow 100% survival with good vigor and 12.4 feet height. White willow 100% survival with good vigor and 18.5 feet height. Coyote willow 70% survival with fair vigor and 6.9 feet height. FY00 Flood irrigated every two weeks with drip irrigation 6-10 gal/week. Carolina poplar 75 percent survival with excellent vigor and 320 inch height. Siouxland poplar 100 percent survival with excellent vigor and 354 inch height. Robust poplar 100 percent survival with poor vigor (disease) and 216 inch height. Laurel willow 100 percent survival with excellent vigor and 180 inch height. White willow 100 percent survival with fair vigor and 240 inch height. Coyote willow 66 percent survival with fair vigor and 90 inch height. FY01 6-year-old planting was flood irrigated every two week this year. Carolina poplar (10-15 feet spacing recommended) - 75% survival, excellent vigor, 36 feet height, 16 feet crown width, and 5.5 inch DBH. Siouxland poplar (10-15 feet spacing recommended) – 100% survival, excellent vigor, 38 feet height, 15 feet crown width, and 5 inch DBH. Robust poplar (10-15 feet spacing recommended) – 100% survival, poor vigor, 25 feet height, 9 feet crown width, and 3.5 inch DBH. Laurel willow (8-10 feet spacing recommended) – 100% survival, good vigor, 17 feet height, 12.5 feet crown width, and 2 inch DBH. White willow (10-12 feet spacing recommended) – 100% survival, fair vigor, 20 feet height, 12 feet crown width, and 2 inch DBH. Coyote willow (3-5 feet spacing recommended) – 70% survival, fair vigor, 8 feet height, and 3 feet crown width. FY02 Carolina poplar 75% survival, excellent vigor, 439 inch height, and 5.75 dbh. Siouxland poplar 100% survival, excellent vigor, 455 inch height, and 17.5 inch dbh. Robusta poplar 100% survival, fair vigor, 319 inch height, and 4 inch dbh. Laurel willow 100% survival, good vigor, 211 inch height, and 2.25 dbh. White willow 100% survival, good vigor, 235 inch height, and 2.25 inch dbh. Coyote willow 66% survival fair vigor, and 139 inch height. FY03 100

percent survival of Carolina poplar (good vigor – 40 feet height), Souixland poplar (good vigor – 44 feet height), Robust poplar (fair-good vigor – 25-25 feet height), Laurel willow (good vigor – 22 feet height – lower limbs dieing), and White willow (excellent vigor – 16 feet height – good density). 50 percent survival of Coyote willow (fair-good vigor – 21 feet height). Souixland best choice of poplars – White willow best choice of willows. **Next evaluation 2007.**

ID96019b Rigby Cottonwood demo planting - Carolina, Siouxland, Robusta. Planted April 29th using fabric mulch and drip irrigation. FY96 Water application 10-14 gallons per week. Growth Carolina 2.0 feet; Siouxland 3.2 feet; Robust 4.0 feet. FY97 100% survival for all poplars. Good vigor for Carolina and Siouxland / poor vigor for Robust. Height 8-9 feet Carolina and Siouxland / 3 feet Robust. FY98 Survival/Vigor/Height: Carolina poplar 100%/good/15 feet; Siouxland poplar 100%/ excellent/18 feet; and Robust poplar 100%/poor/5.5 feet. FY99 Carolina poplar 100% survival with fair vigor and 21 feet height. Siouxland poplar 100% survival with fair vigor and 21 feet height. Robust poplar 100% survival with very poor vigor and 7 feet height. Note – Robust poplars from Lawyers Nursery are thriving, so suspect Aberdeen cuttings may be carrying a disease. FY00 Drip irrigated (14 gal/week) – Carolina poplar 100 percent survival with fair vigor and 240 inch height; Siouxland poplar 100 percent survival with fair vigor and 252 inch height; Robust poplar 100 percent survival with poor vigor and 84 inch height. FY01 6-year-old planting is irrigated with drip irrigation system at 7 gallons per week. Carolina poplar – 100% survival, poor vigor 22 feet height, 7 feet crown width, and 2.5 inch DBH. Siouxland poplar – 100% survival, poor vigor, 24 feet height, 6 feet crown width, and 3 inch DBH. Robust poplar – 100% survival, very poor vigor, 7 feet height, 4 feet crown width, and 1 inch DBH. Drought stress is evident and drip irrigation system is probably not fully functioning with plugged emitters, need for additional emitters, and need for longer watering sets. FY02 Carolina poplar 100% survival, very poor vigor, 300 inch height, and 2.5 inch dbh. Siouxland polar 100% survival, fair vigor, 330 inch height, and 2.75 dbh. Robusta poplar 100% survival, very poor vigor, 92 inch height, and 1 inch dbh. Irrigation system problems were repaired and irrigation sets have been extended - expect improvement next year. FY03 100 percent survival of Carolina poplar (fair to good vigor – 10 feet height – some winter die back), Souixland poplar (good vigor – 28 feet height) and Robusta poplar (very poor vigor – 8 feet height). Best choice Souixland poplar. **Next evaluation 2007.**

ID97019b Camas Creek site 1 Willow field planting. Cuttings of Aberdeen PMC willows - White, Laurel, Streamco, Geyer, Coyote and Meeker PMC willows Scoulers, Pacific, Booth (827), Drummond (828), Greyleaf, Wolf and Geyer (832). Planted April 10, 1997 for streambank protection (no irrigation). On May 21, 1997 Laurel and White were submerged and all others were partially submerged. FY97 Survival/Vigor/Height: White 100%/excellent/3 feet; Laurel 100%/excellent/ 1.5 feet; Streamco 100%/excellent/2.5 feet; Geyer 100%/ excellent/2 feet; Coyote 60%/excellent/2 feet; Scouler 100% excellent/2 feet; Pacific 100%/excellent/3 feet; Booth (827) 100%/good/1.5 feet; Drummond (828) 100%/good/1.5 feet; Greyleaf 80%/fair/2 feet; Wolf 80%/fair/0.5 feet; Geyer (832) 100%/exc./2 feet. FY98 Survival/Vigor/Height: White 100%/good/4 feet; Laurel 100%/fair/2 feet; Streamco 100%/good/3 feet; Geyer 100%/fair/2.5 feet; Coyote 67%/excellent/5-5 feet; Scouler 80%/fair/2 feet; Pacific 100%/good/3 feet; Booth (827) 100%/poor/ 2 feet; Drummond (828) 80%/fair/2.5 feet; Greyleaf 80%/poor/2 feet; Wolf 80%/ poor/l foot; and Geyer (832) 80%/fair/2.5 feet. FY99 White willow 100% survival with good vigor and 6 feet height. Laurel willow 100% survival with fair vigor and 3 feet height. Streamco willow 100% survival with good vigor and 4 feet height. Geyer willow 100% survival with good vigor and 5 feet height. Coyote willow 100% survival with good vigor and 5 feet height. Scoular willow 60% survival with fair vigor and 4 feet height. Pacific willow 100% survival with good vigor and 7 feet height. Booth (827) willow 100% survival with fair vigor and 3 feet height. Drummond (828) willow 20% survival with poor vigor and 2 feet height. Greyleaf willow 80% survival with poor vigor and 1 foot height. Wolf willow 20% survival with poor vigor and 1.5 feet height. Geyer (832) willow 80% survival with fair vigor and 3.5 feet height. FY00 Elk heavily utilize site in winter. Overall the Streamco, White, Pacific, Coyote willows are performing the best under browsed conditions. Streamco is probably the best streambank stabilization willow being tested and is spreading with noticeable root growth. Aberdeen willows - White willow 100 percent survival with excellent vigor and 80 inch height; Laurel willow 75 percent survival with good vigor and 48 inch height; Streamco willow 100 percent survival with good vigor and 48 inch height; Geyer willow 80 percent survival with poor vigor and 60 inch height; Coyote willow 100 percent survival with good vigor and 48 inch height. Meeker willows – Scoular willow 60 percent survival with fair vigor and 40 inch height; Pacific willow 100 percent survival with good vigor and 90 inch height; Booth (827) willow 100 percent survival with fair vigor and 48 inch height; Drummond (828) willow 80 percent survival with fair vigor and 48 inch height; Greyleaf willow 40 percent survival with poor vigor and 28 inch height; Wolf willow 40 percent survival with poor vigor and 28 inch height; Geyer (832) willow 60 percent survival with good vigor and 60 inch height. FY01 riparian planting with moisture provided by stream/subirrigation through 1st week of July (2 years of drought have affected this planting – however, tree type willows Pacific, White, and Streamco are best performers perhaps because they were able to root more deeply than shrub type willows). Scouler willow – 40%

survival, very poor vigor, 4 feet height, and 3 feet crown width. Pacific willow – 100% survival, good vigor, 7 feet height and 7 feet crown width. Booth willow (827) – 100% survival, poor vigor, 2.5 feet height, and 3 feet crown width. Drummond willow (828) – 100% survival, poor vigor, 2.5 feet height, and 2 feet crown width. Greyleaf and Wolf willow failed. Geyer willow (832) – 40% survival, fair vigor, 4 feet height, and 4 feet crown width. White willow – 100% survival, fair vigor, 7 feet height, and 6 feet crown width. Laurel willow – 75% survival, poor vigor, 3 feet height, and 3 feet crown width. Streamco willow – 100% survival, good vigor, 6 feet height, and 8 feet crown width. Geyer (Aberdeen) willow – 100% survival, poor vigor, 3 feet height, and 3 feet crown width. Coyote willow – 40% survival, poor vigor, 4 feet height, and 2 feet crown width. FY02 continuing drought with stream flows drying up in late June. All willows are surviving with reduced growth - Streamco is the most drought tolerant. FY03 **Cancel**

ID98013 Jefferson County Landfill Field planting 1) Ephraim crested wheatgrass, Sodar streambank wheatgrass, and Bannock thickspike wheatgrass; 2) Covar sheep fescue, Schwendimar thickspike wheatgrass, and Secar Snake River wheatgrass. Seed ordered Feb 9, 1998. Site is silty clay loam soil, 0-1 % slope, east aspect, 4785 feet elevation, 10-12 inch ppt, non-irrigated, T6N R33E SEl/4 Section 14. FY98 initial evaluation showed very poor to no establishment of Covar, Schwendimar, Secar, Sodar, and poor to very poor establishment of Ephraim and Bannock. The clay soil portions of the seeding crusted and the sandy soil portion of the seeding may have been too dry. Site should be evaluated one more season before a decision to reseed is made. FY99 Covar – fair stand with poor vigor and .2 plants per square foot. Schwendimar – very poor stand with poor vigor and .1 plants per square foot. Secar – very poor stand with poor vigor and .1 plant per square foot. Bannock fair stand with poor vigor and 1 plant per square foot. Sodar – poor stand with poor vigor and .1 plants per square foot. Ephraim – fair stand with fair vigor and 1 plant per square foot. FY00 Planting Mix 1 – fair stand of Ephraim/Sodar/Bannock is establishing with fair vigor and stand is limiting weed growth. Planting Mix 2 – poor stand of Covar/Schwendimar/Secar is establishing with fair vigor. Secar and Schwendimar failed in planting for the most part, but Covar is establishing slowly. Stand is dominated by kochia weed. Planting 3 – Bannock has good stand with fair vigor. Windbreak planting (drip irrigated) is irrigated once per week for 12-16 hours, is doing very well, and trees are uniform – Russian Olive 5-8 feet height with 5 feet crown width; Rocky Mountain Juniper 3-5 feet height with 3 feet crown width; Siberian Peashrub 4-7 feet height with 4 feet crown width. FY01 the Ephraim-Bannock-Sodar mix and Bannock only plantings are increasing and spreading. Covar in the Covar-Schwendimar-Secar mix is also increasing. Grass densities of 2+ plants per foot squared occur on more favorable sandy soils. The hard packed clayey areas have few grass seedlings established. The windbreak planting is doing very well with 100% survival and very good maintenance for water (drip irrigation system) and weed control. Russian olive is averaging 9 feet tall and 7 feet crowns on sandier soils and 5-6 feet tall with 5 feet crowns on clayey hard packed soils. Junipers and Siberian peashrub are not affected as much by varied soil conditions with Junipers averaging 5 feet tall with 4 feet crowns on sandy soils and 4.5 feet tall with 4 feet crowns on clayey soils. The Siberian peashrub is averaging 6 feet tall with 5 feet crowns on sandy soils and 5.5 feet tall with 5 feet crowns on clayey soils. FY02 grass planting are doing very well and spreading with over 3 plants per square foot. FY03 planting is doing well. **Next evaluation 2006**.

ID98014 Calvin Moser Rush intermediate wheatgrass pasture trial. Seed ordered 2/9/98. Site is sandy loam soil, 0-2 % slope, west aspect, 4795 feet elevation, 10-12 inch ppt, irrigated, T4N R38E SEl/4 Section 29. FY98 two acres of Rush were seeded at the end of March with oats as a cover crop (15 lbs/acre oats). The oats were harvested in mid-September and the Rush is responding with average of one foot tall and 2 plants/ft2 at the end of October. FY99 Rush - excellent stand with excellent vigor, 9000 pounds per acre production, 4 to 6 feet height, and 3+ plants per square foot. Regar – not planted. FY00 good stand with fair vigor and 5400 pounds production. Production lower due to heat and severe drought conditions. FY01 good stand with 3 plants per square feet and good vigor. Stand produced about 4000 pounds per acre this year with two flood irrigation applications. Stand probably would have produced more if cooperator had fertilized planting. FY02 good stand with good vigor - planting produced about 2 tons per acre. **Next evaluation 2006.**

ID01004 Cooperator unknown cottonwood field planting. Ten cuttings each of 9067408 Narrowleaf cottonwood, 9067443 Narrowleaf cottonwood, 9067484 Narrowleaf cottonwood, 9067502 Narrowleaf cottonwood, Robust poplar, Carolina poplar, and Siouxland poplar. FY01 and FY02 no evaluation. FY03 planting is very weedy and poorly maintained. **Cancel**

ID02005 SCD Leafy Spurge Demonstration Plots. Ephraim crested wheatgrass, Covar sheep fescue, Bozoisky Russian wildrye, Luna pubescent wheatgrass, Bannock thickspike wheatgrass, P27 Siberian wheatgrass, Vavilov Siberian wheatgrass, Durar hard fescue, Hycrest crested wheatgrass, Tegmar intermediate wheatgrass, Sodar streambank

wheatgrass, CD-II crested wheatgrass, Newhy hybrid wheatgrass, Syn A Russian wildrye, Rush intermediate wheatgrass and Manchar smooth brome. Seed ordered September 2001. Dormant fall planting 2001. FY02 establishment year: Good stands of P27 Siberian wheatgrass, Hycrest crested wheatgrass, and Rush intermediate wheatgrass; Fair stands of Bozoisky Russian wildrye, Tegmar intermediate wheatgrass, Sodar streambank wheatgrass, Newhy hybrid wheatgrass and Syn A Russian wildrye; Poor stands of Ephraim crested wheatgrass, Covar sheep fescue, Luna pubescent wheatgrass, Bannock thickspike wheatgrass, Vavilov Siberian wheatgrass, Durar hard fescue, CD-II crested wheatgrass and Manchar smooth brome. Weeds are thick in these plots - plots were sprayed this fall to control leafy spurge. FY03 planting destroyed. **Cancel**

FIELD OFFICE: SALMON/CHALLIS

ID80100 IDL Bradbury Flat Multiple Adaptation Evaluation. Planted March 25, 1980. Evaluations 8/7/84, 8/6/86, 7/12/89, 7/7/92, 11/14/95, and 9/99. FY03 evaluated May 21, 2003 by Dan Ogle and Mark Olson - **Next evaluation FY06**.

Accession	Stand	Plants/ft2	Vigor	Comments
B1574 crested wheatgrass	70%	1.0	good-exc.	
P27 Siberian wheatgrass	65%	0.5	good	
Sodar streambank wheatgrass	65%	1.5	good	
AB447 crested wheatgrass	60%	0.5	good	
Secar Snake River wheatgrass	60%	0.25	fair-good	high residue problems
Hatch winterfat	50%	0.5	good-exc.	
AB764 winterfat	50%	0.5	good-exc.	
AB922 fourwing saltbush	1%	< 0.1	fair-good	
AB942 fourwing saltbush	1%	< 0.1	fair-good	

Nezpar Indian ricegrass, Luna pubescent wheatgrass, Goldar bluebunch wheatgrass, Magnar basin wildrye, Topar pubescent wheatgrass, Appar blue flax, NM1143 Firecracker penstemon, Bandera R.M. penstemon, Cedar Palmer penstemon, NM1123 Venus penstemon, AB555 aster, R885a black-eyed susan, Delar small burnet, Immigrant forage kochia, Ladac alfalfa, buckwheat species, and arrowleaf balsamroot failed.

ID80101 IDL Bradbury Flat Multiple Adaptation Evaluation. Planted November 7, 1981. Evaluations 8/7/84, 8/6/86, 7/12/89, 7/7/92, 11/14/95, and 9/99. FY03 evaluated May 21, 2003 by Dan Ogle and Mark Olson - **Next evaluation FY06**.

Accession	Stand	Plants/ft2	Vigor	Comments
B1574 crested wheatgrass	50%	0.5	good	
P27 Siberian wheatgrass	60%	0.75	excellent	
Sodar streambank wheatgrass	80%	1.25	excellent	
AB447 crested wheatgrass	65%	0.5	good-exc.	
Secar Snake River wheatgrass	50%	0.25	good-exc.	High residue problems
AB764 winterfat	20%	0.15	poor	
AB585 winterfat	1%	<0.1	very poor	
AB922 fourwing saltbush	3%	0.1	very poor	
AB942 fourwing saltbush	2%	<0.1	very poor	
Immigrant forage kochia	3%	0.1	fair-good	
Bozoisky Russian wildrye	70%	0.5	excellent	
Vinall Russian wildrye	70%	0.7	excellent	

Nezpar Indian ricegrass, Luna pubescent wheatgrass, Goldar bluebunch wheatgrass, Magnar basin wildrye, Topar pubescent wheatgrass, Appar blue flax, NM1143 firecracker penstemon, Bandera R.M. penstemon, Cedar Palmer penstemon, NM1123 Venus penstemon, Delar small burnet, Lodorm green needlegrass, Blair smooth brome, and Paiute orchardgrass failed

ID82101 BLM Hole In Rock Multiple Adaptation Evaluation. Planted late October 1982. Evaluations 8/7/84, 7/28/86, 7/13/89, 7/7/92, 9/95 and 9/99. **Access to site is very difficult and future evaluations will be cancelled - maintain file for reference.**

ID83100 FS Nip & Tuck Multiple Adaptation Evaluation. Evaluations 7/6/92. 9/95 and 7/02. Site has deteriorated to point future evaluations would provide little future value. **Cancel future evaluations, but maintain file for reference.**

ID82102 BLM Centennial Multiple Adaptation Evaluation. Planted late October 1982. Evaluations 8/7/84, 7/28/86, 7/13/89, 6/26/92, 6/20/95. FY99 not evaluated. FY03 evaluated May 21, 2003 by Dan Ogle and Mark Olson - **Next evaluation FY06**.

Accession	Stand	Plants/ft2	Vigor	Comments
GP52 alfalfa	10%	0.1	fair-good	
BC79 alfalfa	3%	0.05	fair	
RS1 wheatgrass cross	25%	0.5	good	
RS2 wheatgrass cross	15%	0.25	fair	
Newhy hybrid wheatgrass	75%	1.0	good	
Scarlet globemallow	1%	<0.1	fair-good	
Ephraim crested wheatgrass	85%	1.25	fair-good	
Barton western wheatgrass	5%	0.25	poor-fair	
Topar pubescent wheatgrass	1%	<0.1	very poor	
Whitmar beardless wheatgrass	25%	0.25	fair-good	
Goldar bluebunch wheatgrass	25%	0.5	fair-good	
Secar Snake River wheatgrass	50%	0.75	fair-good	
Vinall Russian wildrye	60%	0.75	good-exc.	
Bozoisky Russian wildrye	45%	0.25	excellent	
U7881 alfalfa	1%	<0.1	very poor	
Nordan crested wheatgrass	70%	0.75	good	

Lutana cicer milkvetch, Canbar Canby bluegrass, Immigrant forage kochia, Bandera R.M. penstemon, Cedar Palmer penstemon, Appar blue flax, Paiute orchardgrass, P27 Siberian wheatgrass, Nezpar Indian ricegrass, Magnar basin wildrye, and yellow sweetclover failed

ID82103 BLM Spud Alluvial Multiple Adaptation Evaluation. Planted late October 1982. Evaluations 8/7/84, 7/28/86, 7/13/89, 6/25/92, 11/14/95 and 9/99. FY03 evaluated May 20, 2003 by Dan Ogle and Mark Olson - **Next evaluation FY06**.

Accession	Stand	Plants/ft2	Vigor	Comments
RS1 wheatgrass cross	85%	1.5	fair	
RS2 wheatgrass cross	85%	1.5	fair	
Fairway crested wheatgrass	85%	1.5	fair	
Immigrant forage kochia	50%	2.0	excellent	many young plants
Ephraim crested wheatgrass	75%	1.0	good	
Barton western wheatgrass	<5%	0.1	poor	
Whitmar beardless wheatgrass	70%	1.0	fair	
P27 Siberian wheatgrass	90%	1.5	good	
Goldar bluebunch wheatgrass	30%	0.3	poor	
Secar Snake River wheatgrass	80%	0.75	fair-good	
Vinall Russian wildrye	70%	1.0	good-exc.	
Bozoisky Russian wildrye	85%	0.75	excellent	

BC79 Synthetic alfalfa, GP52 Synthetic alfalfa, scarlet globemallow, Cedar Palmer penstemon, Appar blue flax, Paiute orchardgrass, Topar pubescent wheatgrass, Nezpar Indian ricegrass, Magnar basin wildrye, and yellow sweetclover failed.

ID82104 BLM Jeff's Flat Multiple Adaptation Evaluation. Planted late October 1982. Evaluations 8/7/84, 7/28/86, 7/13/89, 6/26/92. 1995 no evaluation, and 9/99. FY03 evaluated May 19, 2003 by Dan Ogle and Mark Olson - **Next evaluation FY06**.

Accession	Stand	Plants/ft2	Vigor	Comments
GP52 Synthetic alfalfa	1-5%	<0.25	fair	
BC79 Synthetic alfalfa	1-5%	<0.25	fair	
Manchar smooth brome	50%	4	good	
Baylor smooth brome	50%	4	good	
Durar hard fescue	75%	3	good-exc.	
Covar sheep fescue	45%	2	good	
Nordan crested wheatgrass	25%	0.5	fair-good	
P27 Siberian wheatgrass	40%	0.75	good	
Greenar intermediate wheatgrass	65%	4	excellent	
Magnar basin wildrye	5%	0.1	fair	
Vinall Russian wildrye	3%	0.1	poor	
Bozoisky Russian wildrye	5%	0.1	fair	

RS1 wheatgrass cross, RS2 wheatgrass cross, Hycrest crested wheatgrass, Delar small burnet, Lutana cicer milkvetch, Cedar Palmer penstemon, Appar blue flax, Paiute orchardgrass, Sherman big bluegrass, yellow sweetclover failed.

ID82105 BLM Round Valley Multiple Adaptation Evaluation. Planted late October 1982. Evaluations 8/7/84, 8/6/86, 7/12/89, 6/25/92, 11/13/95 and 9/99. FY03 evaluated May 19, 2003 by Dan Ogle and Mark Olson - **Next evaluation FY06**.

Accession	Stand	Plants/ft2	Vigor	Comments
RS1 wheatgrass cross	1%	<0.1	fair	
RS2 wheatgrass cross	1%	<0.1	fair	
Immigrant forage kochia	2%	<0.1	fair-good	
Scarlet globemallow	1%	<0.1	fair	
Nordan crested wheatgrass	70%	1.0	good	
P27 Siberian wheatgrass	70%	1.0	good-exc.	
Vinall Russian wildrye	30%	0.5	good	
Bozoisky Russian wildrye	75%	1.5	excellent	
Nordan crested wheatgrass	60%	1.0	fair-good	

GP52 synthetic alfalfa, BC79 synthetic alfalfa, Critana thickspike wheatgrass, Bandera R.M. penstemon, Cedar Palmer penstemon, Appar blue flax, Paiute orchardgrass, Goldar bluebunch wheatgrass, Secar Snake River wheatgrass, Barton western wheatgrass, Topar pubescent wheatgrass, Whitmar beardless wildrye, Nezpar Indian ricegrass, Magnar basin wildrye, yellow sweetclover failed.

ID82106 BLM Gooseberry/Sheep Creek Multiple Adaptation Evaluation. Evaluations 7/7/92.
FY03 evaluated May 19, 2003 by Dan Ogle and Mark Olson - **Next evaluation FY06**.

Accession	Stand	Plants/ft2	Vigor	Comments
Nordan crested wheatgrass	5%	0.1	fair-good	
Bozoisky Russian wildrye	10%	0.2	poor-fair	
Vinall Russian wildrye	10%	0.3	fair	
Sherman big bluegrass	95%	1.5	fair-good	
Greenar intermediate wheatgrass	2%	<0.1	very poor	
P27 Siberian wheatgrass	1%	<0.1	very poor	
Ephraim crested wheatgrass	3%	<0.1	poor	
Durar hard fescue	85%	2	good	
Covar sheep fescue	80%	2	fair-good	
Manchar smooth brome	50%	0.5	fair	
Baylor smooth brome	20%	0.25	fair	
Fairway crested wheatgrass	5%	0.1	fair	

Magnar basin wildrye, Appar blue flax, Paiute orchardgrass, Cedar Palmer penstemon, Bandera R.M. penstemon, Lutana cicer milkvetch, Delar small burnet, RS2 wheatgrass cross, RS1 wheatgrass cross, BC79 synthetic alfalfa, and GP52 synthetic alfalfa failed.

ID00012 SCD Field Planting – Blanchard blue elderberry, 9023733 dogwood, 9023739 dogwood, and 9023740 dogwood. Materials ordered March 13, 2000 for shipping on April 10, 2000. FY00 - FY03 no evaluations. **Cancel**

ID01001 Cooperator unknown cottonwood field planting. 9067408 Narrowleaf cottonwood, 9067443 Narrowleaf cottonwood, 9067484 Narrowleaf cottonwood, 9067502 Narrowleaf cottonwood, 9067537 Black cottonwood, 9067538 Black cottonwood, 9067562 Black cottonwood, 9067563 Black cottonwood, 9067568 Black cottonwood, 9067569 Black cottonwood, Robust poplar, Carolina poplar, and Siouxland poplar. FY01- FY03 no evaluations. **Cancel**

FIELD OFFICE: ST. ANTHONY

ID02020 Mae Lake Trust field planting. Species include Rush intermediate wheatgrass, Bannock thickspike wheatgrass, Nezpar Indian ricegrass, and Maybell antelope bitterbrush. Seed ordered April 8, 2002. FY03 no evaluation.

PLANT MATERIALS

2003

UTAH EVALUATION SUMMARIES

FIELD, DSI and DEMONSTRATION PLANTINGS

UTAH AREA 1
PLANT MATERIALS PLANTINGS

UT89011 Johnson - Tooele FO Secar Snake River wheatgrass and Hycrest crested wheatgrass field planting for jointed goatgrass control. FY90 seeded in March and stand is establishing. FY91 - FY93 no evaluations. FY94 fair stand of both species. Secar has better vigor and forage production. Secar does not establish as easily as Hycrest. Cattle prefer Secar. FY95 cooperator was disappointed in slow establishment and vigor of Secar in prior years. Secar plants are now well established and very vigorous. Secar is spreading outside of planted rows. During this favorable moisture year Secar remained green and continued to grow throughout the summer. Native bluebunch wheatgrass also remained green the entire growing season. FY96 good stand and vigor for both species. Secar is spreading outside of planted rows, but does not compete well with weeds (goatgrass and morning glory). Cooperator prefers Hycrest for early spring use. Secar is better species for use in later periods. FY97- FY99 no evaluations. FY00 Secar fair stand with good vigor. Hycrest good stand with good vigor. Grazing use is higher on Hycrest (45%) than Secar (10%) in spring grazing period. FY01 and FY02 no evaluation. FY03 Secar fair to good stand – Hycrest good stand. Weed infestation (bindweed) is still a problem with more bindweed in Secar stand than the Hycrest stand. Both species have good vigor. Hycrest is moving into Secar stand. Secar is spreading some from drill rows. Hycrest is spreading into interspaces between rows. Cooperator prefers Hycrest for spring grazing and uniform grazing was observed in both stands in fall.

UT97001 Frank Bohman – Ogden FO Rush intermediate wheatgrass field planting. Site is loamy soil, non-irrigated, 19-inch ppt, 6000 feet elevation, and 30-40% slope on north exposure. Seed ordered July 15, 1996 for dormant fall planting. Seed shipped 9/9/96. FY97 no evaluation. FY98 excellent stand and vigor with .8 AUM/acre. Planting was over-seeded by air the same year as planting resulting in small burnet, orchardgrass, and flax also present in stand. FY99 no evaluation. FY00 excellent stand and vigor with 2 AUM/acre production. This was the first year the planting was grazed in early to mid May. Cooperator is very pleased with planting and production. FY01 - FY02 no evaluations. FY03 **cancel**.

UT98001 Cooperator Unknown – Bonneville FO Pullman PMC shrub field planting - dogwood (3 accessions), chokecherry, mockorange, and Hawthorn. Materials ordered 2/9/98. FY98-FY99 no evaluations. FY00 40 percent survival with fair vigor and 30 inch height. There is a lot of competition from other riparian species, but these plants are surviving and growing slowly. FY01 and FY02 no evaluation. FY03 **cancel**.

UT99002 Scott Hansen - Tremonton FO P27 Siberian wheatgrass, Vavilov Siberian wheatgrass, Rush intermediate wheatgrass, and Goldar bluebunch wheatgrass field planting. Rimrock Indian ricegrass and Maybell antelope bitterbrush demo packets were also ordered. Site is a silt loam soil, 3 percent slope, east aspect, 5075 feet elevation, 20 inch rainfall, and non-irrigated. T12N R2W Section 22 SE Quarter. Seed ordered December 8, 1998 for delivery mid September 1999. FY99 area is heavily infested with weeds. Cooperator plans to control weeds during spring-summer 2000-2001 and plant spring 2002. FY02 no evaluation. FY03 **cancel**.

UT99003 Hathaway Family - Tremonton FO P27 Siberian wheatgrass, Vavilov Siberian wheatgrass, Rush intermediate wheatgrass, Goldar bluebunch wheatgrass, Ephraim crested wheatgrass, Nordan crested wheatgrass, and Lincoln smooth brome field planting. Site is a former beet dump with high organic soil, 1 percent slope, east aspect, 4800 feet elevation, 18 inch rainfall, and non-irrigated. T2N R Section ? Seed ordered December 8, 1998 for delivery as soon as possible. FY99 cooperator plans an additional season of weed control in spring – summer 2000 with planting planned for fall 2000. FY00 weeds continue to be a problem following 3 applications of Roundup this season. FY01 and FY02 no evaluation. FY03 planting failed - **cancel**.

UT99005 Gordon Zito - Tremonton FO Robusta poplar, Carolina poplar, Laurel willow, Golden willow, and White willow field planting. Site is a silt loam soil, 0-25 percent slope, west aspect, 4300 feet elevation, 18 inch rainfall, and non-irrigated. T11N R3W Section 2 NE Quarter. Cuttings ordered December 8, 1998 for delivery about April 1, 1999. FY99 Carolina poplar and white willow failed. Robust poplar .6 percent survival (1 of 15), Laurel willow 13 percent survival (2 of 15), and Golden willow 13 percent survival (2of 15). Best survival in areas near fresh water seep – failure in more saline areas. FY00 site was severely damaged by livestock this season – a few willows remain and will be evaluated next year. FY01 all of the plants are still alive, but showing salt-burn on leaves. FY02 no evaluation. FY03 cattle destroyed planting - **cancel**.

UT99006 Ross McKinnon - Randolph FO Luna pubescent wheatgrass, Rush intermediate wheatgrass, Largo tall wheatgrass, Jose tall wheatgrass, Alkar tall wheatgrass, Bozoisky Russian wildrye, Shoshone beardless wildrye (both seed and plugs), and Prairieland Altai wildrye field planting for saline soil demonstration. Site is silty clay loam soil (saline), 0-1 percent slope, west aspect, 6230 feet elevation, 11 inch rainfall, and non-irrigated. T11N R7E Section 23 NW of NW Quarter. Seed ordered December 8, 1998 for delivery October 1, 1999. FY99 seeding completed in late November 1999. FY00, FY01 and FY02 no evaluations. FY03 planting failed due to drought - **cancel**.

UT99008 Bryner - Logan FO Laurel willow field planting – nursery. Site is Airport loam soil, 7.7 pH, heavy clay sub-soils, 0 slope, 16-inch rainfall zone, high watertable, and 4430 feet elevation. FY99 cuttings planted April 17, 1999 into 12 inch scalped circles, T12N R1E SW quarter of Section 31. Trees are drip-irrigated. June 4, 1999 cuttings have sprouted and appear to be establishing well. FY00, FY01, FY02 and FY03 no evaluations.

UT00001 Don Peterson - Logan FO spring field planting of Rush intermediate wheatgrass (medusahead wildrye control). Leatham silt loam soil, 30 percent slopes, southwest aspect, 5400 feet elevation, 14-17 inch precipitation, non-irrigated, T9N R1E North ½ Section 5. FY00 site burned in fall 1999 and sprayed with Roundup-Escort mix in spring 2000 for medusahead control. Chemical kill of medusahead was excellent. 14 pounds per acre were drilled in 8 inch spacing on May 20, 2000 with good initial germination and establishment. Planted May 2000 with poor initial establishment. Field was reseeded in the fall of 2000. FY01 no evaluation. FY02 stand good with survival estimated at 70 percent, 3-4 plants per square foot, and good vigor. FY03 stand is about 70 percent with fair vigor and good spread.

UT00005A Gordon Zito – Tremonton FO willow field planting. 40 cuttings of 9067556 Coyote willow, 15 cuttings of 9067436 Yellow willow, and 40 cuttings of 9067560 Peachleaf willow were ordered on March 1, 2000 for shipment on April 10, 2000. Planted along Malad River April 20, 2000 on Kr soil, salt limitations, 0-20 percent slopes, west aspect, 4300 feet elevation, 18 inch rainfall, non-irrigated, T11N, R3W, NE ¼ Section 2. FY01 All plants are still alive, but showing salt-burn on leaves. FY02 no evaluation. FY03 planting failed - **cancel**.

UT00005C Bret Selman – Tremonton FO willow field planting. 5 cuttings each of 9067556 Coyote willow, 9067436 Yellow willow, and 9067560 Peachleaf willow were ordered on March 1, 2000 for shipment on April 10, 2000. Planted along Spring Branch of the Little Bear River April 20, 2000 on Kr soil, salt limitations, 0-10 percent slopes, west aspect, 5300 feet elevation, 18 inch rainfall, non-irrigated, T9N, R1E NW ¼ Section 21. FY01 this planting is doing well - more extensive evaluation will occur in FY02. FY03 planting failed - **cancel**.

UT01003 – Randolph FO willow field planting. 9067548 Drummond willow 15 cuttings, 9067435 Geyer willow 15 cuttings, 9067491 Geyer willow 15 cuttings, 9067437 Booth willow 15 cuttings, 9067469 Booth willow 15 cuttings, 9067478 Booth willow 15 cuttings, 9067553 Lemmon willow 15 cuttings, and 9067567 Lemmon willow 15 cuttings. FY01 and FY02 no evaluation. FY03 planting failed due to drought and heavy saline clay soils - **cancel.**

UT01005 Scott Hansen – Tremonton FO field planting. Tarweed control. P27 Siberian wheatgrass, Vavilov Siberian wheatgrass, Ephraim crested wheatgrass, Goldar bluebunch wheatgrass, Nezpar Indian ricegrass, Rimrock Indian ricegrass, Arriba western wheatgrass, Bozoisky Russian wildrye, Mankota Russian wildrye, and Richfield Selection firecracker penstemon. Seed ordered April 16, 2001. FY01 not planted in 2001 or 2002 due to drought. FY03 planted into 4 plots in late March 2003.
Plot 1: Vavilov Siberian wheatgrass, Rush intermediate wheatgrass, and Goldar bluebunch wheatgrass – broadcast planted.

Plot 2: Vavilov Siberian wheatgrass, Rush intermediate wheatgrass, and Goldar bluebunch wheatgrass – broadcast planted.

Plot 3: Vavilov Siberian wheatgrass, Rush intermediate wheatgrass, and Goldar bluebunch wheatgrass – broadcast planted.

Plot 4: Vavilov Siberian wheatgrass, Rush intermediate wheatgrass, Goldar bluebunch wheatgrass, Nezpar Indian ricegrass, Arriba western wheatgrass, P27 Siberian wheatgrass, Ephraim crested wheatgrass, Bozoisky Russian wildrye, Rincon fourwing saltbush, Mankota Russian wildrye, and Rimrock Indian ricegrass – broadcast planted. FY03 initial evaluation during severe drought - Vavilov, P27 and Ephraim fair stands

UT03005 Jon White field planting. Rush intermediate wheatgrass, Topar pubescent wheatgrass, and Tegmar dwarf intermediate wheatgrass were ordered April 18, 2003. Luna pubescent wheatgrass, Oahe intermediate wheatgrass and Regar meadow brome will be provided by cooperator. Purpose: Critical Area Planting - medusahead rye competition. Site Characteristics: Cache County, MLRA E47, 16 acres, Barfuss-Leatham silt loam soil complex, 35 percent slopes, northwest aspect, 5300 feet elevation, 14-17 inch precipitation, non-irrigated, SE1/4 Section 31 T10N R1E. Spring 2003 planting. Planting of 15 pounds per acre was completed on April 29, 2003 using a drill with 6 inch spacing into very good weed free seedbed.

UTAH AREA 2
PLANT MATERIALS PLANTINGS

UT99001 Graymont Western (Lime plant) – Fillmore FO Vavilov Siberian wheatgrass critical area planting. 20 pounds of Vavilov seed was ordered November 19, 1998. The Vavilov will be planted in a mix, which will include Nordan crested wheatgrass, Sodar streambank wheatgrass, Critana thickspike wheatgrass, Nezpar Indian ricegrass, and forbs and shrubs. Site characteristics are a crushed gravelly – silty material lain over rock – cobble material; this material hardens to a near cemented pavement when packed and as moisture occurs; rainfall is about 8-10 inches; site is very windy. Site modifications recommended included 10 ton per acre composted straw, fertilizer based on soil tests, ripping prior to seeding resulting in a rough - rocky soil surface with about 50% of surface being exposed rock to provide micro-sites where seedlings would be protected from constant winds were recommended. FY99 no evaluation. FY00 Three site preparation treatments were installed in the fall/spring of 1998/1999 including 1. Planting directly into shallowly scarified site where soil surface was shattered and smooth; 2. Planting into moderately ripped site where soil surface was rough with approximately 25 percent of surface exposed angular rock; and 3. Planting into severely ripped site where soil surface was very rough with approximately 50 percent of surface exposed large angular rock. Company Manager indicated the past two years were dry winters with below normal rainfall season long. The mid growing season evaluation, on June 6, 2000, indicated Sodar streambank wheatgrass, Bannock or Critana thickspike wheatgrass, Vavilov Siberian wheatgrass, Nezpar Indian ricegrass, penstemon species, scarlet globemallow, winterfat, fourwing saltbush, and Wyoming big sagebrush were all planted and present to some degree on each treatment. Treatment 1 had a 5-10 percent stand present, plants were very small (stunted), and not reproducing (no seedheads present). Treatment 2 had a 30-40 percent stand present, plants were average sized, and a few were reproducing. Treatment 3 had a 70-90 percent stand, plants were tall for site (high vigor), and a high percentage of plants were reproducing. FY01 Graymont has produced a publication "Assessment of Revegetated Test Benches and Reference Transects at Cricket Mountain Plant" that describes the success of this trial. **Next evaluation planned for 2005.**

UT00003 Cooperator Unknown - Beaver FO willow field planting. 50 cuttings each of 9067435 Geyer willow, 9067437 Booth willow, 5730101 Drummond willow, 9067466 Yellow willow, 9067452 Yellow willow, 9067549 Peachleaf willow. Cuttings ordered March 1, 2000 with shipment April 10, 2000. FY00 very poor establishment year due to extreme drought. FY01 grazing has been removed, but deer use is heavy in some locations. Survival-Height-Vigor: 435 Geyer 40% survival, 15 inch height and fair vigor; 437 Booth 46% survival 12 inch height and fair vigor; 101 Drummond 40% survival, 15 inch height and fair vigor; 466 Yellow 20% survival due to poor planting location, 24 inch height and fair vigor; 452 Yellow 80% survival, 26 inch height and excellent vigor; 549 Peachleaf 62% survival, 24 inch height and good vigor. FY02 and FY03 no evaluations.

UT00004 Peterson – Fillmore FO Laurel willow field planting. 100 cuttings ordered March 1, 2000 with shipment April 10, 2000. FY00 no evaluation. FY01 50 percent survival with fair vigor due to inadequate water management. Plant height is 60 inches and crown width is 1-3 feet. FY02 – FY03 no water was available for this planting and planting failed – **cancel**.

UT01002 LaDon Anderson Cottonwood Planting - Fillmore FO Cuttings ordered February 2001 for shipment on April 19, 2001. No evaluation FY01 and FY02. FY03 planting failed – **cancel**.

UT02002 Rasmussen - Fillmore FO demonstration planting of Snake River Plains fourwing saltbush. Seed purchased through Utah Crop Improvement Association. Seed shipped from Aberdeen PMC April 12, 2002. FY03 due to poor climatic conditions, seed has not been planted.

UT03001 Merlin Webb – Cedar City FO. Seed shipped February 2003. Rimrock Indian ricegrass, Critana thickspike wheatgrass, Trailhead basin wildrye, Volga mammoth wildrye , Nezpar Indian ricegrass, Bannock thickspike wheatgrass, Magnar basin wildrye, Vavilov Siberian wheatgrass, P-27 Siberian wheatgrass, Snake River Plains fourwing saltbush broadcast seeded into good seedbed on February 22, 2003. Rained soon after planting was completed.

UT03004 Bob Bliss - Fillmore FO field planting - Durar hard fescue and western wheatgrass. Seed ordered March 20, 2003.

UTAH AREA 3
PLANT MATERIALS PLANTINGS

UT86018 Smith – Roosevelt FO Hycrest crested wheatgrass, Ephraim crested wheatgrass, Appar blue flax, Arriba western wheatgrass, T28606 needle and thread, Magnar basin wildrye, and Nordan crested wheatgrass field planting. FY90 Hycrest, Ephraim, Appar, Magnar, Nordan all 80-100 % survival. Arriba and T28606 are less than 40% survival. FY91 and FY92 no evaluations. FY93 Hycrest, Ephraim, Appar, Nordan, and T28606 doing best. Magnar and Arriba poorer stands. Sagebrush invading site, heavy use by elk, and Appar has many new seedlings. FY94 Hycrest, Appar, Arriba, and Nordan all have good stands. Ephraim, T28606 and Magnar have fair stands. All species are adapted to site and wildlife use is heavy. FY95 no change except vigor has improved due to excellent moisture year. FY96 Hycrest, Ephraim, Appar, T28606 and Nordan have good vigor. Fair vigor for Arriba and Magnar. FY97 Hycrest, Ephraim, Appar, Arriba and Nordan good stands. T28606 and Magnar fair stands. Many sagebrush seedlings within plots, particularly heavy in Arriba western wheatgrass and T28606 needle and thread. FY98 Hycrest, Ephraim, Appar, Arriba, Magnar, and Nordan all have excellent vigor. T28606 has good vigor. FY99 very heavy wildlife use in winter and spring. Poor regrowth due to dry spring/ summer and fair regrowth following late summer rains. Planting is being invaded by sagebrush. FY00 Heavy spring use by wildlife and a very dry spring and summer. Rains began in early September and plants began to green-up. Evaluation indicated good vigor for Ephraim, Appar, Arriba, T28606, Nordan and fair vigor for Hycrest and Magnar. FY01 fair to poor vigor for all species following two years of drought and heavy wildlife use. Sagebrush invasion is effective plant growth and vigor. FY03 good stands of Hycrest, Ephraim, Arriba and Nordan. Fairs stands of T28606 needle and thread and Magnar. Appar failed. Area is experiencing heavy wildlife use.

UT88009 Skyline Mine - Price FO Multiple Grass on critical area planting – slopes. FY90 and FY92 planting summaries available. FY93 portion of seeding destroyed for new beltline. Rest of seeding doing very well. FY95 Appar flax is spreading, both intermediate and pubescent wheatgrass have spread, thickspike wheatgrass is doing very well, Sherman big bluegrass is doing great, mountain rye is not producing well, Paiute is doing well in plots but has not spread, Aster is improving, Covar sheep fescue is not performing well. **FY96** seeding about the same as last year, erosion from slope covered some of the seeding and it will be interesting to see how the plants can withstand this sedimentation. Rush, Sherman and Mountain ryegrass are doing the best overall.
FY99 10 Year Evaluation. Mixture 1: Luna pubescent wheatgrass is very good on steep slopes and fair on gentle slopes. Hycrest crested wheatgrass failed. Manchar smooth brome is not present on steep slopes, but doing very well on gentle slopes. Appar blue flax is fair on steep slopes and excellent on gentle slopes. Kalo birdsfoot trefoil failed on steep slopes and fair on gentle slopes. Delar small burnet and roses are present on both steep and gentle slopes. **Mixture 2:** Topar pubescent wheatgrass is very good on steep slopes and good on gentle slopes. Ephraim crested wheatgrass and Sodar streambank wheatgrass failed. Delar small burnet is fair on steep slopes and very good on gentle slopes. Roses are present on both slopes. **Mixture 3:** Rush intermediate wheatgrass is good on both steep and gentle slopes. P27 Siberian wheatgrass failed. Critana thickspike wheatgrass is fair on both slopes. Cedar Palmer penstemon is poor on steep slopes and fair on gentle slopes. Summit Louisiana sagewort and roses are present on both slopes. **Mixture 4:** Arriba western wheatgrass is fair to good on both slopes. Mountain rye is very good on gentle slopes. Sherman big bluegrass is good steep slopes and excellent on gentle slopes. Summit Louisiana sagewort is fair on both slopes. Roses are present on both slopes. **Mixture 5:** Rosana western wheatgrass is fair on both slopes. Paiute orchardgrass is very good on both slopes. Covar sheep fescue is good on steep slopes and fair on gentle slopes. Bandera Rocky Mountain penstemon is fair on both slopes. Roses are present on both slopes. **Mixture 6:** Tegmar intermediate wheatgrass is fair on both slopes. Durar hard fescue is fair on steep slopes and high fair on gentle slopes. Bannock thickspike wheatgrass is high fair to good on both slopes. Lutana cicer milkvetch is good on both slopes. Roses are present on both slopes. **Mixture 7:** San Luis slender wheatgrass is good on both slopes. Newhy hybrid wheatgrass failed. Cascade birdsfoot trefoil is poor on steep slopes and good on gentle slope. Blueleaf aster is good to very good on both slopes. Western yarrow is good on both slopes. Roses are present on both slopes.
FY02 very difficult to evaluate following 2 years of severe drought. All grasses have very little production.
FY03 15 Year Evaluation: The last several years of drought has damaged these stands. Rain in August 2003 has helped plant survival and vigor. **Mixture 1 – steep slopes:** Luna fair, Manchar failed, Appar failed, Delar failed, Roses are present; **gentle slopes:** Paiute has moved in, Manchar fair, Appar fair, Lutana good. **Mixture 2 – steep slopes:** Topar good, Delar fair, Appar and Roses are present; **gentle slopes:** Delar good, Topar good, Appar good. **Mixture 3 – steep slopes:** Rush good, Critana failed, Cedar failed, Summit good, Roses are present; **gentle slopes:** Rush good,

Critana fair, Cedar failed, Lutana good. **Mixture 4 – steep slopes:** Arriba good, Mountain rye fair, Sherman failed, Summit fair, Roses and Goldenrod present; **gentle slopes:** Arriba good, Mountain rye good, Sherman fair, Lutana good, Summit fair, Roses and Goldenrod present. **Mixture 5 – steep slopes:** Rosana good, Paiute fair, Covar fair, Bandera failed, Current and Roses present; **gentle slopes:** Rosana fair, Paiute good, Covar good, Bandera fair, Appar fair, Lutana good. **Mixture 6 – steep slopes:** Tegmar good, Durar failed, Bannock failed, Lutana good, Roses and Current present; **gentle slopes:** Tegmar good, Durar poor, Bannock fair, Lutana good, Paiute fair. **Mixture 7 – steep slopes:** San Luis fair, Cascade failed, Blueleaf aster good, Western yarrow fair, Roses present; **gentle slopes:** San Luis good, Blueleaf aster good, Western Yarrow fair, Lutana fair.

UT90017 Snowball - Price FO Multiple species irrigated demo plots for saline soils. FY92 and FY94 detailed reports available. Irrigation has pushed salinity down below root zone to a large degree. FY95 and FY96 Cicer milkvetch best producer (5279 lbs/ac) followed by San Luis (2587), Revenue (2326), Alsike (1986), Newhy (1673), Hoffman (1646), Festorina/Forager/Tall wheatgrass (1460), Shoshone/Fawn/Altai (1350), Magnar (1125), Garrison (1050), and Kura/Matua/ Trefoil 850) FY99 No yield data gathered. Excellent stands include Shoshone beardless wildrye, Fawn tall fescue, Newhy hybrid wheatgrass, Festorina tall fescue, Forager tall fescue, RS Hoffman, Kura clover, and SP90 Kura clover. Good stands include: Prairieland altai wildrye, Revenue slender wheatgrass, San Luis slender wheatgrass, Jose tall wheatgrass, Garrison creeping foxtail, Johnstone tall fescue X perennial rye, Lutana/Monarch cicer milkvetch, Regar meadow brome, and orchardgrass. Poor stands include Magnar basin wildrye, some plots of cicer milkvetch, Cascade birdsfoot trefoil, and Dakota/Forestburg switchgrass. Mowing significantly reduces vigor of basin wildrye and switchgrass. Festorina and Forager are preferred over Fawn by sheep. Alsike clover and Matua brome failed/died. The fescue x perennial ryegrass appears to show some signs of winterkill. FY03 No water was applied to plots in 2003. Prairieland Altai wildrye good stand with fair vigor and poor production. Magnar basin wildrye very poor stand with fair vigor and very poor production. Shoshone beardless wildrye fair stand with fair vigor and poor production. Revenue slender wheatgrass failed (short-lived species). San Luis slender wheatgrass failed (short-lived species. Jose tall wheatgrass fair stand with poor vigor and poor production. Monarch cicer milkvetch fair to very poor stand with fair vigor and very poor production. Garrison creeping foxtail fair stand with poor vigor and poor production. Fawn tall fescue good stand with poor vigor and poor production. Newhy hybrid wheatgrass good stand with fair vigor and fair production. Cascade Birdsfoot trefoil failed. Festorina tall fescue good stand with poor vigor and poor production. Forager tall fescue good stand with poor vigor and poor production. Tall fescue – perennial rye cross fair stand with poor vigor and poor production. Orchardgrass poor stand with very poor vigor and very poor production. RS Hoffman grass good stand with fair to good vigor and fair production. Kura clover poor stand with very poor vigor and very poor production. 18SP90 Kura clover poor stand with very poor vigor and very poor production. The few remaining Magnar basin wildrye plant and Altai wildrye plants produced seedheads. RS Hoffman appears to be doing better under drought conditions than Newhy.

UT93005 Smith – Roosevelt FO Trailhead basin wildrye, Magnar basin wildrye field planting for erosion control. FY94 planted October 1993 and initial evaluation indicated Magnar with best seedling establishment and Trailhead doing best in run in areas. FY95 both Trailhead and Magnar rated good stands. Magnar is best adapted. FY96 good stands for both, good vigor for both, good drought tolerance for both, all seedheads of both species eaten by wildlife. FY97 excellent stands and plant vigor for both cultivars. Plant height about 50 inches for Magnar and 38 inches for Trailhead. Magnar has excellent seed production and Trailhead has fair seed production. FY98 excellent vigor and long seedheads for both cultivars. Magnar is a more robust and taller plant than Trailhead. FY99 no evaluation. Excellent stands of each with good vigor and approximately 50 inch height. Basal areas are getting larger, but no seed production this year due to spring/summer drought. FY00 due to very dry spring and summer with rains coming in early September resulting in green-up, both Trailhead and Magnar had fair vigor and only 36-40 inches of growth. FY01 both Magnar and Trailhead have poor vigor after very dry spring and summer (7.7 inches of precipitation this year). Each plant only has 2-3 reproductive stems, which probably did not produce seed this year. FY03 – Fair vigor for both Magnar (45 inch height – 0.5 AUM/ac) and Trailhead (38 inch height – 0.3 AUM/ac). Elk are using the fall greenup.

UT98005 Prevedel – Roosevelt FO Rush intermediate wheatgrass sprinkler irrigated field planting. Materials ordered 3/30/98. FY98 planted August 16, 1998 into excellent seedbed. FY99 excellent stand with excellent vigor and 20 plants per square foot. In early August plants went from very palatable to coarse. Fall rains softened it up making it more palatable to elk now utilizing field. FY00 stand produced approximately 3000 pound/acre under sprinkler irrigation. Elk graze stand until it gets rank, but will graze regrowth. Cooperator states Rush is an excellent grass for intensive grazing systems. FY01 excellent stand and vigor with 7 AUMs per acre. Cooperator is very satisfied with Rush intermediate wheatgrass performance. FY03 Rush is doing very well in the excessive heat of this summer and is

becoming more dominant in the pasture mix of Rush, Regar meadow brome and Paiute orchardgrass. Still producing about 7 AUM/ac.

UT99007 Curtis Rozmon - Price FO field planting on irrigated pasture. Trial includes 905438 switchgrass, 905439 switchgrass, Cave-In-Rock switchgrass, Blackwell switchgrass, Kanlow switchgrass, Latar orchardgrass, perennial ryegrass, and white clover. Site is MLRA D35, loamy fine sand soil, 0-1 percent slope, southwest exposure, 4000 feet elevation, 6-8 inch precipitation, irrigated, T23S R16E SE1/4 Section 25. Seed ordered March 22, 1999. FY99 not planted this year. FY00-FY03 didn't plant due to extreme drought.

UT00007 George Carter – Monticello FO. Tegmar intermediate wheatgrass - Topar pubescent wheatgrass – Paiute orchardgrass critical area planting. Seed ordered July 5, 2000. Site characteristics: Herm-Lles clay loam to stony loam, 8 percent slopes, west aspect, 8500 feet elevation, 14-16 inch rainfall zone, irrigated for establishment, T26S R23E Section 24. Planting planned for October 2000. FY01 no evaluation. FY02 planting was irrigated for establishment. Good stand of all three species establishing with good vigor. FY03 excellent stand of all three species with excellent vigor and production. Stand continues to be irrigated

UT01004 Monument Valley High School – Monticello FO. Critical Area Planting – Volga mammoth wildrye. Seed ordered April 2001. FY01 no evaluation. FY02 – FY03 grass came up initially, but wind blown sand cut the plants off at ground level resulting in stand failure – **cancel**.

UT02001 Ken Pickup – Roosevelt FO. Field planting. Rush intermediate wheatgrass (3 acres) - Topar pubescent wheatgrass (5 acres) – Paiute orchardgrass (2 acres). Site information: MLRA D34, Turzo silt loam soil, 8 inch precipitation zone, irrigated, 4800 feet elevation, 2% slope, south exposure, T7S R2E Section 16. Seed ordered April 19, 2002. FY03 fair stand of Rush producing about 1 AUM/ac with fair vigor. Fair stand of Topar producing about .75 AUM/ac with fair vigor. Weeds are a problem in both stands of grass.

UT03002 David James – Monticello FO demonstration planting. Northern Cold Desert winterfat seed ordered February 18, 2003. Site information: MLRA D35; Limeridge shallow sandy loam soil series; 4 percent slope; south aspect; 4800 feet elevation; 6-8 inch precipitation zone; non-irrigated; T40S R20E Sections 6 and 36.

UT03003 Mike Wilcox - Monticello FO field planting. UT98004 planted fall (seeding germinated) 1998, but failed due to drought with little to no winter-spring precipitation. This is a dormant fall replanting of Rush intermediate wheatgrass. Luna pubescent wheatgrass is the standard of comparison. Barnam loam soil, 3 percent slopes, south aspect, 6000 feet elevation, 14 inch precipitation, non-irrigated, T31N R26E Section 8. FY00 very little germination this spring (<10%) due to very dry spring. FY01 no evaluation. UT00002 FY02 planting failed due to drought. Seed (Topar pubescent wheatgrass) for UT03003 ordered 2-21-03. FY03 not planted due to drought.

United States Department of Agriculture

NRCS Natural Resources Conservation Service

Plant Materials Center

2002
Aberdeen Plant Materials Center
Progress Report of Activities

Issued January, 2003

P.O. Box 296, Aberdeen, ID 83210, Tel: 208-397-4133, Fax: 208-397-3104, Web site: Plant-Materials.nrcs.usda.gov

Aberdeen Plant Materials Center office and greenhouse

Who We Are

The mission of the NRCS Plant Materials Program is to develop and transfer effective state-of-the art plant science technology to meet customer and resource needs. The Aberdeen Plant Materials Center (PMC) was established in 1939 to develop plant materials and techniques for establishment and management of plants for use in resource conservation activities in the Western United States.

There are 26 PMCs nationwide, each serving a particular geographic area. The Aberdeen PMC serves the portions of the Intermountain West including southern Idaho, western Utah, Nevada, northeastern California, and southeastern Oregon.

Program Emphasis

The activities of the Aberdeen PMC are guided by a long-range plan. The priority work areas are:

- **Plant Releases, seed and plant production**
- **Rangeland in poor ecological condition**
- **Riparian and wetland degradation**
- **Agroforestry**
- **Technology transfer and education**

This document highlights some of the major activities at the PMC during 2002. For detailed information, contact the staff at the PMC or the Idaho-Utah Plant Materials Specialist.

Herbicide Trials

The PMC has been cooperating with the University of Idaho to evaluate herbicides that can be used on rangeland to control weeds during the establishment of seedings. One of the trials conducted was to observe the effects of Plateau® herbicide on established perennial grasses that had been burned. The evaluation was conducted during the 2001-growing season on 54 accessions of grasses in the display nursery at the PMC Home Farm. The photograph below shows the effects of the herbicide application.

One half of each plot (right hand side of photo) was sprayed. Plant height was reduced 40 to 60 percent from the herbicide application. Dry matter forage yield was reduced 30 to 60 percent

and the herbicide killed several varieties. The herbicide application delayed initial spring growth and the forage in the treated plots was finer stemmed and less coarse which corresponded to the forage quality data that was also collected.

Maple Grove Flax

In 1980, the United States Department of Agriculture, Shrub Sciences Laboratory, Provo, Utah and the Aberdeen PMC cooperatively released 'Appar' blue flax. Appar is recommended as a component of a seed mixture to provide diversity and beauty. It was originally identified as a native species to North America but was later determined to be an introduced species from Europe. The Shrub Sciences Laboratory has been evaluating native blue flax accessions and requested the PMC to assist in a study to compare Appar to one of the more promising native collections.

The PMC has been comparing Appar to an accession that was originally collected near Maple Grove, Utah. Maple Grove produces 70 to 90 percent as much seed as Appar, an important consideration for seed growers. It is anticipated that Maple Grove will be released as a selected class germplasm to be available to seed growers in early 2004.

Trout Creek, Nevada Off-Center Upland Test Site Evaluated

The PMC recently evaluated the off-center upland test site at Trout Creek, Nevada that was seeded in November, 1987. The purpose of the planting was to evaluate the potential of grasses and shrubs for revegetation and forage for livestock and wildlife in areas of 8 - 12 inches annual

precipitation in northeastern Nevada and south central Idaho.

As a group, the crested wheatgrass accessions have the best stands fifteen years after the site was planted. The native wildrye accessions had the next best stands followed by Russian wildrye accessions. Indian ricegrass accessions had no stands remaining fifteen years after planting.

Breeder and Foundation Seed Production

The PMC is responsible for Breeder and Foundation seed production of 17 plant releases. During 2002, the PMC had Foundation seed fields of 'Magnar' basin wildrye, 'Goldar' bluebunch wheatgrass, 'Nezpar' Indian ricegrass, 'Paiute' orchardgrass, 'Bannock' thickspike wheatgrass, 'Delar' small burnet, Richfield Selection firecracker penstemon, Clearwater Selection Venus pentsemon, Northern Cold Desert Selection winterfat and Snake River Plains Selection fourwing saltbush. Anatone bluebunch wheatgrass and Maple Grove flax fields were also established.

Certified Foundation seed of the releases from the PMC are provided to seed growers through the University of Idaho Foundation Seed Stocks Program and the Utah Crop Improvement Association.

Interagency Riparian/Wetland Plant Development Project

The Interagency Riparian/Wetland Plant Development Project was established in 1991. NRCS and several federal, state, local, and private organizations decided that they needed more information on how to propagate and plant riparian and wetland plants, how to establish and maintain wetland and riparian vegetation in artificial situations, and other uses related to water quality improvement.

Riparian Ecology and Restoration Workshops

As part of our technology transfer program, a two-day Riparian Ecology and Restoration Management Workshop was developed. The first day of the workshop is devoted to the classroom where basic riparian dynamics, riparian zone vegetation, plant acquisition, and bioengineering techniques are discussed. The second day is spent at a field location where participants classify the riparian site and install a series of bioengineering treatments on an eroding section of streambank.

Each year the Project conducts several workshops in different parts of our service area. This year workshops were held in Bend, OR for the Deschutes Land Trust and at Malheur National Wildlife Refuge south of Burns, OR.

In Bend, we trained volunteers for the Deschutes Basin Land Trust who were interested in streambank bioengineering on streams in the Deschutes Basin.

At Malheur NWR, planting and bioengineering recommendations were made for the realignment of the Donner and Blitzen River to enhance fish habitat.

Wetland Enhancement to improve Northern Leopard Frog Habitat on the Pyramid Lake Shoshone Paiute Tribal Lands

In March, the project assisted the Pyramid Lake Shoshone-Paiute tribe and Nevada NRCS in the development of additional habitat for the northern leopard frog (*Rana pipiens*). Consultants designed construction aspects of the wetland to improve the habitat components for the northern leopard frog and the project designed the vegetative components. Volunteers from a variety of organizations and tribal employees spent several days planting a variety of native wetland plants collected from adjacent areas.

After one growing season, the plants have established and filled in. Over the course of the summer, additional frogs have been observed in the new wetland.

Native American Native Plant Nursery Conference

In June, Chris Hoag presented two papers on propagation of Nebraska Sedge and the use of the waterjet stinger to plant hardwood cuttings. Representatives from Tribal native plant nurseries from throughout the country attended a two day session on how to operate a native plant nursery and how to propagate a wide variety of native plants.

Homedale High School Constructed Wetland System and Outdoor Classroom

In May, assistance was provided to the Homedale, Idaho School District and the Southwest Idaho RC& D in the design and planting of a Constructed Wetland System. The system will treat irrigation wastewater from farmland owned by the school district. The wetland will also serve as an outdoor classroom for the students in the Homedale School District. The students will learn about wetlands, wetland plants, water quality issues, invertebrate populations, and wildlife that use wetlands. The installation of the system also demonstrates that the school district, as a landowner, is interested in protecting surface and ground water.

Waterjet Stinger Trailer

The waterjet stinger was originally designed to fit on the back of a large 4-wheeler. In field trials, we found that there wasn't much room for the ATV driver. Boyd Simonson developed a trailer that would attach to the 4-wheeler and pack all of the parts and pieces of the waterjet stinger. He also added barrels to carry cuttings. Now the entire waterjet stinger can be hauled to the site and up and down the stream planting section. The pump can be operated on the trailer or dismounted and placed on the streambank. When the planting is completed, the trailer with all the equipment can be loaded into a pickup truck. The PMC plans to develop a Technical Note that will include design specifications and a cost estimate.

Check out the Riparian/Wetland Project web page attached to http://plant-materials.nrcs.usda.gov/idpmc for further information and more papers on wetland and riparian plants and management.

Conservation Plant Materials Tested at Trout Creek, Nevada

Loren St. John, Aberdeen Plant Materials Center

In 1987, an off-center advanced upland plant test site in an 8 to 12 inch annual precipitation zone was established at Trout Creek, approximately 20 miles southeast of Jackpot, Nevada. The PMC is cooperating with the Bureau of Land Management, San Jacinto Ranch, Salmon River Grazing Association and the Northeast Elko Conservation District at this test site. The PMC is also evaluating riparian plants and bioengineering practices along the creek that runs through the test site.

The upland grass and shrub plots were planted in November, 1988. There were 51 accessions of grasses, 7 accessions of fourwing saltbush and 6 accessions of winterfat planted in complete randomized block designs with 4 replications. A bottomland grass performance trial included 5 accessions of wildrye species and an upland display nursery including 64 accessions of grasses, forbs and shrubs was also planted.

In September, 2002 Dan Ogle and myself evaluated the plots. It was quite interesting to observe how the planted accessions had performed since they were planted in November, 1988 - fifteen years of some good conditions as well as some pretty tough conditions in terms of annual precipitation. We evaluated percent stand, plant vigor, ability to spread and also estimated forage production.

As a group the crested wheatgrass accessions had the best stands 15 years after the site was planted. The native wildrye group had the next best stands followed by the Russian wildrye accessions. Accessions of fourwing saltbush also performed well. Indian ricegrass accessions had disappeared from the test site.

Forage production significantly declined from data collected in 1992 to the data collected in 2002. The decline in stands and forage yields is primarily attributed to a series of 3 years of poor winter and spring precipitation before the evaluation that was conducted in 2002. The buildup of excess plant residues because the plants are not grazed or harvested periodically has also resulted in lower plant vigor and productivity.

A detailed summary of the data from the upland test plots and a project report have been completed and is available. To obtain a copy, contact Loren St. John at the PMC or Dan Ogle, Plant Materials Specialist in Boise, Idaho.

Submitted to Idaho, Nevada, Oregon, and Utah NRCS State Offices for inclusion in "Current Developments" June, 2003.

Windbreak Maintenance Pointers

Loren St. John, Aberdeen Plant Materials Center

We all are aware that once a windbreak is planted, there are important maintenance items that should be performed. The following checklist of items may help your field office customers to enhance the function and value of their windbreaks.

- Controlling weeds reduces plant stress, improves windbreak growth rates and can also reduce susceptibility to insect and disease damage.

- Replace dead trees and shrubs during the first three years of the windbreak. Gaps reduce the effectiveness of the windbreak and can also be an eyesore.

- Ensure that the irrigation system is operating properly during each growing season. Check for trees or shrubs that are getting too much as well as too little water.

- Inspect the windbreak often during the growing season to spot any insect or disease damage that may be taking place. Catch problems early and implement control measures.

- Inspect windbreak frequently for signs of animal damage. Find problems early and initiate control measures.

- Pruning windbreaks should be discouraged unless the health of the windbreak is at risk or safety is a factor. If pruning is necessary, use proper equipment and pruning techniques.

- If weed barrier fabric was installed on the windbreak, make sure that fabric is not damaging trees and shrubs by rubbing or girdling the trunk or stem. You may need to enlarge the slit in the fabric as trees and shrubs grow larger.

Plant Materials Technical Note No. 43, Tree Planting Care and Management provides guidance for establishing and management of woody planting practices. Be sure to review it for specific maintenance pointers.

Submitted to Idaho, Oregon, Nevada, and Utah NRCS State Offices for inclusion in "Current Developments" May 29, 2003.

New Tools from the Plant Materials Toolkit

Loren St. John, Aberdeen Plant Materials Center

The Aberdeen PMC is cooperating with the Bureau of Land Management and the Forest Service to release a native flax and a bluebunch wheatgrass. These new releases will be a nice addition to the Plant Materials "toolkit" that you use to help solve resource problems.

In 1980, the Forest Service Shrub Sciences Laboratory in Provo, Utah and the Aberdeen PMC cooperatively released 'Appar' blue flax. It is recommended as a component of a seed mixture to provide diversity and beauty. Appar was originally identified as a native species to North America but was later determined to be an introduced species from Europe.

The PMC is assisting the Shrub Sciences Lab to compare Appar to one of the more promising native accessions collected near Maple Grove, Utah. The Maple Grove Selection produces 70 to 90 percent as much seed as Appar, an important consideration for seed growers. The PMC has established a seed increase field at the PMC and Certified seed will be available to commercial seed growers in early 2004.

'Goldar' was the first released cultivar of bluebunch wheatgrass. It was released by the Aberdeen PMC and the ARS Forage and Range Laboratory Logan, Utah in 1989. Goldar has been noted for rapid establishment, high forage production and the ability to survive in areas receiving at least 12 inches of annual precipitation. However, less than desirable seedling vigor has occasionally been noted. The PMC is assisting the Shrub Sciences Lab to increase seed of 'Anatone' bluebunch wheatgrass.

'Anatone' was selected from seed originating near Anatone, Washington. Its full range of adaptation is unknown at this time but it is expected to have rapid establishment, and to survive in areas receiving at least 10 inches of annual precipitation. The seed increase field that the PMC established last spring did exhibit excellent seedling vigor. Certified seed from the Anatone seed increase field at the PMC will also be available to commercial seed growers in early 2004.

These new plant materials products have been developed under the auspices of the Great Basin Native Plant Selection and Increase Project. This work is funded by the Bureau of Land Management Great Basin Restoration Initiative and the Forest Service Rocky Mountain Research Station with many other cooperating agencies including the Aberdeen PMC.

Submitted to Idaho, Nevada, Oregon, and Utah NRCS State Offices for inclusion in "Current Developments" June, 2003.

Maintenance Tips for Your Windbreak or Ornamental Plantings

Loren St. John, Aberdeen Plant Materials Center

We should be are aware that once a windbreak or ornamental area is planted, there are important maintenance items that need to be performed. The following checklist of items may help you to enhance the function and value of your windbreak or ornamental planting.

- Controlling weeds reduces plant stress, improves tree and shrub growth rates and can also reduce susceptibility to insect and disease damage.

- Replace dead trees and shrubs during the first three years of the windbreak or ornamental planting. Gaps reduce the effectiveness of windbreaks and can also be an eyesore.

- Ensure that the irrigation system is operating properly during each growing season. Check for trees or shrubs that are getting too much as well as too little water.

- Inspect the windbreak or ornamental planting often during the growing season to spot any insect or disease damage that may be taking place. Catch problems early and implement control measures.

- Inspect frequently for signs of animal damage. Find problems early and initiate control measures.

- Pruning windbreaks should be discouraged unless the health of the windbreak is at risk or safety is a factor. If pruning is necessary, use proper equipment and pruning techniques. Ornamental plantings may require pruning occasionally but be sure to use proper equipment and techniques.

- If weed barrier fabric was installed on the windbreak or ornamental planting, make sure that fabric is not damaging trees and shrubs by rubbing or girdling the trunk or stem. You may need to enlarge the slit in the fabric as trees and shrubs grow larger.

For additional information on windbreak maintenance and guidance in windbreak establishment and woody planting management practices, check out the Aberdeen Plant Materials Center web site at http://Plant-Materials.nrcs.usda.gov/idpmc. Click on publications and look for Plant Materials Technical Note No. 43, Tree Planting, Care and Management. Also, feel free to give us a call at (208) 397-4133 for further information.

Submitted by Loren St. John, Aberdeen Plant Materials Center
(208)397-4133
Loren.Stjohn@id.usda.gov

Submitted to:

Aberdeen Times
Idaho State Journal
Post Register

August 19, 2003

Aberdeen Plant Materials Center

Economic Impact

"The plant materials program and its cooperators have contributed the bulk of the material and technology now used in ecosystem restoration and are our foundation for meeting conservation challenges of the future."
D. T. Booth and T. A. Jones, Plants for Ecological Restoration: a foundation and philosophy for the future. In: *Native Plants Journal, Spring 2001*

Seed and Plant Production – What is it Worth?

The sale of seed and plants represents a significant economic value to growers, distributors, and retailers. The following table summarizes the annual 2002 value to local communities from 254 plant releases nationwide and 17 plant releases from the Aberdeen, Idaho, Plant Materials Center.

	Releases from All Plant Materials Centers		Releases from Aberdeen Plant Materials Center	
Type	**Amount (lbs)**	**Annual Value**	**Amount (lbs)**	**Annual Value**
Certified Seed	8,672,431	$38,776,762	2,031,795	$11,213,477
Common Seed	8,675,177	$37,562,171	2,348,050	$12,959,340
All Plants	16,194,338	$17,081,734	----------	----------
Total Annual Value		**$93,420,667**		**$24,172,817**

Conservation Benefits – What is the Value?

Plant materials program releases are used to address a wide variety of conservation needs throughout the U. S. and beyond our borders. Based on the annual commercial production of seed and plants during the year 2002, it is estimated that Plant Materials Program releases had the following impact:

- enough seed to plant 3.4 million acres (Aberdeen 0.87 million acres)
- enough plants to revegetate 16,000 acres
- enough trees and shrubs to plant a row 2,000 miles long
- in all, Plant Materials Program releases would cover an area three times the size of Delaware

The Plant Materials Program transfers seed production technology to growers

Technology Development – Who Uses It?

Private landowners, NRCS field offices, federal and state land management agencies and many conservation partners benefit from the more than 400 non-genetically manipulated plant releases available and the associated plant science technology. Nearly 75 percent of the plant releases listed in the NRCS Field Office Technical Guide are from the USDA-NRCS Plant Materials Program.

For more information: http://Plant-Materials.nrcs.usda.gov

NRCS Natural Resources Conservation Service

N
▲

PMC Display Nursery Field 20 (planted June, 2002)
12 inch or less precipitation

one drill width border mix	
Sand Hollow squirreltail	*Elymus multisetus*
High Plains sandberg bluegrass	*Poa secunda (Poa sandbergii)*
Canbar canby bluegrass	*Poa secunda (Poa canbyi)*
Sodar streambank wheatgrass	*Elymus lanceolatus ssp. lanceolatus*
Schwendimar thickspike wheatgrass	*Elymus lanceolatus ssp. lanceolatus*
Bannock thickspike wheatgrass	*Elymus lanceolatus ssp. lanceolatus*
Critana thickspike wheatgrass	*Elymus lanceolatus ssp. lanceolatus*
Vavilov Siberian wheatgrass	*Agropyron fragile*
P-27 Siberian wheatgrass	*Agropyron fragile*
Nordan crested wheatgrass	*Agropyron desertorum*
Hycrest crested wheatgrass	*Agropyron cristatum* X *desertorum*
CD-II crested wheatgrass	*Agropyron cristatum* X *desertorum*
Roadcrest crested wheatgrass	*Agropyron cristatum*
Douglas crested wheatgrass	*Agropyron cristatum*
Fairway crested wheatgrass	*Agropyron cristatum*
Ephraim crested wheatgrass	*Agropyron cristatum*
Whitmar beardless wheatgrass	*Pseudorogneria spicata*
Anatone bluebunch wheatgrass	*Pseudorogneria spicata*
P-238 bluebunch wheatgrass	*Pseudorogneria spicata*
P-7 bluebunch wheatgrass	*Pseudorogneria spicata*
Goldar bluebunch wheatgrass	*Pseudorogneria spicata*
Secar Snake River wheatgrass	*Elymus wawawaiensis*
Tetracan Russian wildrye	*Psathyrostachys juncea*
Mankota Russian wildrye	*Psathyrostachys juncea*
Bozoisky-Select Russian wildrye	*Psathyrostachys juncea*
one drill width border mix	

12 - 16 inch precipitation

Rosana western wheatgrass	*Pascopyrum smithii*
Arriba western wheatgrass	*Pascopyrum smithii*
Sherman big bluegrass	*Poa secunda (Poa ampla)*
San Luis slender wheatgrass	*Elymus trachycaulus*
Pryor slender wheatgrass	*Elymus trachycaulus*
Covar sheep fescue	*Festuca ovina*
Bighorn sheep fescue	*Festuca ovina*
Durar hard fescue	*Festuca trachyphylla*
Newhy hybrid wheatgrass	*Elytrigia* X *Pseudoroegneria*
Paiute orchardgrass	*Dactylis glomerata*
Rush intermediate wheatgrass	*Thinopyrum intermedium*
Oahe intermediate wheatgrass	*Thinopyrum intermedium*
Luna pubescent wheatgrass	*Thinopyrum intermedium*
Reliant intermediate wheatgrass	*Thinopyrum intermedium*
Manska pubescent wheatgrass	*Thinopyrum intermedium*
Magnar basin wildrye	*Leymus cinereus*
Trailhead basin wildrye	*Leymus cinereus*
Shoshone beardless wildrye	*Leymus triticoides*
Prairieland altai wildrye	*Leymus angustus*
Alkar tall wheatgrass	*Thinopyrum ponticum*
Jose tall wheatgrass	*Thinopyrum ponticum*
Largo tall wheatgrass	*Thinopyrum ponticum*
Garnet mountain brome	*Bromus marginatus*
Bromar mountain brome	*Bromus marginatus*
one drill width border mix	

16 inch or greater precipitation

BG-23 Perennial rye	*Lolium perenne*
Garrison creeping foxtail	*Alopecurus arundinaceus*
Hi-Mag tall fescue	*Lolium arundinaceum*
Johnstone tall fescue	*Lolium* X *Festuca*
Potomac orchardgrass	*Dactylis glomerata*
Latar orchardgrass	*Dactylis glomerata*
Manchar smooth brome	*Bromus inermis*
Regar meadow brome	*Bromus biebersteinii*
Fleet meadow brome	*Bromus biebersteinii*
Paddock meadow brome	*Bromus biebersteinii*
one drill width border mix	

The Aberdeen Plant Materials Center in cooperation with the South Bingham Soil Conservation District established this display nursery in June, 2002. The purpose of the display nursery is to allow the public to observe grasses used to conserve soil, provide forage for livestock and wildlife, habitat for wildlife and to improve water quality. This guide is intended to provide you basic information on each of the varieties included in the display. The display nursery includes 59 varieties of 29 different grass species arranged so similar varieties are located next to each other for visual comparison. Irrigated grasses are grouped together on the south side and grasses used in more arid desert areas are found on the north side. Each plot has a sign for identification and a map is also included for your convenience. The following descriptions begin with the non-irrigated grasses on the north side of the display nursery.

Squirreltail, Bottlebrush *Elymus elymoides* ssp. *elymoides or californicus* and *Elymus multisetus*
Bottlebrush squirreltail is a short-lived, drought tolerant, cool season, native bunchgrass. It is short to medium sized (6 to 22 inches tall), tufted and has fair forage value in winter and spring and poor forage value in summer when seedheads are present. The bristly awns are objectionable to grazing animals and cause difficulties in seed handling, planting and harvesting. This species is often an increaser on poor condition to improving rangelands. It is adapted to a wide variety of soils including saline soils in the 8-18 inch precipitation zones. It is hoped it will have attributes that will enable it to establish a foothold in annual rangelands dominated by cheatgrass or medusahead rye. ARS and NRCS have released three squirreltail accessions, Sand Hollow Selected Germplasm (*E. multisetus)* in 1996; Toe Jam Selected Germplasm (*E. elymoides* ssp. *californicus)* in 2003; and Fish Creek Selected Germplasm (*E. elymoides* ssp. *elymoides)* in 2003. These have not been fully tested and their full range of adaptation is not known at this time. Sand Hollow is best adapted to sandy foothill rangelands receiving 12 inches or more annual precipitation in the lower Snake River Plains. Toe Jam is best adapted to loam to sandy loam soils in the Great Basin and lower to middle Snake River Plains receiving 8-14 inches of precipitation. Fish Creek is best adapted to sandy loam to silt loam to clay loam soils receiving 10 inches or more annual precipitation in the middle to upper Snake River Plains. Additional bottlebrush squirreltail accessions are currently under evaluation by ARS in Logan, NRCS at Bridger and Meeker PMCs and the Forest Service in Provo, Utah. Average seeds per ft^2 at 1 lb. rate 4. Seeding rate 7 lb./ac.

Bluegrass, Sandberg *Poa secunda* (*Poa sandbergii*)
Sandberg bluegrass is a small, low producing, very drought tolerant, native, perennial bunchgrass that grows in small tufts usually no larger than 6-8 inches in diameter. It is widely distributed throughout western range plant communities where it is considered an important grass for soil stabilization and forage for wildlife. It is best adapted to medium to heavy textured soils. It is found from 1,000 feet in Washington to 12,000 feet in northern New Mexico. It is adapted to 8-20 inches of moisture annually. It is tolerant of heavy trampling. Forage yields are very low, seed viability is generally poor, and forage quality declines rapidly in mid to late spring as it matures. It is one of the first grasses to green-up in the spring. Due to its low stature, Sandberg bluegrass can withstand heavy grazing pressure. On large areas of western semi-desert rangelands, overgrazing has depleted most of the desirable bunchgrasses except Sandberg bluegrass. It provides little to no forage in summer and fall unless fall rains occur. High Plains Selected Class Germplasm is a recent release from Bridger PMC. The Forest Service is nearing release of another accession. Plant at 1/4 inch or less depth. Average seeds/ft^2 at one pound rate 21. Recommended pure stand seeding rate 2 lb./ac. It is best utilized in low rainfall area native mixes.

Wheatgrass, Streambank *Elymus lanceolatus ssp. lanceolatus*
A long-lived, very drought tolerant, creeping sod-former adapted to fine-medium textured well-drained soils. Streambank wheatgrass has excellent seeding vigor and is particularly well adapted for erosion control where effective precipitation is 8 or more inches. It has little value as forage and is primarily used for stabilization of roadsides, airport runways, ditchbanks, and lakeshores. It has also been used as a drought tolerant turfgrass, but care must be taken to not over irrigate this grass or stand will be lost. Planting depth 1/4 to 1/2 inch. The only variety is 'Sodar' released by Aberdeen PMC. Average seeds per ft^2 at 1 lb. rate 3. Recommend pure stand rate 6 lb./ac. (double to triple seeding rate for turf and critical area applications)

Wheatgrass, Thickspike *Elymus lanceolatus* spp. *lanceolatus*
A long-lived, native sod-forming grass widely distributed in the northern part of the Intermountain Region. Drought tolerance, early spring growth, fair palatability, but low forage production characterizes this species. More drought tolerant than western wheatgrass, it is well suited for wind erosion control on medium to coarse-textured soils. It is best utilized as forage until early fall. Can tolerate moderate grazing and considerable trampling. Adapted to disturbed range sites and dry areas subject to erosion, roadsides, and waterways in the 8-18 inch precipitation zones. Use as a native component in rangeland mixes. Planting depth 1/4 to 1/2 inch. Improved varieties include 'Bannock' (Aberdeen release), 'Schwendimar', 'Critana' and 'Elbee'. Bannock is noted for its rapid establishment, moderate sod formation and greater forage production. Critana is more drought tolerant, exhibits good seedling vigor and readily establishes on critical areas. Schwendimar is noted for quick stabilization of coarse textured soils along the Columbia River. Average seeds per ft^2 at 1 lb. rate 3. Recommend pure stand rate 6 lb./ac.

Wheatgrass, Siberian *Agropyron fragile*
Similar to crested wheatgrass, Siberian wheatgrass has finer leaves, and retains its greenness and palatability later into the summer than crested wheatgrass. It yields less than most crested wheatgrass cultivars. It occupies sites where standard crested wheatgrass will grow but is more drought tolerant (7-16 inches of precipitation) and is especially useful on juniper sites. Once established, it is reported to be well adapted to light-sandy, droughty soils and can withstand extended periods of drought better than crested wheatgrasses. Planting depth 1/4 to 1/2 inch. Adapted varieties include 'P-27' (Aberdeen release) and 'Vavilov' (recently released with improved seedling vigor). Average seeds per ft^2 at 1 lb. rate 4. Recommend pure stand rate 6 lb./ac.

Wheatgrass, Crested (Standard type-AGDE2) *Agropyron desertorum*
A very long-lived, drought tolerant bunchgrass adapted to a wide range of sites and precipitation zones as low as 9-10 inches. Growth begins early in the spring and again with fall moisture. Palatability is excellent in the spring and late fall, less during summer dormancy and after seed formation. It has very vigorous seedlings. Adapted to foothills with 9-16 inches precipitation, sagebrush, ponderosa pine, mountain brush, and juniper-pinyon ranges. Expect low vigor and poor stands above 6500 feet elevation. This species is more drought tolerant than Fairway type crested wheatgrasses. A recent release by ARS, 'Douglas' crested wheatgrass is the first hexaploid on the market. Douglas is characterized as having larger seed, broader leaves and stays green longer into the early summer than other types mentioned above, but requires 14 inches of precipitation or more for long-term survival. It also establishes easily, but produces less forage. Because it stays green longer than other types, it is a preferred forage selection. Douglas is not as drought resistant as Nordan, Summit, Hycrest or CD-II. Planting depth 1/4 to 1/2 inch. Adapted varieties are 'Douglas', 'Nordan' and 'Summit'. Average seeds per ft^2 at 1 lb. rate 4. Recommend pure stand rate 5 lb./ac.

Wheatgrass, Crested (CD-II and Hycrest-hybrids) *Agropyron cristatum x A. desertorum*
A hybrid cross between Standard type and induced tetraploid Fairway type crested wheatgrass. Seedlings are extremely vigorous during germination and early establishment. Survives under greater competition than other crested wheatgrasses. Yields more forage (15-20%) in younger stands; is an outstanding seed producer, but more stemmy. Occupies same sites as standard and Fairway crested wheatgrass. Especially useful in drier sagebrush - cheatgrass sites. Survives in areas with 9-16 inches precipitation. Does not persist as well as Standard type crested wheatgrass or Siberian wheatgrass in very droughty sites. Planting depth 1/4 to 1/2 inch. Cultivars include 'CD-II' and 'Hycrest'. Average seeds per ft^2 at 1 lb. rate 4. Recommend pure stand rate 5 lb./ac.

Wheatgrass, Crested (Fairway type-AGCR) *Agropyron cristatum*
A very long-lived, drought-tolerant, vigorous introduced bunchgrass. Similar to standard crested wheatgrass but shorter, earlier maturing, with finer stems and leaves. Establishes on similar sites (10-18 inches precipitation) as standard and grows more effectively than standard at higher elevations. This species does not survive as well as standard crested wheatgrass under severe drought conditions. Planting depth 1/4 to 1/2 inch. Adapted varieties are 'Fairway' and 'Ephraim' (Aberdeen release). 'Ephraim', is a tetraploid variety of *A. cristatum* that is weakly rhizomatous in higher rainfall areas. 'Roadcrest' is a turf-type with short rhizomes and is recommended for low maintenance lawns. Other cultivars available but less adapted include 'Parkway', 'Kirk' and 'Ruff'. Average seeds per ft^2 at 1 lb. rate 4. Recommend pure stand rate 5.0 lb./ac.

Wheatgrass, Beardless *Pseudoroegneria spicata inerme*
A long-lived, drought tolerant, erect native bunchgrass. It differs from bluebunch wheatgrass in the absence of awns. It begins growth in early spring and readily greens up in fall following fall rains. It is very palatable, quality persists longer into growing season and yields are equal to crested wheatgrass. Recommended sites include the 12-18 inch precipitation areas in mountain foothills after timber harvest or wildfire. It is best adapted to winter-wet and summer dry climates. It has poor seedling vigor. Planting depth 1/4 to 1/2 inch. Adapted variety is 'Whitmar'. Average seeds/ft^2 at 1 lb. rate 3. Recommended pure stand rate 7.0 lb./ac.

Wheatgrass, Bluebunch *Pseudoroegneria spicata*
A long-lived, drought-tolerant, widespread native bunchgrass. It begins growth early in spring and again with the onset of fall rains. It is highly palatable and recovers rapidly after grazing but has low resistance to repeated or heavy grazing. It is not recommended as a hay crop. Several years are required for stand to obtain full productivity due to poor seedling vigor. Allow seedings to reach maturity (seedhead development) before grazing. Recommended sites include foothills and valleys with 10-20 inches precipitation, sagebrush, ponderosa pine, mountain brush and juniper-pinyon ranges. Low plant vigor results in poor stands on sites above 6500-ft. elevation. Planting depth 1/4 to 1/2 inch. Adapted varieties are 'Anatone' (Aberdeen release) for use above 10" precipitation and 'Goldar' (Aberdeen release) and 'P7' for use above 12" precipitation. Average seeds per ft^2 at 1 lb. rate 3. Recommend pure stand rate 7.0 lb./ac.

Wheatgrass, Snake River *Elymus wawawaiensis*
Snake River wheatgrass is a native of the lower canyons of the Snake River and its tributaries in Washington, eastern Oregon, and western to northern Idaho. 'Secar' Snake River Wheatgrass, previously considered to be bluebunch wheatgrass but found to be a subspecies of thickspike wheatgrass, is more drought tolerant than bluebunch wheatgrass. It is similar in appearance to bluebunch wheatgrass, but differs morphologically in having narrower, acuminate (pointed) to aciculate (needle-like) glumes, a more imbricate (overlapping) spike, and glabrate (without hairs) basal leaf sheaths. It is adaptable to most bluebunch wheatgrass areas but is best suited for the lower precipitation areas (8 to 12 inches). (See bluebunch wheatgrass). The only variety is 'Secar'. It is an early maturing bunchgrass with good seedling vigor and establishes well in native seed mixes. Secar is considered more drought tolerant than previously released bluebunch wheatgrasses. Average seeds per ft^2 at 1 lb. rate 3. Recommend pure stand rate 7 lb./ac.

Wildrye, Russian *Psathyrostachys juncea*
A long-lived introduced very drought tolerant bunchgrass. Grows rapidly in the spring and produces abundant basal leaves that remain green and palatable through summer and fall as long as soil moisture is available. It endures close grazing better than most grasses. It cures well on the stump (better than most cool season grasses) and makes excellent late fall and winter feed. Russian wildrye is not suited for hay production due to the predominance of basal leaves, which makes it difficult to harvest. Once established, it competes effectively against undesirable plants and it withstands drought as effectively and is more palatable than crested wheatgrass. However, most varieties have been erratic in establishment, demonstrate poor seedling vigor, and provide poor soil protection. Seed in areas receiving at least 8 inches of precipitation. Adapted to sagebrush, mountain brush, juniper-pinyon, and moderately saline sites. Useful on soils too alkaline for crested wheatgrass and too dry for tall wheatgrass. Planting depth 1/4 to 1/2 inch; and is very sensitive to deeper placement. Highest production occurs in wide row spacing of >18 inches. On steep slopes it should be planted on the contour. 'Vinall', an earlier variety, has poor seedling vigor and is not recommended. Canadian releases include 'Swift', which was selected for seedling vigor, and 'Cabree', selected both for seedling vigor and reduced seed shattering. U.S. releases include 'Bozoisky-Select', selected for increased seedling vigor and forage production and 'Mankota', selected for establishment from deeper seeding depths. In plantings in the Intermountain West, Bozoisky-Select and Mankota should be the varieties of choice. Average seeds per ft^2 at 1 lb. rate 4. Recommend pure stand seeding rate 6 lb./ac.

Wheatgrass, Western *Pascopyrum smithii*
A long-lived, late maturing, widely distributed, winter hardy, strongly rhizomatous, native grass with coarse blue-green leaves. Western wheatgrass begins spring growth later than most wheatgrasses and is typified by poor germination and low seedling vigor. When used as pasture it is considered to be an excellent source of spring and early summer forage with protein content of 16 to 18 percent. However, forage quality rapidly declines as plants mature. Provides winter grazing if protein supplements are provided. Protein content of western wheatgrass is usually a little higher (4-5 percent) than other wheatgrasses once cured. Plantings usually result in scattered stands that spread in 3 to 4 years to site dominance. Western wheatgrass is the most aggressive native sod grass available. Once established, it becomes very persistent and provides excellent soil binding erosion control characteristics. It is productive native hay in above normal precipitation years, under water spreading, and other supplemental water irrigation systems. It is particularly productive in clayey swales and silty waterways, and has moderate to high salt tolerance. Adapted to lowlands prone to early season flooding with precipitation at or above 12 inches (use 14 inch + for areas that receive 50 percent or greater winter precipitation) and most mountain brush areas. Planting depth 1/4 to 1/2 inch. Adapted varieties include 'Rosana' (northern variety), 'Rodan' (northern variety), and 'Arriba' (southern variety). Other releases include 'Barton', 'Flintlock', and 'Walsh'. Average seeds per ft^2 at 1 lb. PLS rate is 3. Recommended pure stand seeding rate 6 PLS lb./ac. Not recommended in pure stands. Recommended 50% mixed stand seeding rate 3.0 lb./ac.

Bluegrass, Big *Poa secunda* (*Poa ampla*)
A medium-lived native bunchgrass, which re-establishes from seed for long-lived, stands. Adapted for early spring grazing, sometimes as much as four weeks ahead of crested wheatgrass, but becomes unpalatable earlier in summer than most grasses. It has poor seedling vigor and requires as much as 4 to 8 years to reach full productivity. Because young plants are easily pulled up, grazing should be deferred until roots are well anchored. Recommended sites include sagebrush - grass sites at 2,000 to 6,000 feet elevation, sunny places on mountain brush and ponderosa pine ranges. It provides excellent nesting cover for upland birds. Adapted to 9 to 20 inch precipitation. It will not tolerate early spring flooding, high water tables, or poor drainage. It tolerates weakly acidic to weakly saline conditions. It can also be used for ground cover and erosion control on cut or burned-over timberland. Use only in native seed mixtures due to its slow establishment. Planting depth 0-1/4 inch. Adapted variety, 'Sherman'. Average seeds/ft^2 at 1 lb. rate 21. Recommend pure stand rate 2 lb./ac.

Wheatgrass, Slender *Elymus trachycaulus trachycaulus*
Slender wheatgrass is a short-lived (3-5 years) native bunchgrass with good seedling vigor and moderate palatability. It is valuable in erosion-control seed mixes because of its rapid development, moderate salt tolerance, and compatibility with other species. It is well adapted as a cover crop to improve soil tilth and to increase organic matter in saline sites. It tolerates a wide range of conditions and adapts well to high altitude ranges and more favorable sites on mountain brush areas receiving 10 inches or more annual precipitation. It is excellent in aspen and tall mountain brush areas and is shade tolerant. Planting depth 1/2 to 3/4 inch. 'Revenue' is a Canadian variety, selected for salinity tolerance, seed set, and forage yield. 'San Luis' is a southern variety adapted to high elevations. 'Pryor' is a northern variety, selected for superior salt tolerance, drought tolerance, and seedling vigor. Average seeds per ft^2 at 1 lb. rate 3.0. Recommend pure stand rate 6 lb./ac. Limit slender wheatgrass to 1 pound PLS per acre in native mixes. Higher rates effect the establishment of slower developing native species.

Fescue, Sheep *Festuca ovina*
A long-lived short stature introduced bunchgrass with short leaf blades. It is more drought tolerant than other fescues. Production is low, but groundcover and root production is excellent. It is used for turf, highway plantings, airport landing strips, burned over timberland and reclamation areas where a long-lived, persistent, competitive ground cover is needed. Not recommended for pasture or hay. Sheep fescue is best adapted to 10+ inch precipitation zones. A very good erosion control and understory species that competes well with weeds. Early spring seedings are recommended. . Only pure stands or mixtures with hard fescue are recommended. Planting depth 0-1/4 inch. Adapted varieties are 'Covar' and 'Bighorn'. Average seed per ft^2 is 16 at a 1 lb. rate. Recommended pure stand rate is 4 lb./ac.

Fescue, Hard *Festuca trachyphylla*
A very fine leafed, low growing introduced bunch grass with poor palatability to livestock. It is widely used for turf, highway plantings, airport landing strips, burned over timberland and reclamation areas where a long-lived, persistent, competitive ground cover is needed. It is adapted to areas having an excess of 14 inches precipitation. Seedlings are slow to establish but persist through the development of abundant fibrous roots. The dense root system may encourage increased rodent populations. Early spring seedings are recommended. Only pure stands or mixtures with sheep fescue are recommended. Planting depth 0-1/4 inch. 'Durar' is the adapted variety. Average seeds per ft^2 at 1 lb. rate 13. Recommended pure stand rate 4 lb./ac.

Wheatgrass, NewHy -RS *Pseudoroegneria spicata x Elytrigia repens*
NewHy -RS is a hybrid cross between quackgrass and bluebunch wheatgrass. NewHy is a mildly rhizomatous grass suited for use under a wide range of soil conditions and specifically saline conditions. It begins growth early in the spring, retaining succulence and palatability for livestock later in the summer than many grasses. Some problems exist with seedling vigor and germination which may reduce initial stands; however, once established it becomes a very vigorous, high producing, high forage quality species capable of withstanding repeated grazing with good recovery. In saline areas, NewHy is not as productive as tall wheatgrass or tall fescue, but forage quality is significantly better. The hybrid is noted for tolerance to very strongly saline soils and responds to irrigation, sub-irrigation or moderately wet conditions, and dryland areas where effective precipitation is 14 inches or more. Adapted to foothills, intermediate sagebrush and juniper sites, and higher mountain areas up to 8000 feet elevation, and on saline dry or wet bottomland and pastures. Planting depth 1/4 to 1/2 inch. The only cultivar is ‘NewHy’. Average seeds per ft^2 at 1 lb. rate 3. Recommend pure stand seeding rate 8 lb./ac.

Orchardgrass *Dactylis glomerata*
A long-lived, high producing, introduced bunchgrass, adapted to well drained soils. It produces long folded leaves arising mostly from the plant base. A shade tolerant plant that is highly palatable to livestock and wildlife, especially in the early part of the growing season. It is a widely preferred species for hay, pasture, or silage. For highest forage quality and regrowth, harvest while still in the boot stage. It is less winter hardy than meadow or smooth brome or timothy and is more vulnerable to diseases than many pasture grasses. Orchardgrass is compatible in alfalfa, sainfoin and clover mixes. It can be grown under irrigation or on dryland where the effective precipitation is 18 inches or more. It requires a good fertility program for high production. It is also used in erosion-control mixes primarily for its forage value. This species does best on soils with few limitations and good drainage. Avoid shallow and sandy soils. Varieties are early-, mid-, and late-season in maturity. Late-season varieties are preferred in mixture with alfalfa. Early - `Hallmark', 'Potomac'; Mid - `Akaroa', 'Ambassador'; Late - 'Latar' (recommended with alfalfa). 'Paiute' orchardgrass (Aberdeen release) is more drought tolerant (adapted to 16 inches + of precipitation) than the other varieties. Planting depth is 1/4 to 1/2 inch. Average seeds per ft^2 at 1 lb. rate 12. Recommend pure stand rate 4 lb./ac.

Wheatgrass, Intermediate *Thinopyrum intermedium*
A mildly rhizomatous sod-forming, late maturing, long-lived, introduced grass, suited for use as hay and pasture, alone or with alfalfa or other legumes on medium to fine textured soils. It begins growth early in the spring and

remains green and palatable into the summer, producing large amounts of quality forage. It does not mature seed at high elevations, but spreads vegetatively. Recommended for the sagebrush to high mountain zones (up to 9000 feet) and deep, upland soils with 13-18 inches of rainfall. This species is excellent for situations where only one to two irrigations are possible, because it readily responds to irrigation with increased forage production, but can also withstand extended drought periods when irrigation water is not available. Useful on disturbed sites for soil stabilization and erosion control. It is not shade tolerant, but is moderately tolerant of saline soil conditions. Planting depth 1/4 to 1/2 inch. Adapted varieties are 'Rush' (Aberdeen release), selected for excellent seedling vigor, drought tolerance, and forage yield; 'Reliant,' selected for disease resistance and production; 'Oahe' with improved seed production, forage yield, and rust resistance; 'Amur' selected for slightly more drought tolerance performs well at higher elevations, and 'Tegmar' (Aberdeen release), a low growing cultivar noted for erosion control, sod-formation and seedling vigor. Average seeds per ft^2 at 1 lb. rate 2. Recommend pure stand rate 8 lb./ac.

Wheatgrass, Pubescent *Thinopyrum intermedium*
A long-lived, late maturing, introduced, sod-forming grass adapted to low-fertility sites and coarse to medium textured soils. Very similar to intermediate wheatgrass (pubescence on leaves and seed heads) but slightly more drought-resistant, alkali tolerant, and somewhat less palatable. It is better adapted for pasture than for hay. Its ability to remain green during the summer, when soil moisture is limited, is a significant characteristic. Adapted to foothills with 11-18 inches precipitation, this species is excellent for situations where only one to two irrigations are possible, because it readily responds to irrigation with increased forage production, but can also withstand extended drought periods when irrigation water is not available. Useful on disturbed sites for soil stabilization and erosion control. It is not shade tolerant, but is moderately tolerant of saline soil conditions. It is very useful for erosion control on a wide range of sites. Suggested varieties are 'Luna' (most commonly used) as well as 'Manska' and 'Greenleaf'. Average seeds per ft^2 at 1 lb. rate 2. Recommend pure stand rate 8 lb./ac.

Wildrye, Basin *Leymus cinereus*
A slightly spreading, robust, large native bunchgrass. Basin wildrye is tall, coarse, long-lived, and highly palatable early in spring and becoming low in palatability as it matures. It is useful for calving pasture and wildlife forage and cover. Poor seedling vigor usually results in sparse stands, but one of the highest producing species once established. Do not grazing new seedings until seedheads are evident or at the end of the second growing season. Mature plants are unpalatable and need to be managed for use at earlier periods with grazing management scheduled to maintain a 10 to 12 inch stubble height to avoid removing the growing point of this species. Great care must be taken to avoid close grazing or clipping which may result in plant loss in a single season. Winter grazing with protein supplements utilize old coarse growth. Best adapted to moderately saline or alkaline lowlands, flood plains, flow in areas with high water holding capacity. Especially suited to deep, fine textured clayey to loamy soils that receive 8-12 inches precipitation. Plantings have been established in rainfall areas as low as 5 inches, however basin wildrye plantings are not recommended in areas with less than 8 inches annual precipitation. Particularly well suited for many juniper areas; performs well throughout the mountain brush zone and in aspen openings. Planting depth 1/2 to 3/4 inch. Adapted cultivars are 'Magnar' (blue-green upright leaves)(Aberdeen release) and 'Trailhead' (green overhanging leaves) selected for excellent drought tolerance. Average seeds per ft^2 at 1 lb. rate 3. Recommend pure stand seeding rate 7 lb./ac. Basin wildrye is highly recommended for native species mixtures.

Wildrye, Beardless *Leymus triticoides*
A long-lived, sod-forming native grass. It is adapted to poorly drained, wet or wet-saline-alkaline soils or dryland areas that receive at least 14 inches of precipitation. Selected primarily for stabilization and cover on wet to wet-saline soils, this plant is one of the most salt tolerant species available. It is of secondary importance as a forage species due to its coarseness in later growth stages, but is considered productive when fertilized and used for hay or winter grazing. Due to poor seedling vigor and high seed dormancy, establishment is difficult and dormant fall planting is recommended. Planting depth 0-1/4 inch in a firm weed free seedbed. Adapted variety 'Shoshone'. Another variety that may have potential, but has not been extensively tested in the Intermountain west is 'Rio'. Average seeds per ft^2 at 1 lb. rate 4. Recommended pure stand rate 6 lb./ac.

Wildrye, Altai *Leymus angustus*
A winter hardy, drought resistant, long-lived, cool season introduced bunchgrass, sometimes with short rhizomes. It is known to root and use moisture to depths of 15 feet. Basal leaves are somewhat course, but very palatable during the late summer and early fall (protein levels of 8 percent are common in standing winter-feed). In northern regions it is commonly swathed into windrows and utilized as forage for winter feeding operations. Adapted to moderately deep to deep loams to clay loams with 14 inch or greater rainfall. It can withstand saline conditions almost as well as tall wheatgrass and is also almost as productive as tall wheatgrass on saline sites. Seedlings develop slowly and good seedbed preparation and weed control is essential. 'Eejay', 'Pearl' and 'Prairieland' are released varieties. Average seeds per ft^2 at 1 lb. rate 2. Recommended pure stand rate 10 lb./ac.

Wheatgrass, Tall *Thinopyrum ponticum*
A long-lived, tall-statured, coarse, vigorous, very late maturing, winter hardy introduced bunchgrass. Once established, (seedlings are slow to establish) tall wheatgrass is one of the most tolerant grasses of salt, alkali and high water table conditions. It starts growth early in the spring, reaching maturity in late summer. Reported to be the latest maturing of the wheatgrasses. Palatability is fair early in the growing season, but mature plants become very unpalatable and must be managed for use at earlier stages of growth. It does not stand continuous close grazing. Old coarse growth often makes current growth unavailable. Late standing material becomes good winter forage for livestock when used with supplemental protein sources. This grass has a very wide range of soil and climate adaptation (recommended for 14 inch or higher rainfall zones or sites with high watertables) and is useful for erosion control on critical areas. Provides nesting and food for upland game birds and is also used for wind barriers to control soil erosion and drifting snow. It is adapted to salty areas such as greasewood and saltgrass sites where the water table is from a few inches to several feet below ground surface. Also intermediate and favorable sagebrush, mountain brush, and juniper sites where its drought tolerance is evidenced. Planting depth 1/4 to 3/4 inch. Adapted varieties are 'Alkar' (northern areas), 'Jose' (southern areas), 'Largo' (southern areas), and 'Platte' (Great Plains - not tested in west). Average seeds per ft^2 at 1 lb. rate 2. Recommend pure stand rate 10 lb./ac on good soils. Increase rate to 14 lb./ac. on saline soils.

Brome, Mountain *Bromus marginatus*
A short-lived vigorous native bunchgrass which reaches full productivity in 1 to 3 years. It establishes quickly on clean or disturbed sites, volunteers well on disturbed sites, is moderately palatable, and valuable for quick cover. Because it is short-lived, it is replaced by long-lived species over time. It is shade tolerant and must be allowed to go to seed every 3-4 years to reseed site. It is susceptible to seed head smut. Recommended sites include mountain brush, aspen, conifer forest and subalpine areas in mountain valleys at medium to high altitudes and timber harvest or burns with 16 inches or more annual precipitation. Planting depth 1/4 to 1/2 inch. Adapted varieties are 'Bromar', susceptible to seed head smut and Garnet Tested Class Germplasm, that is more smut resistant. Average seeds per ft^2 at 1 lb. rate 2. Recommended pure stand rate 10 lb./ac. Limit mountain brome to 2 lb. PLS per acre in native mixes. Higher rates effect establishment of slower developing native species.

Ryegrass, Perennial *Lolium perenne*
A relatively short-lived, rapid developing, vigorous, high forage producing with high quality forage, introduced perennial bunchgrass adapted to a wide variety of soil conditions. Perennial ryegrass can be grown under irrigation or on dryland where the effective precipitation is 15 inches or more. To produce high yields, perennial ryegrass requires as much as 30-50 inches of irrigation and high fertility inputs (split applications recommended). It can be grazed within two months of planting, if vegetation is 10-12 inches high and well established so livestock can not pull plants out by the roots. Well established stands are productive for 3-5 years, if annual over-seeding (5 pounds per acre) of fields occurs each year in late fall or early spring. It does best where winters are mild. It may retard the growth of other perennials if seeded too heavily in a mixture. Generally not recommended in a mixture with other grasses because of strong grazing animal preference towards perennial ryegrass over other grasses. It has good recovery after grazing in the spring but tends to go dormant when summer temperatures exceed 80º F. Suited for most acidic to mildly basic (5-8 pH) areas as a turf, hay or pasture. Perennial ryegrass can be differentiated from annual ryegrass by lack of awns, whereas annual ryegrass has awns. Perennial ryegrass usually contains a fungal endophyte which is linked to the occurrence of ryegrass staggers (there have been reports of ryegrass staggers in Oregon and California). Planting depth 1/4 to 1/2 inch. Adapted varieties are 'Linn', and 'Manawa (H1)'. Tetraploids are also available and have shown promising results in tests at several locations. Most tetraploids are developed for short rotation pastures or green chop. These varieties include 'Bastian', 'Grimalda', and 'Reville'. Many other varieties are available and it is recommended that you consult a seed dealer in your area for locally adapted varieties and be sure to request an endophyte-free forage type. Average seeds per ft^2 at 1 lb. rate 6. Recommend pure stand rate 5 lb./ac. Higher seeding rates in pure stands may be considered.

Foxtail, Creeping *Alopecurus arundinaceus*
A long-lived, cool-season, dense sod forming introduced grass that is adapted to wet-slightly saline-acidic-poorly drained pasture sites. It has low seedling vigor, but once established spreads readily by rhizomes. Growth begins early in the spring, and leaves remain green until after hard frosts in the late fall. It is very cold tolerant and can persist in areas where the frost-free period averages less than 30 days. It is only moderately salt-alkaline tolerant but produces abundant good quality forage on wet fertile sites (with proper fertility) where it is usually superior to other wet area pasture grasses such as reed canarygrass and timothy (it is similar in appearance to timothy, but seedheads are generally black and hairy). It can be invasive in wet areas. Compatible with cicer milkvetch in a mixture. 'Garrison' and 'Retain' are well-adapted cultivars. Canadian varieties 'Dan' and 'Mountain' have not been tested, and may have potential in Intermountain areas. NOTE: Seed is very light and difficult to seed without the use of cracked corn, 2 bushels of rice hulls/acre, or other carrier. Planting depth 1/8 to 1/4 inch. Average seeds per ft^2 at 1 lb. rate 17. Recommend pure stand rate 3 lb./ac.

Fescue, Tall *Lolium arundinaceum*
A long-lived, deep rooted, high producing introduced cool-season bunchgrass suited for use under a wide range of soil and climatic conditions. It has lower palatability than most other pasture grasses and other species will be grazed out of a mixed stand. Suited to irrigation, subirrigation, or moderately wet conditions, as well as dryland areas where the effective precipitation is over 18 inches. Best suited for acidic to moist, saline to alkali areas in lowlands with pH from 4.7 to 9.5. It is not well adapted to sandy soils having prolonged droughty periods. It is a high forage producer under well-fertilized conditions. Planting depth 1/4 to 1/2 inch. Adaptable varieties include 'Alta', 'Fawn', and 'Forager'. Turf types are becoming more prevalent on the market and many of these contain endophytes. 'Johnstone' is a hybrid of tall fescue and perennial ryegrass. It is more palatable than regular strains of tall fescue, but retains its wide adaptation and resiliency. NOTE: Fungal endophyte problems can develop in livestock foraging on tall fescue. This problem can be greatly reduced, if not eliminated, by seeding with endophyte-free seed (production may be lower with endophyte free plants). Average seeds per ft^2 at 1 lb. rate 5. Recommend pure stand rate 5 lb./ac.

Orchardgrass *Dactylis glomerata*
A long-lived, high producing, introduced bunchgrass, adapted to well drained soils. It produces long folded leaves arising mostly from the plant base. A shade tolerant plant that is highly palatable to livestock and wildlife, especially in the early part of the growing season. It is a widely preferred species for hay, pasture, or silage. For highest forage quality and regrowth, harvest while still in the boot stage. It is less winter hardy than meadow or smooth brome or timothy and is more vulnerable to diseases than many pasture grasses. Orchardgrass is compatible in alfalfa, sainfoin and clover mixes. It can be grown under irrigation or on dryland where the effective precipitation is 18 inches or more. It requires a good fertility program for high production. It is also used in erosion-control mixes primarily for its forage value. This species does best on soils with few limitations and good drainage. Avoid shallow and sandy soils. Varieties are early-, mid-, and late-season in maturity. Late-season varieties are preferred in mixture with alfalfa. Early - `Hallmark', 'Potomac'; Mid - `Akaroa', 'Ambassador'; Late - 'Latar' (recommended with alfalfa). 'Paiute' orchardgrass (Aberdeen release) is more drought tolerant (adapted to 16 inches of precipitation) than the other varieties. Planting depth is 1/4 to 1/2 inch. Average seeds per ft^2 at 1 lb. rate 12. Recommend pure stand rate 4 lb./ac.

Brome, Smooth *Bromus inermis*
A long-lived, introduced aggressive sod-forming grass. Very palatable, productive, and shade tolerant. Seedlings are often weak, but once established, plants spread vegetatively to provide full stands. It has notable ability to suppress invasion of undesirable vegetation. Recovery is slow when cut for hay, becomes dormant during hot dry summer periods, and its tendency for sod binding requires occasional root ripping and high fertility. A very useful plant for erosion control seedings. Pasture or hay mixtures with smooth brome become sod bound and must be re-established periodically to maintain the legume component. It should not be planted directly adjacent to areas being restored to native plant communities. It is best adapted to moist well-drained soils in 14 inch or higher rainfall zones. Cultivars have traditionally been divided into three adaptation types: northern, southern and intermediate. Only southern and intermediate types are recommended for the Intermountain West. It is tolerant of slightly saline and alkaline conditions. The southern type (Lincoln) is best for sites that had supported mountain brush and favorable sites in the southern sagebrush and pinyon-juniper zone. An intermediate type, (Manchar) performs best on foothill to mountain rangelands. Planting depth 1/4 to 1 /2 inch. 'Manchar' is recommended for forage plantings on northern or higher elevation meadows, hayland or pasture. 'Lincoln' is recommended for erosion control and waterways, and produces less forage but is more aggressive in vegetative spread than 'Manchar'. Average seeds per ft^2 at 1 lb. rate 3. Recommend pure stand rate 6 lb./ac.

Brome, Meadow *Bromus biebersteinii*
Previously known as *Bromus erectus* and *B. riparius*, this perennial long-lived, introduced, weakly rhizomatous grass reaches full productivity in 2 to 3 years. Seedling vigor is strong and palatability to livestock and wildlife is excellent. Use in pasture and hayland seedings under irrigation or non-irrigated areas where precipitation is above 14 inches annually. Applications of nitrogen during the growing season will significantly increase forage production and regrowth following clipping or grazing. Do not graze until forage has reached 8-12 inch height for best stand management. It is moderately shade tolerant, winter hardy, recovers quickly after grazing, and is well adapted to sites that had supported mountain brush, aspen, conifer forest and subalpine sites in mountain valleys and plains. It is more productive and does not go dormant following harvest or under high summer temperatures as does smooth brome. It is an excellent choice in areas that are prone to early to late spring frost. Productive and compatible in mixtures with legume species such as alfalfa, sainfoin, cicer milkvetch, and birdsfoot trefoil. Varieties include 'Fleet', "Montana PVP', 'MacBeth PVP', 'Paddock' and 'Regar' (Aberdeen release). Planting depth 1/4 to 1/2 inch. Average seeds per ft^2 at 1 lb. rate 2. Recommended pure stand rate 10 lb./ac.

Fact Sheet

'GOLDAR' BLUEBUNCH WHEATGRASS

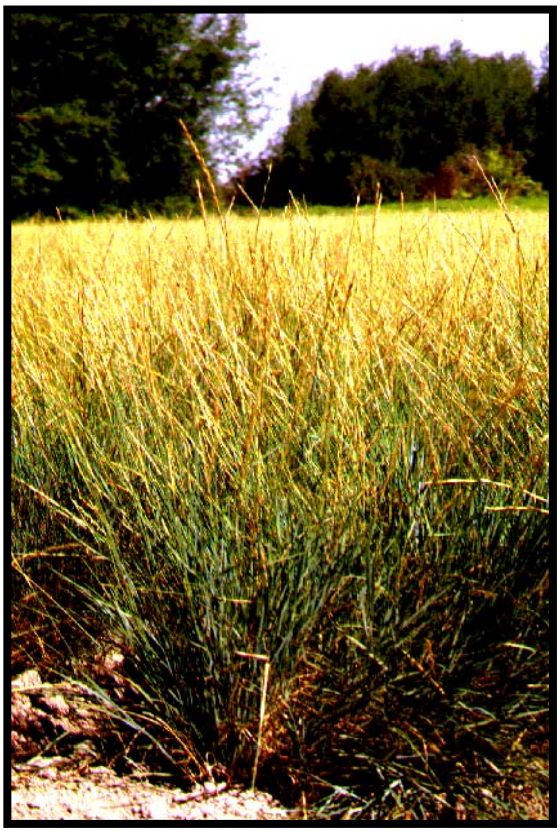
Species: ***Pseudoroegneria spicata***
Common Name: **Bluebunch Wheatgrass**
Plant Symbol: **PSSP6**
Accession Number: **PI-539873**

Source: Goldar is a selection from a native plant collection made in Asotin County, Washington in 1934. The collection site was on a ponderosa pine-grassland plant community at an elevation of about 4000 feet above sea level. Detailed collection site information is not available.

Native Site Information: Bluebunch wheatgrass is a perennial cool season bunchgrass native throughout the western U.S. Its natural distribution ranges from Alaska to northern California and New Mexico where annual precipitation averages 10 inches or more.

Method of Selection: Goldar was selected for superior total yield and basal area, superior stand, vigor and seed production in comparison with 'Whitmar' beardless wheatgrass and 'Secar' Snake River wheatgrass. It is particularly well adapted to areas above 12 inches annual precipitation and elevations greater than 3,300 feet elevation. It has been compared to more than 1000 accessions of bluebunch wheatgrass at the Aberdeen and Pullman, WA Plant Materials Centers.

Description: Goldar is a densely tufted bunchgrass with abundant leaves. Seed spikes are typically open and lemma awns



'Goldar' Bluebunch Wheatgrass

are strongly divergent at maturity. Abundant leaves and culms average 24 to 39 inches tall. Spikes generally loose, open with spikelets about the same length as the rachis internodes at maturity. Plants are diploid, 2N = 14.

Use: Goldar bluebunch wheatgrass uses include: as a component of a seed mix for rangeland, erosion control, forage and cover seedings in 12 to 20 inch rainfall zones; mine spoil reclamation; critical area stabilization; and competition with

aggressive annuals such as cheatgrass and medusahead.

Insect and Disease Problems: No detrimental disease symptoms or insect problems have been observed in plantings of Goldar. It is susceptible to stripe rust and mildew if conditions are favorable for these pathogens.

Environmental Considerations: This variety release is from a species native to the Intermountain West and has no known negative impacts on wild or domestic animals. Goldar is not considered a weedy or invasive species but can spread to adjoining vegetative communities under ideal environmental conditions.

Area of Adaptation: Goldar is adapted to the Northwest and Intermountain regions of the United States where annual precipitation averages above 12 inches and elevation above 3300 feet.

Soil Adaptation: Goldar prefers medium to coarse-textured soils over 10 inches deep, but can grow on sandy and clayey soils.

Planting and Harvesting: Goldar should be seeded with a drill to a depth of 1/2 to 3/4 inches on a firm, weed-free seedbed. The full seeding rate is 7 pounds Pure Live Seed (PLS) per acre. When used as a component of a seed mix, adjust to the percent of mix desired. For seed production, Goldar should be seeded in 36 inch rows at a rate of 3 to 4 pounds PLS per acre to allow mechanical weed control and to maintain rows. Goldar may be seeded during the spring or late fall (dormant). Mid-August to early fall seedings should only be performed if irrigation is available to ensure stand establishment.

Harvesting seed is best accomplished by swathing, followed by combining of the cured windrows. The seed readily shatters, requiring close scrutiny of maturing stands. Seed is generally harvested in late-July to early August. Seed yields range from 80 pounds per acre (dryland) to 170 pounds per acre (irrigated).

Seed Maintenance: Breeder and Foundation seed is maintained at:

USDA-NRCS, Aberdeen PMC
P.O. Box 296
1691A S. 2700 W.
Aberdeen, ID 83210
Phone: (208) 397-4133

Foundation seed is available through the Idaho and Utah Crop Improvement Associations and Soil Conservation Districts in Idaho, Utah and Nevada. Certification of seed shall be limited to not more than two generations from Foundation seed (Registered and Certified).

March 2003

TECHNICAL NOTE

USDA-Natural Resources Conservation Service
Boise, Idaho - Bozeman, Montana - Spokane, Washington

TN PLANT MATERIALS NO. 24 **MAY 2003**
REVISION

GRASS, GRASS-LIKE, FORB, LEGUME, AND WOODY

SPECIES FOR THE

INTERMOUNTAIN WEST

Dan Ogle, Plant Materials Specialist, NRCS, Boise, Idaho
Loren St. John, PMC Manager, NRCS, Aberdeen, Idaho
Mark Stannard, PMC Manager, NRCS, Pullman, Washington
Larry Holzworth, Plant Materials Specialist, Bozeman, Montana

This is a literature review and includes narrative descriptions for species commonly occurring and/or seeded or planted throughout the Intermountain West. The descriptions cover common name, scientific name, origin, sod verses bunch, life span, adaptation, seeding and planting recommendations including vigor, ease of establishment, precipitation range, planting depth, seeds per square foot at a one pound rate, recommended pure stand seeding rates, recommended mixture seeding rates, and adapted cultivars/varieties or germplasm for the Intermountain West. Source identified germplasm should only be recommended for geographic locations near collection site of original collections. This document is not a blanket endorsement of the listed species. Always consult appropriate guides when making species selections for your planting in order to match plants and sites.

All seeding rates should be based on Pure Live Seed (PLS). The rates used in this guide generally target 20-30 seeds/ft^2 for the larger seed size varieties (< 500,000 seeds per pound) and 40-50 seeds/ft^2 for the smaller seed size varieties (> 500,000 seeds per pound). The rates have also been adjusted based on past research findings for establishing stands and optimizing production.

The first scientific name listed is the accepted name in the USDA-NRCS, PLANTS Database and should be considered the proper scientific name. All other scientific names listed are intended for cross-reference in older publications.

Table of Contents

GRASS, GRASS-LIKE, FORB, LEGUME AND WOODY SPECIES FOR THE INTERMOUNTAIN WEST

DESCRIPTIONS OF SPECIES

CHARACTERISTICS OF GRASSES

Bentgrass (Redtop) *Agrostis spp.*

The *Agrostis* genus includes many species, usually perennial, often occurring on hydric soils. There are over 100 species worldwide of which approximately 20 are native to North America. Colonial bentgrass and creeping bentgrasses are important turf grasses. Bentgrasses are long-lived, fine textured, usually stoloniferous and commonly occur in wetland and riparian areas. Many naturalized stands were probably introductions from Europe. Recommended planting depth for bentgrass (Redtop) is 0 to 1/4 inch. Average seeds/ft^2 at 1 lb. rate 115. Recommend pure stand rate 0.5 lb./ac.

Bluegrass, Big *Poa secunda* or *P. ampla*

A medium-lived native bunchgrass, which re-establishes from seed for long-lived, stands. Adapted for early spring grazing, sometimes as much as four weeks ahead of crested wheatgrass, but becomes unpalatable earlier in summer than most grasses. It has poor seedling vigor and requires as much as 4 to 8 years to reach full productivity. Because young plants are easily pulled up, grazing should be deferred until roots are well anchored. Recommended sites include sagebrush - grass sites at 2,000 to 6,000 feet elevation, sunny places on mountain brush and ponderosa pine ranges. It provides excellent nesting cover for upland birds. Adapted to 9 to 20 inch precipitation. It will not tolerate early spring flooding, high water tables, or poor drainage. It tolerates weakly acidic to weakly saline conditions. It can also be used for ground cover and erosion control on cut or burned-over timberland. Use only in native seed mixtures due to its slow establishment. Planting depth 0-1/4 inch. Adapted variety, 'Sherman'. Average seeds/ft^2 at 1 lb. rate 21. Recommend pure stand rate 2 lb./ac.

Bluegrass, Canby *Poa secunda* or *P. canbyi*

A long-lived native, understory bunchgrass. This grass makes vigorous early spring growth for spring grazing. Where season-long moisture is available, it is commonly crowded out by other species. It thrives on early season moisture and sets seed and goes dormant in late spring. Plants go dormant easily to resist drought. Recommended sites include dry, shallow and rocky well-drained soils in the sagebrush, and ponderosa pine areas. Adapted to 9 to 15 inch precipitation environments. Use only in native seed mixtures due to its slow establishment. Planting depth 1/4 inch or less. Adapted variety, 'Canbar.' Average seeds/ft^2 at 1 lb. rate 21. Recommended pure stand rate 2 lb./ac. Not recommended in pure stands.

Bluegrass, Canada *Poa compressa* or *P. canadensis*

A long-lived, low growing introduced bluegrass with short rhizomes and tolerance to shade, adapted to areas of low fertility and medium acid soils. Growth occurs in the early spring providing good ground cover but can be slow to establish. This attractive low maintenance plant provides excellent groundcover and erosion control on roadsides, ditch banks, barrow pits, dam sites, under trees and recreational areas. Once established, it is very persistent and performs better than Kentucky bluegrass on poorer soils and drier sites above 18 inches precipitation. It is not well adapted to heavy grazing. Planting depth, 1/4 to 1/2 inch. Adapted low maintenance turf varieties are 'Canon', Foothills Germplasm (Montana), 'Rubens' and 'Talon'. Average seeds/ft^2 at 1 lb. rate 36. Recommended pure stand rate 1 lb./ac.

Bluegrass, Kentucky *Poa pratensis*

A major lawn and turf grass, introduced from Europe, adapted to cool climates and moist growing conditions. This species has relatively low herbage production and should not be planted for pasture. It commonly out-competes desired species on irrigated pasture and along riparian areas when poor grazing management has occurred due to its low growing point which makes it very resistant to over grazing. It is an excellent erosion control species in appropriate areas and may be recommended for small acreages. Do not plant in riparian areas, wetlands, irrigated pasture and native meadows. Kentucky bluegrass requires 18 inches of annual precipitation or irrigation. Plant at 1/4 inch or less depth. Numerous adapted varieties have been developed in the northwest and are available. Average seeds/ft^2 at one pound rate 50. Recommended seeding rate is for turf applications 2-3 lb./1000 ft^2.

Bluegrass, Sandberg *Poa secunda* or *P. sandbergii*

Sandberg bluegrass is a small, low producing, very drought tolerant, native, perennial bunchgrass that grows in small tufts usually no larger than 6-8 inches in diameter. It is widely distributed throughout western range plant communities where it is considered an important grass for soil stabilization and forage for wildlife. It is best adapted to medium to heavy textured soils. It is found from 1,000 feet in Washington to 12,000 feet in northern New Mexico. It is adapted to 8-20 inches of moisture annually. It is tolerant of heavy trampling. Forage yields are very low, seed viability is generally poor, and forage quality declines rapidly in mid to late spring as it matures. It is one of the first grasses to green-up in the spring. Due to its low stature, Sandberg bluegrass can withstand heavy grazing pressure. On large areas of western semi-desert rangelands, overgrazing has depleted most of the desirable bunchgrasses except Sandberg bluegrass. It provides little to no forage in summer and fall unless fall rains occur. High Plains Selected Class Germplasm is a recent release from Bridger PMC. The Forest Service is nearing release of another accession. Plant at 1/4 inch or less depth. Average seeds/ft^2 at one pound rate 21. Recommended pure stand seeding rate 2 lb./ac. It is best utilized in low rainfall area native mixes.

Brome, Meadow *Bromus biebersteinii* or *B. erectus* or *B. riparius*

Previously known as *Bromus erectus* this perennial long-lived, introduced, weakly rhizomatous grass reaches full productivity in 2 to 3 years. Seedling vigor is strong and palatability to livestock and wildlife is excellent. Use in pasture and hayland seedings under irrigation or non-irrigated areas where precipitation is above 14 inches annually. Applications of nitrogen during the growing season will significantly increase forage production and regrowth following clipping or grazing. Do not graze until forage has reached 8-12 inch height for best stand management. It is moderately shade tolerant, winter hardy, recovers quickly after grazing, and is well adapted to sites that had supported mountain brush, aspen, conifer forest and subalpine sites in mountain valleys and plains. It is more productive and does not go dormant following harvest or under high summer temperatures as does smooth brome. It is an excellent choice in areas that are prone to early to late spring frost. Productive and compatible in mixtures with legume species such as alfalfa, sainfoin, cicer milkvetch, and birdsfoot trefoil. Planting depth 1/4 to 1/2 inch. Varieties include 'Fleet', "Montana PVP', 'MacBeth PVP', 'Paddock' and 'Regar'. Average seeds per ft^2 at 1 lb. rate 2. Recommended pure stand rate 10 lb./ac.

Brome, Mountain *Bromus marginatus* or *B. cartinatus*

A short-lived vigorous native bunchgrass which reaches full productivity in 1 to 3 years. It establishes quickly on clean or disturbed sites, volunteers well on disturbed sites, is moderately palatable, and valuable for quick cover. Because it is short-lived, it is replaced by long-lived species over time. It is shade tolerant and must be allowed to go to seed every 3-4 years to reseed site. It is susceptible to seed head smut. Recommended sites include mountain brush, aspen, conifer forest and subalpine areas in mountain valleys at medium to high altitudes and timber harvest or burns with 16 inches or more annual precipitation. Planting depth 1/4 to 1/2 inch. Adapted varieties are 'Bromar', susceptible to seed head smut and Garnet Tested Class Germplasm, that is more smut resistant. Average seeds per ft^2 at 1 lb. rate 2. Recommended pure stand rate 10 lb./ac. Limit mountain brome to 2 lb. PLS per acre in native mixes. Higher rates effect establishment of slower developing native species.

Brome, Smooth *Bromus inermis*

A long-lived, introduced aggressive sod-forming grass. It has notable ability to suppress invasion of undesirable vegetation and is also an excellent erosion control species. Smooth brome is very shade tolerant. Seedlings are often weak, but once established, plants spread vegetatively to provide full stands. Recovery is slow when mowed and it becomes dormant during hot dry summer periods. It should not be planted directly adjacent to areas being restored to native plant communities. It is best adapted to moist well-drained soils in 14 inch or higher rainfall zones. Cultivars have traditionally been divided into three adaptation types: northern, southern and intermediate. Only southern and intermediate types are recommended for the Intermountain West. It is tolerant of slightly saline and alkaline conditions. The southern type (Lincoln) is best for sites that had supported mountain brush and favorable sites in the southern sagebrush and pinyon-juniper zone. An intermediate type, (Manchar) performs best on foothill to mountain rangelands. Planting depth 1/4 to 1 /2 inch. 'Manchar' is recommended for erosion and invasive species control plantings on northern or higher elevation areas. 'Lincoln' is recommended for erosion control and waterways, but is more aggressive in vegetative spread than 'Manchar'. Average seeds per ft^2 at 1 lb. rate 3. Recommend pure stand rate 6 lb./ac.

Canarygrass, Reed *Phallaris arundinecea*

A widely adapted, coarse, vigorous, productive, long-lived Eurasian and North American sod grass. It is frost tolerant and suited to wet soils with a pH range of 4.9 to 8.2. It has moderate drought tolerance on upland soils, but requires greater than 18 inches annual precipitation. It has the ability to utilize tremendous amounts of nitrogen and is used to remove nitrogen from dairy, food processing and other effluent. Initial stands are often poor because of poor germination and weak seedlings. Once established, it can withstand continuous water inundation for 70 days in cool weather. It invades wet areas along ditches, canals, drains and is a serious weed in these areas because of this tendency. Produces an abundance of spring foliage with tremendous annual yields on moist fertile soils, high in nitrogen and organic matter. Infertile soils promote sod bound problems. Mature stands prove to be unpalatable, requiring close grazing and mowing management for quality production. The lack of palatability and poor animal performance often characterized by reed canarygrass may result from the presence of several toxic alkaloids in the forage. Breeding new varieties low in alkaloids is ongoing in several Midwest breeding programs. Planting depth 1/4 to 1/2 inch. Adapted varieties include 'Rise', 'Venture' and 'Palaton'. Palaton and Venture are the result of breeding programs to reduce the alkaloid problems in this grass. Average seeds per ft^2 at 1 lb. rate 12. Recommend pure stand rate 4 lb./ac.

Dropseed, Sand *Sporobolus cryptandrus*

Sand dropseed is a warm season grass commonly found growing on sandy to gravelly soils and highly compacted loamy soils in the Intermountain West. It most commonly grows at lower elevations and dry coarse soils in the 7 to 12 inch precipitation zones. Sand dropseed has a low grazing preference by livestock and wildlife and is best utilized as winter forage when more palatable species are not available. This plant is a prolific seed producer. The seed coat of sand dropseed is very hard and scarifying seed prior to planting results in better germination. It should be used in seed mixtures on dry areas with coarse textured soils. Planting depth 1/4 inch. No varieties have been released. Average seeds per ft^2 at 1 lb. rate 122. Recommend pure stand rate 0.5 lb./ac.

Fescue, Hard *Festuca trachyphylla* or *F. ovina duriuscula*

A very fine leafed, low growing introduced bunch grass with poor palatability to livestock. It is widely used for turf, highway plantings, airport landing strips, burned over timberland and reclamation areas where a long-lived, persistent, competitive ground cover is needed. It is adapted to areas having an excess of 14 inches precipitation. Seedlings are slow to establish but persist through the development of abundant fibrous roots. The dense root system may encourage increased rodent populations. Early spring seedings are recommended. Only pure stands or mixtures with sheep fescue are recommended. Planting depth 0-1/4 inch. 'Durar' is the adapted variety. Average seeds per ft^2 at 1 lb. rate 13. Recommended pure stand rate 4 lb./ac.

Fescue, Idaho *Festuca idahoensis*

A long-lived, native, perennial bunchgrass. It has fine leaves and stems, which grow primarily from the base. It is a palatable grass in spring, cures well on the stem and makes good fall forage. It commonly greens up in fall with rain. Idaho fescue occurs abundantly on north exposures in areas with 14 inches and above rainfall and is best adapted to areas above 16 inches precipitation. It prefers medium textured soils but is also found on coarser textured soils with steep north slopes. Planting depth 1/4 to 1/2 inch. 'Joseph' and 'Nezpurs' are adapted varieties, but are very difficult to establish due to poor seedling vigor. Winchester Source Identified Germplasm is a selection originating from the Winchester grade between Lewiston and Grangeville, Idaho. Average seeds/ft^2 at 1 lb. rate 10. Recommended pure stand seeding rate 4 lb./ac.

Fescue, Red (Creeping) *Festuca rubra*

A major lawn and turf grass that is long-lived, slow developing, low growing, weakly rhizomatous, very competitive, fine leafed introduced grass native to North America and Europe. Chewings and slender creeping fescue are subspecies of creeping red fescue. These fescues perform best on acidic soils (pH 5.5-6.5) and increases in overall production as acidity increases. They are most commonly used as turf grasses and sometimes used for erosion control and roadside stabilization. It is not recommended for pasture or hayland production. It is susceptible to snow mold that can seriously weaken stands in areas prone to extended snow cover. They require at least 16, but prefer 18 inches of precipitation. 'Dawson' (on saline soils), 'Fortress', 'Illahhe' and 'Recent' are adapted varieties and many others are commercially available. Planting depth 0-1/4 inch. Average seeds per ft^2 at 1 lb. rate 14. Recommended seeding rate for turf applications 4 lb./ac.

Fescue, Sheep *Festuca ovina*

A long-lived short stature introduced bunchgrass with short leaf blades. It is more drought tolerant than other fescues. Production is low, but groundcover and root production is excellent. It is used for turf, highway plantings, airport landing strips, burned over timberland and reclamation areas where a long-lived, persistent, competitive ground cover is needed. Not recommended for pasture or hay. Sheep fescue is best adapted to 10+ inch precipitation zones. A very good erosion control and understory species that competes well with weeds. Early spring seedings are recommended. . Only pure stands or mixtures with hard fescue are recommended. Planting depth 0-1/4 inch. Adapted varieties are 'Covar' and 'Bighorn'. Average seed per ft^2 is 16 at a 1 lb. rate. Recommended pure stand rate is 4 lb./ac.

Fescue, Tall *Lolium arundinaceum* or *Festuca arundinacea*

A long-lived, deep rooted, high producing introduced cool-season bunchgrass suited for use under a wide range of soil and climatic conditions. It has lower palatability than most other pasture grasses and other species will be grazed out of a mixed stand. Suited to irrigation, subirrigation, or moderately wet conditions, as well as dryland areas where the effective precipitation is over 18 inches. Best suited for acidic to moist, saline to alkali areas in lowlands with pH from 4.7 to 9.5. It is not well adapted to sandy soils having prolonged droughty periods. It is a high forage producer under well-fertilized conditions. Planting depth 1/4 to 1/2 inch. Adaptable varieties include 'Alta', 'Fawn', and 'Forager'. Turf types are becoming more prevalent on the market and many of these contain endophytes. 'Johnstone' is a hybrid of tall fescue and perennial ryegrass. It is more palatable than regular strains of tall fescue, but retains its wide adaptation and resiliency. NOTE: Fungal endophyte problems can develop in livestock foraging on tall fescue. This problem can be greatly reduced, if not eliminated, by seeding with endophyte-free seed (production may be lower with endophyte free plants). Average seeds per ft^2 at 1 lb. rate 5. Recommend pure stand rate 5 lb./ac.

Foxtail, Creeping *Alopecurus arundinaceus*

A long-lived, cool-season, dense sod forming introduced grass that is adapted to wet-slightly saline-acidic-poorly drained pasture sites. It has low seedling vigor, but once established spreads readily by rhizomes. Growth begins early in the spring, and leaves remain green until after hard frosts in the late fall. It is very cold tolerant and can persist in

areas where the frost-free period averages less than 30 days. It is only moderately salt-alkaline tolerant but produces abundant good quality forage on wet fertile sites (with proper fertility) where it is usually superior to other wet area pasture grasses such as reed canarygrass and timothy (it is similar in appearance to timothy, but seedheads are generally black and hairy). It can be invasive in wet areas. Compatible with cicer milkvetch in a mixture. 'Garrison' and 'Retain' are well-adapted cultivars. Canadian varieties 'Dan' and 'Mountain' have not been tested, and may have potential in Intermountain areas. NOTE: Seed is very light and difficult to seed without the use of cracked corn, 2 bushels of rice hulls, or other carrier. Planting depth 1/8 to 1/4 inch. Average seeds per ft^2 at 1 lb. rate 17. Recommend pure stand rate 3 lb./ac.

Hairgrass, Tufted *Deschampsia cespitosa*

A native, perennial, cool season bunchgrass found along streams, moist meadows, lakes and wetlands. Potential uses include streambank, shoreline, and wetland enhancement and reclamation stabilization. It is slow establishing, but long-lived with moderate production. Varieties include 'Norcoast' and 'Peru Creek', a released cultivar from Meeker PMC with adaptation in soils with a pH of 3.0 to 7.8. Additional work is being conducted at Corvallis PMC. Average seeds per ft^2 at 1 lb. rate 57. Recommended seeding rate 1.0 lb./ac. Not recommended in pure stands.

Junegrass, Prairie *Koeleria macrantha* or *Koeleria cristata*

A long-lived, cool season, tufted, North American and European perennial grass. One half to two feet in height. This species prefers deep to very deep silty to sandy soils and is a component of a rangeland plant communities. It does best at 12-20 inches annual precipitation. 'Barkoel' (a European ecotype) is a released cultivar available, but limited quantities are sold commercially. Wildland collections are available and as with all native plant collections you should request "Source Identified" seed. Average seeds per ft^2 at 1 lb. rate 53. Seeding rate 1 lb./ac. Recommended pure stand rate 1 lb./ac. Not recommended in pure stands.

Needlegrass, Green *Nassella viridula* or *Stipa viridula*

A cool season, medium fine-leafed bunchgrass native to the Great Plains and portions of the Intermountain West. It is adapted to a wide range of soils, but prefers clayey soils in 12-20 inch precipitation areas. It is moderately palatable to livestock and wildlife. It has good drought tolerance in the 12-20 inch precipitation zone. Widely adapted from Alberta to New Mexico. High levels of seed dormancy is common and scarification and/or wet prechilling (fall dormant planting) is recommended to break dormancy and improve germination. It is used primarily as a part of native seed mixtures. 'Lodorm' and 'Green Stipagrass' are available releases. Average seeds per ft^2 at 1 lb. rate 4. Recommend pure stand rate 6 lb./ac.

Needlegrass, Letterman *Achnatherum lettermanii* or *Stipa lettermanii*

A cool season, perennial, native bunchgrass. It is best adapted to mountain foothills and valleys at 5,000 to 10,000 feet elevation. It prefers at least 16 inches of precipitation. Adapted to a wide range of soils, most often clayey to loamy soils. No releases are available. Native seed collections should specify "Source Identified" seed. Average seeds per ft^2 at 1 lb. rate 4. Recommend pure stand rate 6 lb./ac.

Needle and Thread *Hesperostipa comata* or *Stipa comata*

A cool season, tufted, perennial, native bunchgrass, 1-3 feet tall. Adapted to fine sandy loam to sandy soils in the 7-16 inch precipitation zone. This species is a fairly early vegetative component on sand dunes in the intermountain region. Used for grazing in spring and winter following disarticulation of seed. The long awn (3-5 inches) attached to the seed can cause injury to livestock. No cultivars are available. Native seed collections should specify "Source Identified" seed. Average seeds per ft^2 at 1 lb. rate 3. Seeding rate 7 lb./ac.

Needlegrass, Thurbers *Achnatherum thurberianum* or *Stipa thurberiana*

A medium height, cool season, native bunchgrass. It is very drought tolerant and often found on well drained, rocky sites and southern exposures in the 8-16 inch rainfall zones. It has fine leaves and is fair to good forage in the early spring when most species are not productive and can green-up in fall with rainfall. It is currently under development by Forest Service. Native seed collections should specify "Source Identified" seed. Average seeds per ft^2 at 1 lb. rate 3. Seeding rate 7 lb./ac.

Orchardgrass *Dactylis glomerata*

A long-lived, high producing, introduced bunchgrass, adapted to well drained soils. It produces long folded leaves arising mostly from the plant base. A shade tolerant plant that is highly palatable to livestock and wildlife, especially in the early part of the growing season. It is a widely preferred species for hay, pasture, or silage. For highest forage quality and regrowth, harvest while still in the boot stage. It is less winter hardy than meadow or smooth brome or timothy and is more vulnerable to diseases than many pasture grasses. Orchardgrass is compatible in alfalfa, sainfoin and clover mixes. It can be grown under irrigation or on dryland where the effective precipitation is 18 inches or more. It requires a good fertility program for high production. It is also used in erosion-control mixes primarily for its forage value. This species does best on soils with few limitations and good drainage. Avoid shallow and sandy soils. Varieties are early-, mid-, and late-season in maturity. Late-season varieties are preferred in mixture with alfalfa. Early - `Hallmark', 'Potomac'; Mid - `Akaroa', 'Ambassador'; Late - 'Latar' (recommended with alfalfa). 'Paiute' orchardgrass is more drought tolerant (adapted to 16 inches of precipitation) than the other varieties. Planting depth is 1/4 to 1/2 inch. Average seeds per ft^2 at 1 lb. rate 12. Recommend pure stand rate 4 lb./ac.

Ricegrass, Indian *Achnatherum hymenoides* or *Oryzopsis hymenoides*

A native perennial, very drought tolerant bunchgrass adapted to well drained sandy to clayey soils and dry desert ranges. Seed is very slow to germinate due to a thick seedcoat resulting in high seed dormancy. To improve seed germination, the seed can be treated in sulfuric acid, mechanically scarified, or dormant fall planted to allow for a cool moist stratification. Untreated seed requires a greater depth of planting than most species to promote seed germination. Recommended sites are sunny exposures in 7 inches or more precipitation zones with sandy or gravelly soils (10 inch plus rainfall areas result in most successful seedings). Grows on raw subsoil from lowlands into high mountains. Recommended planting depth is 1.5 inches in loamy soils to 3 inches on sandy to gravelly soils. It is very palatable, considered excellent winter forage, and the seed production enhances forage value because of high protein and fat content in the seed. It is also considered an excellent plant for wildlife habitat seedings. Good grazing management is necessary if stands are to persist. 'Nezpar' is a northern variety with improved germination characteristics. 'Paloma' is best adapted to southern semidesert areas. 'Rimrock' and Ribstone Germplasm are northern varieties selected for better seed retention characteristics. ARS is working on additional selections. Average seeds per ft^2 at 1 lb. rate 5. Recommend pure stand rate 6 lb./ac.

Ryegrass, Perennial *Lolium perenne*

A relatively short-lived, rapid developing, vigorous, high forage producing with high quality forage, introduced perennial bunchgrass adapted to a wide variety of soil conditions. Perennial ryegrass can be grown under irrigation or on dryland where the effective precipitation is 15 inches or more. To produce high yields, perennial ryegrass requires as much as 30-50 inches of irrigation and high fertility inputs (split applications recommended). It can be grazed within two months of planting, if vegetation is 10-12 inches high and well established so livestock can not pull plants out by the roots. Well established stands are productive for 3-5 years, if annual over-seeding (5 pounds per acre) of fields occurs each year in late fall or early spring. It does best where winters are mild. It may retard the growth of other perennials if seeded too heavily in a mixture. Generally not recommended in a mixture with other grasses because of strong grazing animal preference towards perennial ryegrass over other grasses. It has good recovery after grazing in the spring but tends to go dormant when summer temperatures exceed 80º F. Suited for most acidic to mildly basic (5-8 pH) areas as a turf, hay or pasture. Perennial ryegrass can be differentiated from annual ryegrass by lack of awns, whereas annual ryegrass has awns. Perennial ryegrass usually contains a fungal endophyte which is linked to the

occurrence of ryegrass staggers (there have been reports of ryegrass staggers in Oregon and California). Planting depth 1/4 to 1/2 inch. Adapted varieties are 'Linn', and 'Manawa (H1)'. Tetraploids are also available and have shown promising results in tests at several locations. Most tetraploids are developed for short rotation pastures or green chop. These varieties include 'Bastian', 'Grimalda', and 'Reville'. Many other varieties are available and it is recommended that you consult a seed dealer in your area for locally adapted varieties and be sure to request a forage type. Average seeds per ft^2 at 1 lb. rate 6. Recommend pure stand rate 5 lb./ac. Higher seeding rates in pure stands may be considered.

Sacaton, Alkali *Sporobolus airoides*

Alkali sacaton is a native (central Utah and Nevada and south), warm season; perennial grass that grows in large bunches, 1-3 feet tall. It sometimes forms a uniform cover and appears to be a sod type. It is slow establishing and grows in areas with saline-alkali to rocky to semiarid soils as low as 12 inches precipitation commonly with a high watertable present. It is used mainly for erosion control, forage plantings and increased diversity in adapted areas. Two cultivars released for southwestern states include 'Salado' and 'Saltalk'. 'Saltalk' is considered more winter hardy. Average seed per ft^2 at 1 lb. rate is 39. Seeding rate 2 lb./ac.

Squirreltail, Bottlebrush *Elymus elymoides* ssp. *elymoides or californicus* and *Elymus multisetus* or *Sitanion hystrix*

Bottlebrush squirreltail is a short-lived, drought tolerant, cool season, native bunchgrass. It is short to medium sized (6 to 22 inches tall), tufted and has fair forage value in winter and spring and poor forage value in summer when seedheads are present. The bristly awns are objectionable to grazing animals and cause difficulties in seed handling, planting and harvesting. This species is often an increaser on poor condition to improving rangelands. It is adapted to a wide variety of soils including saline soils in the 8-18 inch precipitation zones. It is hoped it will have attributes that will enable it to establish a foothold in annual rangelands dominated by cheatgrass or medusahead rye. ARS and NRCS have released three squirreltail accessions, Sand Hollow Selected Germplasm (*E. multisetus)* in 1996; Toe Jam Selected Germplasm (*E. elymoides* ssp. *californicus)* in 2003; and Fish Creek Selected Germplasm (*E. elymoides* ssp. *elymoides)* in 2003. These have not been fully tested and their full range of adaptation is not known at this time. Sand Hollow is best adapted to sandy foothill rangelands receiving 12 inches or more annual precipitation in the lower Snake River Plains. Toe Jam is best adapted to loam to sandy loam soils in the Great Basin and lower to middle Snake River Plains receiving 8-14 inches of precipitation. Fish Creek is best adapted to sandy loam to silt loam to clay loam soils receiving 10 inches or more annual precipitation in the middle to upper Snake River Plains. Additional bottlebrush squirreltail accessions are currently under evaluation by ARS in Logan, NRCS at Bridger and Meeker PMCs and the Forest Service in Provo, Utah. Average seeds per ft^2 at 1 lb. rate 4. Seeding rate 7 lb./ac.

Switchgrass *Panicum virgatum*

Switchgrass is a perennial, tall, weakly sod-forming grass native to the Midwest and the Great Plains. It grows on a wide range of soil textures and is tolerant of wet acid soils and brackish marshes. It provides excellent wildlife cover, and seed is utilized as food by songbirds and game birds. Provides excellent late summer forage for livestock. There may be a niche for this species in the corn producing areas of the Intermountain West under irrigation as a mid summer forage. It will probably not exceed forage production of other irrigated forage varieties including orchardgrass and meadow brome. The best-adapted winter hardy cultivar tested in Idaho, Nevada and Utah is 'Blackwell'. Other releases include 'Dakotah', 'Forestburg', and 'Sunburst'. Accessions under development at Bridger PMC may also have potential. Average seeds per ft^2 at 1 pound rate 10. Seeding rate: 4 lb./ac.

Timothy *Phleum pratensis*

An introduced bunchgrass adapted to cool, humid areas. It performs well, with moderate to high yields, on wet fertile pasturelands; establishes cover quickly, volunteers readily on preferred sites, is late maturing, and is very palatable early in the growing season (jointing stage) and only moderately palatable later in the growing season (post seed head development). It should be grazed before the jointing stage and hayed before seed heads have emerged from boot.

Timothy hay is a premium feed for horses and is compatible in legume mixes. Severe damage can result from early grazing during moist conditions. It recovers (regrowth) very slowly following grazing or haying. It is adapted to high elevations and areas where effective precipitation is 18 inches or irrigated. Recommended sites include cool, moist meadows, ponderosa pine zone and above. Can also be used for ground cover and erosion control on cut or burned-over timberland. Planting depth 1/8 to 1/2 inch. Adapted varieties are 'Climax', 'Mohawk'. Average seeds per ft^2 at 1 lb. rate 28. Recommend pure stand rate 3 lb./ac.

Wheatgrass, Beardless *Pseudoroegneria spicata inerme* or *Agropyron inerme*

A long-lived, drought tolerant, erect native bunchgrass. It differs from bluebunch wheatgrass in the absence of awns. It begins growth in early spring and readily greens up in fall following fall rains. It is very palatable, quality persists longer into growing season and yields are equal to crested wheatgrass. Recommended sites include the 12-18 inch precipitation areas in mountain foothills after timber harvest or wildfire. It is best adapted to winter-wet and summer dry climates. It has poor seedling vigor. Planting depth 1/4 to 1/2 inch. Adapted variety is 'Whitmar'. Average seeds/ft^2 at 1 lb. rate 3. Recommended pure stand rate 7.0 lb./ac.

Wheatgrass, Bluebunch *Pseudoroegneria spicata* or *Agropyron spicatum*

A long-lived, drought-tolerant, widespread native bunchgrass. It begins growth early in spring and again with the onset of fall rains. It is highly palatable and recovers rapidly after grazing but has low resistance to repeated or heavy grazing. It is not recommended as a hay crop. Several years are required for stand to obtain full productivity due to poor seedling vigor. Allow seedings to reach maturity (seedhead development) before grazing. Recommended sites include foothills and valleys with 10-20 inches precipitation, sagebrush, ponderosa pine, mountain brush and juniper-pinyon ranges. Low plant vigor results in poor stands on sites above 6500-ft. elevation. Planting depth 1/4 to 1/2 inch. Adapted varieties are 'Anatone' for use above 10" precipitation and 'Goldar' and 'P7' for use above 12" precipitation. 'Secar' (See Snake River Wheatgrass), previously considered to be bluebunch wheatgrass but found to be a subspecies of thickspike wheatgrass, is more drought tolerant than bluebunch wheatgrass in lower precipitation areas (8-12"). Average seeds per ft^2 at 1 lb. rate 3. Recommend pure stand rate 7.0 lb./ac.

Wheatgrass, Crested (Fairway type-AGCR) *Agropyron cristatum*

A very long-lived, drought-tolerant, vigorous introduced bunchgrass. Similar to standard crested wheatgrass but shorter, earlier maturing, with finer stems and leaves. Establishes on similar sites (10-18 inches precipitation) as standard and grows more effectively than standard at higher elevations. This species does not survive as well as standard crested wheatgrass under severe drought conditions. Planting depth 1/4 to 1/2 inch. Adapted varieties are 'Fairway' and 'Ephraim'. 'Ephraim', is a tetraploid variety of *A. cristatum* that is weakly rhizomatous in higher rainfall areas. 'Roadcrest' is a turf-type with short rhizomes and is recommended for low maintenance lawns. A recent release by ARS, 'Douglas' crested wheatgrass is the first hexaploid on the market. Douglas is characterized as having larger seed, broader leaves and stays green longer into the early summer than other types mentioned above, but requires 14 inches of precipitation or more for long-term survival. It also establishes easily, but produces less forage. Because it stays green longer than other types, it is a preferred forage selection. Douglas is not as drought resistant as Nordan, Summit, Hycrest or CD-II. Other cultivars available but less adapted include 'Parkway', 'Kirk' and 'Ruff'. Average seeds per ft^2 at 1 lb. rate 4. Recommend pure stand rate 5.0 lb./ac.

Wheatgrass, Crested (Standard type-AGDE2) *Agropyron desertorum*

A very long-lived, drought tolerant bunchgrass adapted to a wide range of sites and precipitation zones as low as 9-10 inches. Growth begins early in the spring and again with fall moisture. Palatability is excellent in the spring and late fall, less during summer dormancy and after seed formation. It has very vigorous seedlings. Adapted to foothills with 9-16 inches precipitation, sagebrush, ponderosa pine, mountain brush, and juniper-pinyon ranges. Expect low vigor and poor stands above 6500 feet elevation. This species is more drought tolerant than Fairway type crested

wheatgrasses. Planting depth 1/4 to 1/2 inch. Adapted varieties are 'Nordan' and 'Summit'. Average seeds per ft^2 at 1 lb. rate 4. Recommend pure stand rate 5 lb./ac.

Wheatgrass, Crested (CD-II and Hycrest-hybrids) *Agropyron cristatum x A. desertorum*

A hybrid cross between Standard type and induced tetraploid Fairway type crested wheatgrass. Seedlings are extremely vigorous during germination and early establishment. Survives under greater competition than other crested wheatgrasses. Yields more forage (15-20%) in younger stands; is an outstanding seed producer, but more stemmy. Occupies same sites as standard and Fairway crested wheatgrass. Especially useful in drier sagebrush - cheatgrass sites. Survives in areas with 9-16 inches precipitation. Does not persist as well as Standard type crested wheatgrass or Siberian wheatgrass in very droughty sites. Planting depth 1/4 to 1/2 inch. Cultivars include 'CD-II' and 'Hycrest'. Average seeds per ft^2 at 1 lb. rate 4. Recommend pure stand rate 5 lb./ac.

Wheatgrass, Intermediate *Thinopyrum intermedium* or *Elytrigia intermedia* or *Agropyron intermedium*

A mildly rhizomatous sod-forming, late maturing, long-lived, introduced grass, suited for use as hay and pasture, alone or with alfalfa or other legumes on medium to fine textured soils. It begins growth early in the spring and remains green and palatable into the summer, producing large amounts of quality forage. It does not mature seed at high elevations, but spreads vegetatively. Recommended for the sagebrush to high mountain zones (up to 9000 feet) and deep, upland soils with 13-18 inches of rainfall. This species is excellent for situations where only one to two irrigations are possible, because it readily responds to irrigation with increased forage production, but can also withstand extended drought periods when irrigation water is not available. Useful on disturbed sites for soil stabilization and erosion control. It is not shade tolerant, but is moderately tolerant of saline soil conditions. Planting depth 1/4 to 1/2 inch. Adapted varieties are 'Rush,' selected for excellent seedling vigor, drought tolerance, and forage yield; 'Reliant,' selected for disease resistance and production; 'Oahe' with improved seed production, forage yield, and rust resistance; 'Amur' selected for slightly more drought tolerance performs well at higher elevations, and 'Tegmar', a low growing cultivar noted for erosion control, sod-formation and seedling vigor. Average seeds per ft^2 at 1 lb. rate 2. Recommend pure stand rate 8 lb./ac.

Wheatgrass, NewHy -RS *Pseudoroegneria spicata x Elytrigia repens* or *Agropyron repens x Agropyron spicatum*

NewHy -RS is a hybrid cross between quackgrass and bluebunch wheatgrass. NewHy is a mildly rhizomatous grass suited for use under a wide range of soil conditions and specifically saline conditions. It begins growth early in the spring, retaining succulence and palatability for livestock later in the summer than many grasses. Some problems exist with seedling vigor and germination which may reduce initial stands; however, once established it becomes a very vigorous, high producing, high forage quality species capable of withstanding repeated grazing with good recovery. In saline areas, NewHy is not as productive as tall wheatgrass or tall fescue, but forage quality is significantly better. The hybrid is noted for tolerance to very strongly saline soils and responds to irrigation, sub-irrigation or moderately wet conditions, and dryland areas where effective precipitation is 14 inches or more. Adapted to foothills, intermediate sagebrush and juniper sites, and higher mountain areas up to 8000 feet elevation, and on saline dry or wet bottomland and pastures. Planting depth 1/4 to 1/2 inch. The only cultivar is 'NewHy'. Average seeds per ft^2 at 1 lb. rate 3. Recommend pure stand seeding rate 8 lb./ac.

Wheatgrass, Pubescent *Thinopyrum intermedium* or *Elytrigia intermedia* or *Agropyron trichophorum*

A long-lived, late maturing, introduced, sod-forming grass adapted to low-fertility sites and coarse to medium textured soils. Very similar to intermediate wheatgrass (pubescence on leaves and seed heads) but slightly more drought-resistant, alkali tolerant, and somewhat less palatable. It is better adapted for pasture than for hay. Its ability to remain green during the summer, when soil moisture is limited, is a significant characteristic. Adapted to foothills with 11-18 inches precipitation, this species is excellent for situations where only one to two irrigations are possible, because it readily responds to irrigation with increased forage production, but can also withstand extended drought periods when irrigation water is not available. Useful on disturbed sites for soil stabilization and erosion control. It is not shade

tolerant, but is moderately tolerant of saline soil conditions. It is very useful for erosion control on a wide range of sites. Suggested varieties are 'Luna' (most commonly used) as well as 'Manska' and 'Greenleaf'. Average seeds per ft^2 at 1 lb. rate 2. Recommend pure stand rate 8 lb./ac.

Wheatgrass, Siberian *Agropyron fragile* or *A. sibericum*

Similar to crested wheatgrass, Siberian wheatgrass has finer leaves, and retains its greenness and palatability later into the summer than crested wheatgrass. It yields less than most crested wheatgrass cultivars. It occupies sites where standard crested wheatgrass will grow but is more drought tolerant (7-16 inches of precipitation) and is especially useful on juniper sites. Once established, it is reported to be well adapted to light-sandy, droughty soils and can withstand extended periods of drought better than crested wheatgrasses. Planting depth 1/4 to 1/2 inch. Adapted varieties include 'P-27' and 'Vavilov' (recently released with improved seedling vigor). Average seeds per ft^2 at 1 lb. rate 4. Recommend pure stand rate 6 lb./ac.

Wheatgrass, Slender *Elymus trachycaulus trachycaulus* or *Agropyron trachycaulum*

Slender wheatgrass is a short-lived (3-5 years) native bunchgrass with good seedling vigor and moderate palatability. It is valuable in erosion-control seed mixes because of its rapid development, moderate salt tolerance, and compatibility with other species. It is well adapted as a cover crop to improve soil tilth and to increase organic matter in saline sites. It tolerates a wide range of conditions and adapts well to high altitude ranges and more favorable sites on mountain brush areas receiving 10 inches or more annual precipitation. It is excellent in aspen and tall mountain brush areas and is shade tolerant. Planting depth 1/2 to 3/4 inch. 'Revenue' is a Canadian variety, selected for salinity tolerance, seed set, and forage yield. 'San Luis' is a southern variety adapted to high elevations. 'Pryor' is a northern variety, selected for superior salt tolerance, drought tolerance, and seedling vigor. Average seeds per ft^2 at 1 lb. rate 3.0. Recommend pure stand rate 6 lb./ac. Limit slender wheatgrass to 1 pound PLS per acre in native mixes. Higher rates effect the establishment of slower developing native species.

Wheatgrass, Snake River *Elymus wawawaiensis* or *Pseudoroegneria spicata*

Snake River wheatgrass is a native of the lower canyons of the Snake River and its tributaries in Washington, eastern Oregon, and western to northern Idaho. It is similar in appearance to bluebunch wheatgrass, but differs morphologically in having narrower, acuminate (pointed) to aciculate (needle-like) glumes, a more imbricate (overlapping) spike, and glabrate (without hairs) basal leaf sheaths. It is adaptable to most bluebunch wheatgrass areas but is best suited for the lower precipitation areas (8 to 12 inches). (See bluebunch wheatgrass). The only variety is 'Secar'. It is an early maturing bunchgrass with good seedling vigor and establishes well in native seed mixes. Secar is considered more drought tolerant than previously released bluebunch wheatgrasses. Average seeds per ft^2 at 1 lb. rate 3. Recommend pure stand rate 7 lb./ac.

Wheatgrass, Streambank *Elymus lanceolatus ssp. lanceolatus* or *Agropyron riparium*

A long-lived, very drought tolerant, creeping sod-former adapted to fine-medium textured well-drained soils. Streambank wheatgrass has excellent seeding vigor and is particularly well adapted for erosion control where effective precipitation is 8 or more inches. It has little value as forage and is primarily used for stabilization of roadsides, airport runways, ditchbanks, and lakeshores. It has also been used as a drought tolerant turfgrass, but care must be taken to not over irrigate this grass or stand will be lost. Planting depth 1/4 to 1/2 inch. The only variety is 'Sodar'. Average seeds per ft^2 at 1 lb. rate 3. Recommend pure stand rate 6 lb./ac. (double to triple seeding rate for turf and critical area applications)

Wheatgrass, Tall *Thinopyrum ponticum* or *Elytrigia elongata* or *Agropyron elongatum*

A long-lived, tall-statured, coarse, vigorous, very late maturing, winter hardy introduced bunchgrass. Once established, (seedlings are slow to establish) tall wheatgrass is one of the most tolerant grasses of salt, alkali and high water table conditions. It starts growth early in the spring, reaching maturity in late summer. Reported to be the latest maturing of the wheatgrasses. Palatability is fair early in the growing season, but mature plants become very unpalatable and must be managed for use at earlier stages of growth. It does not stand continuous close grazing. Old coarse growth often makes current growth unavailable. Late standing material becomes good winter forage for livestock when used with supplemental protein sources. This grass has a very wide range of soil and climate adaptation (recommended for 14 inch or higher rainfall zones or sites with high watertables) and is useful for erosion control on critical areas. Provides nesting and food for upland game birds and is also used for wind barriers to control soil erosion and drifting snow. It is adapted to salty areas such as greasewood and saltgrass sites where the water table is from a few inches to several feet below ground surface. Also intermediate and favorable sagebrush, mountain brush, and juniper sites where its drought tolerance is evidenced. Planting depth 1/4 to 3/4 inch. Adapted varieties are 'Alkar' (northern areas), 'Jose' (southern areas), 'Largo' (southern areas), and 'Platte' (Great Plains - not tested in west). Average seeds per ft^2 at 1 lb. rate 2. Recommend pure stand rate 10 lb./ac on good soils. Increase rate to 14 lb./ac. on saline soils.

Wheatgrass, Thickspike *Elymus lanceolatus* spp. *lanceolatus* or *E. lanceolatus* or *Agropyron dasystachyum*

A long-lived, native sod-forming grass widely distributed in the northern part of the Intermountain Region. Drought tolerance, early spring growth, fair palatability, but low forage production characterizes this species. More drought tolerant than western wheatgrass, it is well suited for wind erosion control on medium to coarse-textured soils. It is best utilized as forage until early fall. Can tolerate moderate grazing and considerable trampling. Adapted to disturbed range sites and dry areas subject to erosion, roadsides, and waterways in the 8-18 inch precipitation zones. Use as a native component in rangeland mixes. Planting depth 1/4 to 1/2 inch. Improved varieties include 'Bannock', 'Schwendimar', 'Critana' and 'Elbee'. Bannock is noted for its rapid establishment, moderate sod formation and greater forage production. Critana is more drought tolerant, exhibits good seedling vigor and readily establishes on critical areas. Schwendimar is noted for quick stabilization of coarse textured soils along the Columbia River. Average seeds per ft^2 at 1 lb. rate 3. Recommend pure stand rate 6 lb./ac.

Wheatgrass, Western *Pascopyrum smithii* or *Agropyron smithii*

A long-lived, late maturing, widely distributed, winter hardy, strongly rhizomatous, native grass with coarse blue-green leaves. Western wheatgrass begins spring growth later than most wheatgrasses and is typified by poor germination and low seedling vigor. When used as pasture it is considered to be an excellent source of spring and early summer forage with protein content of 16 to 18 percent. However, forage quality rapidly declines as plants mature. Provides winter grazing if protein supplements are provided. Protein content of western wheatgrass is usually a little higher (4-5 percent) than other wheatgrasses once cured. Plantings usually result in scattered stands that spread in 3 to 4 years to site dominance. Western wheatgrass is the most aggressive native sod grass available. Once established, it becomes very persistent and provides excellent soil binding erosion control characteristics. It is productive native hay in above normal precipitation years, under water spreading, and other supplemental water irrigation systems. It is particularly productive in clayey swales and silty waterways, and has moderate to high salt tolerance. Adapted to lowlands prone to early season flooding with precipitation at or above 12 inches (use 14 inch + for areas that receive 50 percent or greater winter precipitation) and most mountain brush areas. Planting depth 1/4 to 1/2 inch. Adapted varieties include 'Rosana' (northern variety), 'Rodan' (northern variety), and 'Arriba' (southern variety). Other releases include 'Barton', 'Flintlock', and 'Walsh'. Average seeds per ft^2 at 1 lb. PLS rate is 3. Recommended pure stand seeding rate 6 PLS lb./ac. Not recommended in pure stands. Recommended 50% mixed stand seeding rate 3.0 lb./ac.

Wildrye, Altai *Leymus angustus* or *Elymus angustus*

A winter hardy, drought resistant, long-lived, cool season introduced bunchgrass, sometimes with short rhizomes. It is known to root and use moisture to depths of 15 feet. Basal leaves are somewhat course, but very palatable during the late summer and early fall (protein levels of 8 percent are common in standing winter-feed). In northern regions it is commonly swathed into windrows and utilized as forage for winter feeding operations. Adapted to moderately deep to deep loams to clay loams with 14 inch or greater rainfall. It can withstand saline conditions almost as well as tall wheatgrass and is also almost as productive as tall wheatgrass on saline sites. Seedlings develop slowly and good seedbed preparation and weed control is essential. 'Eejay', 'Pearl' and 'Prairieland' are released varieties. Average seeds per ft^2 at 1 lb. rate 2. Recommended pure stand rate 10 lb./ac.

Wildrye, Basin *Leymus cinereus* or *Elymus cinereus*

A slightly spreading, robust, large native bunchgrass. Basin wildrye is tall, coarse, long-lived, and highly palatable early in spring and becoming low in palatability as it matures. It is useful for calving pasture and wildlife forage and cover. Poor seedling vigor usually results in sparse stands, but one of the highest producing species once established. Do not grazing new seedings until seedheads are evident or at the end of the second growing season. Mature plants are unpalatable and need to be managed for use at earlier periods with grazing management scheduled to maintain a 10 to 12 inch stubble height to avoid removing the growing point of this species. Great care must be taken to avoid close grazing or clipping which may result in plant loss in a single season. Winter grazing with protein supplements utilize old coarse growth. Best adapted to moderately saline or alkaline lowlands, flood plains, flow in areas with high water holding capacity. Especially suited to deep, fine textured clayey to loamy soils that receive 8-12 inches precipitation. Plantings have been established in rainfall areas as low as 5 inches, however basin wildrye plantings are not recommended in areas with less than 8 inches annual precipitation. Particularly well suited for many juniper areas; performs well throughout the mountain brush zone and in aspen openings. Planting depth 1/2 to 3/4 inch. Adapted cultivars are 'Magnar' (blue-green upright leaves) and 'Trailhead' (green overhanging leaves) selected for excellent drought tolerance. Average seeds per ft^2 at 1 lb. rate 3. Recommend pure stand seeding rate 7 lb./ac. Basin wildrye is highly recommended for native species mixtures.

Wildrye, Beardless *Leymus triticoides* or *Elymus triticoides*

A long-lived, sod-forming native grass. It is adapted to poorly drained, wet or wet-saline-alkaline soils or dryland areas that receive at least 14 inches of precipitation. Selected primarily for stabilization and cover on wet to wet-saline soils, this plant is one of the most salt tolerant species available. It is of secondary importance as a forage species due to its coarseness in later growth stages, but is considered productive when fertilized and used for hay or winter grazing. Due to poor seedling vigor and high seed dormancy, establishment is difficult and dormant fall planting is recommended. Planting depth 0-1/4 inch in a firm weed free seedbed. Adapted variety 'Shoshone.' Another variety that may have potential, but has not been extensively tested in the Intermountain West is 'Rio''. Average seeds per ft^2 at 1 lb. rate 4. Recommended pure stand rate 6 lb./ac.

Wildrye, Blue *Elymus glaucus*

A fast developing, short-lived, cool season bunchgrass native to North America. This species is common to open forests, thickets and other areas that are semi-shaded in the 16 inch and above precipitation areas. This species is noted for its high seed production and rapid stand establishment for early erosion control in disturbed areas. Plant at 1/4 to 1/2-inch depth. No Intermountain West adapted varieties have been released, but a selection is being developed by the Pullman PMC. Northwest coastal releases not recommended for the Intermountain West include 'Arlington' and 'Elkton'. Average seeds/ft^2 at 1 lb. rate 3. Recommended pure stand rate is 7 lb./ac.

Wildrye, Canada *Elymus canadensis*

A short-lived cool season bunchgrass native to North America in the 15-inch and greater rainfall areas. Its seedheads commonly droop, spikelets are tipped with one inch curling awns giving it a bristly appearance and its auricles are large and clasping. It grows primarily on sites that are moist with sandy soil in western prairies and foothill to mountainous areas. It tolerates very cold temperatures and can grow late into fall and early winter. It establishes quickly, peak production occurs in the second and third growing seasons, and then production and stand declines thereafter. It is commonly used for reclamation where quick establishment is desirable for erosion control. It is not strongly competitive, thus allows slower establishing species to establish and dominate over time. It is considered very palatable to cattle and horses in early growth stages. It is a prolific seed producer. Plant at 1/4 to 1/2 inch. 'Mandan' was released from Bismarck, North Dakota PMC. Average seeds/ft2 at 1 lb. rate 3. Recommended pure stand seeding rate 7 lb./ac.

Wildrye, Mammoth *Leymus racemosus* or *Elymus giganteus*

A coarse introduced slightly saline tolerant, drought tolerant, creeping rhizomatous grass. It is palatable to livestock early in the growing season and can provide good cover and may be useful for calving pastures and wildlife cover. It is long lived on well-drained inland sand dunes, highway right-of-ways, juniper sites, and dredge spoils where it will stop soil movement and provide permanent cover. It requires at least 7 inches of precipitation. It is available as seed, but can also be propagated vegetatively. It is typically transplanted onto sand dunes for stabilization. Because of its showy inflorescence, it has been used as an ornamental and seed heads have been used in floral arrangements. 'Volga' is the only released cultivar. It was selected for superior performance in stabilizing inland sand dunes and critical areas on coarse textured soils. Average seeds per ft^2 at 1 lb. rate 1. Seeding rate 15 lb./ac.

Wildrye, Russian *Psathyrostachys juncea* or *Elymus junceus*

A long-lived introduced very drought tolerant bunchgrass. Grows rapidly in the spring and produces abundant basal leaves that remain green and palatable through summer and fall as long as soil moisture is available. It endures close grazing better than most grasses. It cures well on the stump (better than most cool season grasses) and makes excellent late fall and winter feed. Russian wildrye is not suited for hay production due to the predominance of basal leaves, which makes it difficult to harvest. Once established, it competes effectively against undesirable plants and it withstands drought as effectively and is more palatable than crested wheatgrass. However, most varieties have been erratic in establishment, demonstrate poor seedling vigor, and provide poor soil protection. Seed in areas receiving at least 8 inches of precipitation. Adapted to sagebrush, mountain brush, juniper-pinyon, and moderately saline sites. Useful on soils too alkaline for crested wheatgrass and too dry for tall wheatgrass. Planting depth 1/4 to 1/2 inch; and is very sensitive to deeper placement. Highest production occurs in wide row spacing of >18 inches. On steep slopes it should be planted on the contour. 'Vinall', an earlier variety, has poor seedling vigor and is not recommended. Canadian releases include 'Swift', which was selected for seedling vigor, and 'Cabree', selected both for seedling vigor and reduced seed shattering. U.S. releases include 'Bozoisky-Select', selected for increased seedling vigor and forage production and 'Mankota', selected for establishment from deeper seeding depths. In plantings in the Intermountain West, Bozoisky-Select and Mankota should be the varieties of choice. Average seeds per ft^2 at 1 lb. rate 4. Recommend pure stand seeding rate 6 lb./ac.

CHARACTERISTICS OF GRASS-LIKE PLANTS

Descriptions for additional grass and grass-like species recommended for Intermountain West wetland and riparian zones can be found in Idaho Plant Materials Technical Note No. 38 "Users Guide To Description, Propagation and Establishment of Wetland Plant Species and Grasses for Riparian Areas in the Intermountain West".

Bulrush, Alkali *Schoenoplectus maritimus* or *Scirpus maritimus*

Alkali bulrush is a short-lived, pioneering, perennial, rhizomatous native wetland plant found at mid to low elevation in marshes, transient wetlands, pond margins and backwater areas. It frequently forms large dense stands on alkaline and saline sites. It is found on most soils from sands to clays with pH as high as 9.0. It survives periods of flooding to depths of 3 feet. Due to poor seedling vigor, direct seeding usually results in marginal stands. Planting vegetative plugs is recommended. It is used primarily for erosion control, constructed wetlands, wildlife cover, and increased plant diversity. It reduces wind and wave erosion on exposed soils. Livestock and wildlife rarely utilize alkali bulrush as a forage species. Four germplasm releases have been made for the Intermountain West, but seed is not commercially available. Wildland plug and seed collection is recommended. Nursery container plants may be available.

Bulrush, Hardstem *Schoenoplectus acutus* or *Scirpus acutus*

Hardstem bulrush is a tall, stout, long-lived, perennial, rhizomatous native wetland plant commonly found in monotype stands at mid to low elevation in marshes and long lake and reservoir shorelines. It inhabits areas of standing water ranging from 3 to 8 feet deep. Stands are reduced when it is exposed to extended periods deep water. It tolerates alkaline, saline and brackish soils. It can spread up to 1 foot per growing season. It also tolerates periods of drought and will resprout after fire. Due to poor seedling vigor, direct seeding usually results in marginal stands. Planting vegetative plugs is recommended. Uses include erosion control, constructed wetlands, and increased biodiversity in wetland communities. Livestock will utilize hardstem bulrush under heavy winter snow conditions as forage. Stands are valued for waterfowl feed and nesting. Four germplasm releases have been made for the Intermountain West, but seed is not commercially available. Wildland plug and seed collection is recommended. Nursery container plants may be available.

Cattail, Broadleaf *Typha latifolia*

Common cattail is tall, stout, long-lived, perennial, rhizomatous native wetland plant commonly found in large monotype stands in marshes, along shorelines, and drainage areas. It is adapted to silty clay to sand to gravelly soils with season long saturated soils and standing or slow moving water to 8-12 inches deep. It will not tolerate heavy clay soils. It will tolerate long periods of flooding (to 3 feet deep), long periods of drought, saline soils, and resprouts following burning. It can be very invasive. Uses include erosion control, cover and food source for waterfowl and muskrats, and increased biodiversity in wetland communities. Due to poor seedling vigor, direct seeding usually results in marginal stands. Plant vegetative plugs. Fluctuate water levels for establishment. No releases have been made for the Intermountain West and seed is not commercially available. Wildland plug and seed collection is recommended.

Rush, Baltic *Juncus balticus*

Baltic rush is a short, long-lived, perennial, rhizomatous, native wetland plant commonly found at mid to low elevations, but occasionally in higher mountain locations in wet depressions, swales, moist meadows, sloughs, and near spring sources. It prefers sites that experience spring flooding followed by a dropping watertable and extended periods of drought. It is adapted to clay to silt to coarse substrate and peat soils. Uses include food and cover for waterfowl, songbirds and small mammals and increased biodiversity in wetland communities. Livestock do not utilize baltic rush. Due to poor seedling vigor, direct seeding usually results in marginal stands. Plant vegetative plugs. Fluctuate water levels for establishment. Four germplasm releases have been made for the Intermountain West, but seed is not commercially available. Wildland plug and seed collection is recommended. Nursery container plants may be available.

Sedge, Beaked *Carex rostrata*

Beaked sedge is a medium sized, long-lived, perennial, rhizomatous, native wetland plant found at mid to high elevations in saturated to standing water conditions to 2.5 feet deep. It is adapted to moderately acidic to moderately alkaline soils. Uses include food and cover for waterfowl and songbirds and increased biodiversity in wetland communities. Livestock and wildlife utilize beaked sedge as forage in early spring. Due to poor seedling vigor, direct seeding usually results in marginal stands. Plant vegetative plugs. Fluctuate water levels for establishment. No releases have been made for the Intermountain West and seed is not commercially available. Wildland plug and seed collection is recommended. Nursery container plants may be available.

Sedge, Nebraska *Carex nebrascensis*

Nebraska sedge is a medium sized, long-lived, perennial, rhizomatous, native wetland plant found at mid to low elevations in moist meadows, marshes, swamps, ditches, seeps, near low gradient streams and shorelines where it persists under water for up to 3 months. It commonly forms dense stands and is often the dominant species in these communities. It is adapted to moderately acidic to moderate-highly alkaline soils. Uses include erosion control, constructed wetlands, food and cover for waterfowl and songbirds, and increased biodiversity in wetland communities. Livestock and wildlife utilize Nebraska sedge as forage in early spring and late summer through fall. Due to poor seedling vigor, direct seeding usually results in marginal stands. Plant vegetative plugs. Fluctuate water levels for establishment. Four germplasm releases have been made for the Intermountain West, but seed is not commercially available. Wildland plug and seed collection is recommended. Nursery container plants may be available.

Sedge, Water *Carex aquatilis*

Water sedge is a medium sized, long-lived, perennial, moderately rhizomatous, and native wetland plant found at mid to high elevations in saturated to shallow standing water conditions. It is adapted to moist loam to silt to sandy gravelly soils. Uses include food and cover for waterfowl and songbirds and increased biodiversity in wetland communities. Due to poor seedling vigor, direct seeding usually results in marginal stands. Plant vegetative plugs. Fluctuate water levels for establishment. No releases have been made for the Intermountain West and seed is not commercially available. Wildland plug and seed collection is recommended. Nursery container plants may be available.

Spikerush, Creeping *Eleocharis palustris*

Creeping spikerush is a medium to tall, long-lived, perennial, strongly rhizomatous wetland plant found at mid to low elevations in wet meadows, irrigation ditches, springs, seepage areas, fresh marshes, rivers and lakeshores. It is a pioneering species that establishes quickly in soils that are flooded to 3 feet deep in spring and saturated in fall. It is best adapted to fine textured soils that are neutral, but will tolerate moderately alkaline conditions. It is used for erosion control, constructed wetlands, wildlife cover and soil stabilization. Livestock and wildlife will graze this species. Due to poor seedling vigor, direct seeding usually results in marginal stands. Planting vegetative plugs is recommended. Four germplasm releases have been made for the Intermountain West, but seed is not commercially available. Wildland plug and seed collection is recommended. Nursery container plants may be available.

Threesquare, Common *Schoenoplectus pungens* or *Scirpus pungens*

Common threesquare is a medium sized, long-lived, perennial, rhizomatous wetland plant found at mid to low elevations in backwater areas of streams, ponds, reservoirs, and lake fringes. It is adapted to fine silty clay to sandy loam soils that experience 2 to 4 inches of standing water. It will tolerate alkaline and saline soil conditions. Uses include erosion control, constructed wetlands, food and cover for waterfowl and songbirds and increased biodiversity in wetland communities. Due to poor seedling vigor, direct seeding usually results in marginal stands. Plant vegetative plugs. Fluctuate water levels for establishment. Four germplasm releases have been made for the Intermountain West, but seed is not commercially available. Wildland plug and seed collection is recommended. Nursery container plants may be available.

CHARACTERISTICS OF LEGUMES AND FORBS

Alfalfa *Medicago sativa*

A very productive, palatable perennial introduced legume with numerous varieties that have specific characteristics for given purposes. Suited for use as hay, pasture, or haylage under irrigation or on dryland where the effective precipitation is 12 inches or more. Compatible with most dryland and irrigated forage grasses. Does not persist with moderate to heavy grazing on rangeland unless rest periods occur. It is vulnerable to pocket gophers because of the taproot; however, creeping varieties are less susceptible to damage. Root proliferating alfalfa types are more tolerant to grazing than crown type alfalfa's. Seedings should occur in mid spring to avoid risk to a killing frost. Seed requires inoculation with nitrogen-fixing bacteria before planting. Addition of phosphorus and potassium increase tolerance to close grazing or haying, increase number of nodules present improving nitrogen fixation, and improve production. Bloat can be a problem when grazing alfalfa. Planting a 75 percent grass 25 percent alfalfa mixture will greatly reduce the risk of bloat. Adapted to well-drained intermediate and favorable sagebrush, juniper, mountain brush, and ponderosa pine sites. Does poorly at higher elevations and areas with a high watertable. 'Ladak', 'Trevois,' 'Ranger', 'Spreador 3', and 'Nomad' are commonly used for low precipitation sites including juniper, sagebrush and mountain brush areas. Irrigated varieties are not less drought tolerant than dryland varieties. The irrigated varieties differ in that they respond better to supplemental water. A major difference in varieties is the fall dormancy rating. Fall dormancy is correlated with winter hardiness (this information is available from several sources to help you in making a selection). ARS, Pullman PMC and USFS are working with alfalfa in hopes of selecting more drought tolerant rangeland varieties. Varieties are being changed and improved continually. Consult Extension Service or seed supplier for information on new varieties adapted to specific areas. Planting depth 1/16 to 1/2 inch. Plant in a very firm, weed-free seedbed. Average seeds per ft^2 at 1 lb. rate 5. Full seeding rate 5 lb./ac. Full seeding rate for hayland production is commonly 10-15 pounds per acre. Recommended 25% mixed stand rate at 1.0 lb./ac for pasture situations to help reduce bloat problems.

Aster, Blueleaf *Eurybia glauca* or *Aster glaucodes*

A native perennial forb that commonly occurs in all vegetative types from the upper sagebrush-grass to the subalpine. This forb is generally found on exposed depleted and disturbed sites. It is one of the first forbs to green up in the spring, making it highly sought out by livestock and big game. The strong rhizomatous root system enables this species to be very useful in stabilization of disturbed and erosive areas and in withstanding considerable grazing and trampling. Fall seeding is preferred. Seed at 0 to 1/2 inch deep. Average seeds per ft^2 at 1 lb. rate 18. Pure stand seeding rate 2 lb./ac. Not recommended in pure stands.

Balsamroot, Arrowleaf *Balsamorhiza sagittata*

A long-lived broadleaf native perennial with a deep woody taproot that can be found growing on well-drained silty, loamy to granitic soils in sagebrush-grass, mountain brush, ponderosa pine, and on open sunny slopes in the aspen and coniferous forests. This forb is strongly drought-resistant (12 inch + precipitation), has good winter-hardiness, is tolerant of semi-shade, and strongly tolerant of grazing and trampling. Livestock and big game make extensive use of this forb, especially on spring ranges. It is very difficult to attain good stands of this species because of its extremely slow establishing characteristics that can take up to 8 years. Fall seeding is recommended. Seed can be drilled or broadcast but should be covered more than 1/3 inch deep. Average seeds per ft^2 at 1 lb. rate 1. Pure stand seeding rate 20 lb./ac. Not recommended in pure stands.

Burnet, Small *Sanguisorba minor*

A perennial semi-evergreen introduced forb, growing to 2 feet tall. It has moderate forage production and is non-leguminous but deep-rooted, and has good palatability. Growth is most vigorous in fall and spring. It is best adapted to well-drained soils in the sagebrush-grass and juniper areas. It can be grown on low fertility, droughty soils as well as moderately wet acid soils. It establishes with ease but will not persist in most instances below 14 inches of

precipitation or shaded, poorly drained, high watertable areas. Small burnet is very palatable to livestock and wildlife and upland game and songbirds utilize its seed. Grazing should be deferred to the second growing season to allow plants to become established. 'Delar' is an improved forage yielding variety that should be seeded at 1/4 to 1/2-inch depth. Average seeds per ft^2 at 1 lb. rate 1. Recommended pure stand rate 20 lb./ac.

Clover Alsike *Trifolium hybridum*

A short-lived (3-5 years) perennial legume that produces abundant palatable foliage on fertile soils. It produces best when used in mixtures with grasses suited for hay or pasture under irrigation or on dryland where the effective precipitation is 18 inches or more. It is adapted for use on flooded to poorly drained, acid soils, especially in cool areas. It is not well adapted to sands, droughty conditions or tolerant of shade. Makes good wet-bottomland hay and is very tolerant of cold temperatures, frost heaving and moderately saline-alkaline conditions with high water tables. Bloat is a potential problem. Planting depth 1/4 inch. Adaptable variety is 'Aurora'. Average seeds per ft^2 at 1 lb. rate 16. Pure stand seeding rate 3 lb./ac. Recommended 25% mixed stand rate 1 lb./ac for pasture situations.

Clover, Red *Trifolium pratense*

A short-lived (2-3 years) perennial legume suited primarily for hay and silage under irrigation or on dryland where the effective precipitation is 25 inches or more. Red clover requires well-drained soil and is tolerant of shaded conditions, but not tolerant of flooding, saline conditions or water logged soils. Produces best under medium acid (6.0 pH +) to neutral soil conditions. It is compatible with white clover and grasses in pasture mixtures and will reseed itself and spread under favorable conditions. Planting depth 1/4 to 1 inch. The bloat hazard with red clover is nearly the same as alfalfa. Because it is short lived, second year production is usually greater than the first or third. Adapted varieties are 'Big Bee', 'Kenland', 'Dollard', 'Redman', and 'Reddy'. Average seeds per ft^2 at 1 lb. rate 6. Pure stand seeding rate 6 lb./ac. Recommended 25% mixed stand rate 1.5 lb./ac for pasture situations.

Clover, Strawberry *Trifolium fragiferum*

A spreading, pasture-type, perennial legume suited for use under irrigation or semi-wet to wet soils and strongly to very strongly saline-sodic conditions. It is not adapted to dryland conditions. Less productive than white clover where the latter can be grown. Strawberry clover is more salt tolerant than any of the clovers normally used in the Intermountain West. Bloat hazard is medium. 'Salina' is tolerant to winter flooding, making it a suitable legume for use adjacent to overflowing waterways. Planting depth 1/4 inch or less. Average seeds per ft^2 at 1 lb. rate 7. Pure stand seeding rate 4 lb./ac. Recommended 25% mixed stand rate 1 lb./ac for pasture situations.

Clover, White *Trifolium repens*

A long-lived, stoloniferous low-growing perennial legume suited primarily for pasture, but can also be used for hay and silage. Can be grown under irrigation or on dryland where the effective precipitation is 18 inches or more. Requires medium to high fertility and adequate moisture for optimum production. Is not tolerant of strongly acid or strongly alkaline conditions. Is not tolerant of poor drainage. May present a bloat hazard when it represents a high percentage of the pasture. Is a good erosion control plant on streambanks and roadsides, though usually lacking in persistence. White clover thrives best in a cool, moist; winter snow covered mountain and intermountain climate in soils with ample lime, phosphate, and potash. In general, white clover is best adapted to clay and silt soils in humid and irrigated areas. It grows successfully on sandy soils with a high water table or irrigated droughty soils when adequately fertilized. White clover is shallow rooted and seldom roots deeper than 2 feet which makes it adapted to shallow soils, when adequate precipitation or irrigation is available. There are three general types:

- 'Ladino' is a large type and the only hay type variety. It is two to four times as large as common white clover. It will winter kill under dry winter conditions. It requires a high soil phosphate level and good management for maximum production. 'Pilgram' and 'Merit' have been developed for winter hardiness.
- Intermediate - 'Grassland Huia' is representative of the intermediate type.

- Small type - 'New York' wild and 'Kent Wild' white clover are examples of the small type that is adapted to higher elevations and colder areas. It is the most drought resistant type. It is very persistent in pastures, withstands close grazing, and is the least productive of the white clover.

Average seeds per ft^2 at 1 lb. rate 18. Pure stand seeding rate 3 lb./ac. Recommended 25% mixed stand rate 1 lb./ac for pasture situations.

Crownvetch *Coronilla varia*

An introduced, long-lived perennial legume with a strong rhizome and a deep taproot system. This legume does well in sites that had supported mountain big sagebrush, mountain brush, and aspen communities with over 15 inches of annual precipitation. It prefers soils slightly acid to basic and does especially well in calcareous derived soils. It does not do well in poorly drained soils. This semi-evergreen forb is preferred by all classes of livestock and wildlife. The strong spreading fleshy rhizome enables this species to be an excellent soil stabilizer. Crownvetch does well seeded as a component of a mixture but often become weedy. It requires fall seeding 1/4 to 1/2-inch deep but seedling vigor is poor. Three improved varieties are available: 'Emerald', 'Penngift', and 'Chemung'. 'Emerald' is the smallest in stature and produces less foliage; however, it is the most aggressive underground spreader. Average seeds per ft^2 at 1 lb. rate 2. Pure stand seeding rate 13 lb./ac. Recommended 25% mixed stand rate 3 lb./ac for pasture situations.

Flax, Blue *Linum perenne and Linum lewisii*

An introduced, perennial, semi-evergreen, blue-flowered forb that prefers well-drained soils that range from moderately basic to weakly acidic. It prefers growing in the open, but does have some shade tolerance. It is intolerant of poor drainage, flooding and high water tables. This species grows well in 10-18 inch precipitation areas including all three big sagebrush types, juniper and mountain brush communities. It has been successfully seeded in the salt desert shrub type. Flax does well seeded in mixtures with other species. It can be surface seeded on a disturbed seedbed and should not be seeded deeper than 1/8 inch. This semi-evergreen forb is eaten readily by big game especially during spring and winter and upland game and songbirds relish seeds. This species does well seeded on disturbed sites. 'Appar' was released for its superior forage and seed production and palatability to livestock and wildlife. Recent research has identified 'Appar' as introduced from European origins. Maple Grove Germplasm (*Linum lewisii)* is a new native release by the USFS and Aberdeen PMC. Average seeds per ft^2 at 1 lb. rate 6. Pure stand seeding rate 4 lb./ac. Not recommended in pure stands.

Globemallow, Gooseberry Leaf and Scarlet *Sphaeralcea murroana* and *S. coccinea*

Gooseberryleaf globemallow is a drought tolerant perennial native forb that occurs throughout juniper, sagebrush-rabbitbrush, shadscale and blackbrush communities. Greatest area of occurrence is between 8 and 12 inches annual precipitation. This species has been successfully seeded in the blackbrush, shadscale, juniper and sagebrush communities and on disturbed sites with basic soils. Fall seeding is recommended. A hard seed coat often prevents germination. Seed should not be planted deeper than 1/4 inch. Livestock and big game make fair to good use of this species. It greens up early in the spring and following fall storms. It is one of few forbs that can be successfully seeded on disturbed, exposed, eroded sites in harsh environments.

Scarlet globemallow is a native, low-spreading perennial with creeping rhizomes. This species has considerable drought resistance with greatest area of occurrence is between 8 and 12 inches annual precipitation. It establishes especially well on disturbed sites. It is an excellent soil stabilization species in native species mixtures on harsh sites. Fall seeding is recommended. A hard seed coat often prevents germination. Seed should not be planted deeper than 1/4 inch. Average seeds per ft^2 at 1 lb. rate 17. Pure stand seeding rate 3 lb./ac. Not recommended in pure stands.

Milkvetch, Cicer *Astragalus cicer*

Cicer milkvetch is a long-lived, slow establishing, late maturing, grazing tolerant, introduced, rhizomatous, low-bloating legume that requires inoculation with the proper rhizobium for successful nitrogen fixation. It is a heavy seed and forage producer and forage quality and hay yields are nearly equal that of alfalfa. It is slow to dry in windrows due to its large stems and requires a pickup attachment on swather to cut. It is adapted to cold temperature, lowland areas, and soils with high water holding capacity that receives at least 14 inches precipitation. It is moderately tolerant of flooding. This species is slow to establish due to very hard seed; scarification of seed is recommended. It responds very favorably to applications of phosphorus and potassium. It is very compatible with irrigated pasture grasses and should be considered as a substitute for alfalfa at higher elevations where alfalfa winterkills or where high watertables limit alfalfa's adaptation. Well adapted to sagebrush-grass, juniper and mountain brush areas, except in the shade of trees or tall shrubs. Planting depth 1/4 to 1/2 inch. Recommended varieties include 'Lutana', 'Monarch' and 'Windsor'. Average seeds per ft^2 at 1 lb. rate 3. Pure stand seeding rate 7 lb./ac. Recommended 50% mixed stand rate 4 lb./ac for pasture situations.

Penstemon Species

Firecracker Penstemon *Penstemon eatonii*: A perennial, erect, cool season, short-lived, good reseeder, native forb that has a fibrous root system, stems that are decumbent or reclining, leaves that are slightly pubescent, flowers on upright stems that are bright red and bloom in mid summer through early fall. It is adapted to sagebrush, juniper and ponderosa pine zones at 3,300 to 8,000 feet elevation in 10-16 inch precipitation zones. It does best in full sunlight and can survive cold winter temperatures if snow insulates the plant. It does not do well in poorly drained areas. Potential uses include erosion control, diversity and beautification. The Richfield Selection is a release of firecracker penstemon from Aberdeen PMC. Due to hard seed, plant penstemon species in late fall-early winter at soil surface to 1/8-inch depth. Average seeds per ft^2 at 1 lb. rate 7. Not recommended in pure stands.

Palmer Penstemon *Penstemon palmeri*: A short-lived, good reseeder, semi-evergreen native forb that occurs in the blackbrush, sagebrush-grass and juniper types in basic and slightly acidic soils, on disturbed and exposed sites. The flowers are pink to lavender and bloom in late spring to early summer. It is a pioneering species and is especially suited for seeding exposed, depleted, and disturbed sites. It has considerable potential as an ornamental. Big game and livestock readily seek out this species during winter and spring months. It can be fall broadcast or drilled. Do not seed deeper than 1/8 inch. The only released variety is 'Cedar,' selected for its wide area of adaptation, winter succulence, forage production and preference of livestock and wildlife. Due to hard seed, plant penstemon species in late fall-early winter at soil surface to 1/8-inch depth. Average seeds per ft^2 at 1 lb. rate 7. Not recommended in pure stands.

Rocky Mountain Penstemon *Penstemon strictus*: A perennial, semi-evergreen, long-lived, native forb that occurs in the upper juniper, mountain big sagebrush, mountain brush, and open areas in aspen and coniferous forest. Flowers are bright blue to purple and bloom from mid May to late June. This species does well in areas over 15 inches annual precipitation and on rocky and sandy loam soils that range from weakly acidic to alkaline. It is eaten by livestock and wildlife. Ornamentally, this species has potential. It is widely used to stabilize depleted, disturbed, and eroded sites. Seed can be broadcast or drilled up to 1/8 inch deep. Fall seeding for hard seed stratification is recommended. The variety 'Bandera' was released for its long-lived and seed production characteristics. Plant penstemon species in late fall-early winter at soil surface to 1/8-inch depth. Average seeds per ft^2 at 1 lb. rate 7. Not recommended in pure stands.

Venus (Alpine) Penstemon *Penstemon venustus*: A perennial, cool season, long-lived, native half shrub, with a strong taproot and woody base. The flowers are bright lavender to purple. Its natural habitat is from 1,000 to 6,000 feet elevation and 20-35 inches precipitation. It does best in full sunlight, on open slopes of mountain valleys and foothills. It does not tolerate poorly drained soils. Potential uses include erosion control, plant diversity and beautification on droughty sites. The Clearwater Selection is a release of Alpine penstemon from Aberdeen PMC. Due to hard seed, plant penstemon species in late fall-early winter at soil surface to 1/8-inch depth. Average seeds per ft^2 at 1 lb. rate 25.

A number of penstemons are seeded primarily for soil stabilization on depleted, disturbed and erosive areas and as ornamentals, but no releases have been made. These include Low penstemon (*P. humilis*), Rydberg penstemon (*P. rydbergii*) and Thickleaf penstemon (*P. pachyphyllus*).

Sagewort, Louisiana *Artemisia ludoviciana*

A perennial, rhizomatous, long-lived, fast-growing, native forb to subshrub that occurs in many vegetative types from the sagebrush to the subalpine zone. This species does well on shallow, as well as deep, slightly acid to basic soils. It is considered a pioneering species and is commonly seeded on disturbed areas and plays an important role in providing initial soil cover and stabilization. Germination is low (30 to 40 percent) and plants often take 3 years to mature and set seed. Seed requires light to germinate and it must be broadcast or drilled with seed placement on the soil surface. Do not seed deeper than 1/8-inch. The variety 'Summit' was released for its vigorous rhizome activity, forage production and wide area of adaptation. Average seeds per ft^2 at 1 lb. rate 86. Pure stand seeding rate 0.5 lb./ac. Not recommended in pure stands.

Sainfoin *Onobrychis viciifolia*

Sainfoin is a medium-lived, introduced, cool-season, non-bloating legume. It is impervious to alfalfa weevil, blooms early, and not as productive as alfalfa. It is highly palatable, but has problems with stem and root rot resulting in stands that seldom live more than 10 years. Stands can be maintained long-term by allowing established plants to reseed every 3 to 4 years. Adapted to deep well-drained soils of medium texture, high lime, dryland and irrigated conditions, and slightly alkaline soils. It is not tolerant of wet soils or high water tables. Adapted to areas with 14 inches or more precipitation. It has good seedling vigor but seedlings are weakly competitive against weeds or other plants. Can be grazed or used for hay. Melrose and Remont varieties have the best regrowth characteristics. Planting depth 1/2 to 3/4 inches. Plant in spring and fall. Adapted varieties are 'Eski', 'Melrose' and 'Renumex' for dryland plantings, and 'Remont' for irrigated plantings. Average seeds per ft^2 at 1 lb. rate 0.4. Full seeding rate 34 lb/ac. Recommended 50% mixed stand rate 17 lb./ac for pasture situations.

Sweetclover, Yellow *Melilotus officinalis* Sweetclover, White *M. alba*

An introduced, tall, stemmy, deep rooted, biennial legume. Produces an abundance of forage the first two years and is commonly utilized as a cover crop for perennial seedings. Also reseeds and maintains good stands where perennials do not crowd it out and in years of above normal precipitation. Poor quality forage at mid to later growth stages. Adapted sites include sagebrush-grass to subalpine areas, moist salty lowlands, road cuts and roadsides but does not tolerate acid soils. Maintains stands in grass where ample moisture is available. Suited for green manure or green-chop haylage under irrigation or on dryland where the effective precipitation is 15 inches or more. Sweetclover is the most drought tolerant of the commercially available legumes and has been used successfully in plantings that receive as little as 9 inches effective precipitation. Sweetclover contains Coumarin, a derivative of dicoumarol, a blood anti-coagulant. Death may occur in animals foraging on pure stands or from spoiled hay or silage. Planting depth 1/8 to 1/2 inch. Adapted variety is 'Madrid'. Average seeds per ft^2 at 1 lb. rate 6. Pure stand seeding rate 4 lb./ac. Recommended 25% mixed stand rate 1 lb./ac for pasture situations and 5 to 10% mixed stand rate 0.12 to 0.25 lb./ac for covercrop situations.

Sweetvetch Utah *Hedysarum boreale*

Utah sweetvetch is a native perennial legume. This species occurs in the foothills and upland areas that receive 10 or more inches of precipitation. Sweetvetch prefers well-drained soils ranging from rocky, gravelly, and sandy to heavy clay. Its deep taproot enables it to take advantage of deep soil moisture that results in considerable drought resistance and winter hardiness. Seed should be fall seeded at 1/8 inch to 3/4 inch deep. It is very slow to establish in mixed stands and requires alternate row planting to provide optimum establishment. Livestock and big game graze this species when available. Spring green up occurs early, and basal leaves remain green throughout the winter. 'Timp' is a release from Meeker PMC. Average seeds per ft^2 at 1 lb. rate 2. Pure stand seeding rate 18 lb./ac. Not recommended for pure stands.

Trefoil, Birdsfoot *Lotus corniculatus*

A short-lived, deep-rooted, non-bloat introduced legume suited for use as pasture or hay. It can be grown under irrigation or on dryland where the effective precipitation is 16 inches or more. It is very winter hardy (where protected by snow cover), resistant to water logged soils, and useful at high elevations. Is better than alfalfa for retaining high quality forage on mature growth. The decumbent and intermediate types are more tolerant to close grazing than erect types. Tolerant of poor drainage, this legume is quite vigorous and an excellent plant for erosion control, big game food, and beautification. If plants are allowed to go to seed, stands will persist for many years. Is short lived (2-4 years), making reseeding necessary. It is a nuisance in subsequent crops because of its ability to recruit from the seedbank. Also it may invade adjacent areas that have proper growing conditions. Has some drought tolerance and does well in the upper half of the mountain brush, openings in aspen and also irrigated pasture. Planting depth 1/4 to 1/2 inch. Adapted varieties are 'Empire' (decumbent growth), and 'Maitland' (erect growth). Average seeds per ft^2 at 1 lb. rate 9. Pure stand seeding rate 5 lb./ac. Recommended 50% mixed stand rate 2.5 lb./ac for pasture situations.

Yarrow, Western *Achillea millefolium*

Western yarrow is a perennial forb (member of the sunflower family) and is one of the most widely distributed forbs in the western United States. Native ecotypes are white flowered while Eurasian ecotypes are pink to yellow flowered. It can be found from the valley bottoms to the subalpine zone. Greatest areas of occurrence are mountain brush, aspen, and open timber. It has some shade, drought, and grazing tolerance and can be found in sandy to loamy soils ranging from weakly basic to weakly acid. Yarrow spreads by seed and rhizomes; does an especially good job on disturbed and depleted areas. It may invade adjacent areas that have proper growing conditions. Fall seeding is recommended. Depth of seeding should not exceed 1/4 inch. Western yarrow should be seeded in mixtures with other species. It is easily transplanted. It has been successfully used in plantings that receive as little as 8 inches effective precipitation. Bridger PMC has recently release Great Northern Germplasm from a source in northwestern Montana. The Forest Service is expected to release Eagle Germplasm from a source near Boise, Idaho in the near future. Average seeds per ft^2 at 1 lb. rate 95. Pure stand seeding rate 0.25 lb./ac. Not recommended for pure stands.

CHARACTERISTICS OF WOODY PLANTS

This list includes only those shrubs that should be used in rangeland, and forestland plantings. For additional information: Refer to Idaho Plant Materials Technical Note No. 41 "Restoration and Diversification of Plant Communities with Woody Species".

Descriptions for shrubs and trees recommended for Intermountain West riparian zones can be found in Idaho Plant Materials Technical Note No. 32 "Users Guide To Propagation and Establishment of Native Shrubs and Trees for Riparian Areas".

Descriptions for shrubs and trees commonly utilized for Intermountain West windbreak or shelterbelt plantings can be found in appropriate "Tree and Shrub Handbooks" and Idaho Plant Materials Technical Note No. 43 "Tree Planting, Care and Management".

Bitterbrush, Antelope *Purshia tridentata*

Antelope bitterbrush is a native, multiple branched shrub varying in stature from low prostrate 2 feet tall forms to erect arborescent forms as tall as 15 feet. It normally occurs in well-drained, medium to sandy gravelly, or rocky soils throughout upper sagebrush, juniper, mountain brush, ponderosa pine, and lodgepole pine zones. Seedlings are vigorous and compete well when seeded with herbs. It grows fairly rapidly and furnishes considerable browse. Upright growth forms are heavily browsed during the winter. It is one of the principal species used in wildlife and range seedings. Antelope bitterbrush is an important winter browse plant for game animals, sheep, and cattle. This species maintains itself very well even under severe grazing conditions. It is not tolerant of fire. 'Lassen' antelope bitterbrush is a large upright variety suited to neutral, especially granitic soils. Other varieties include 'Fountain Green' and 'Maybell'. Wildland seed collection is a common practice and Source Identified seed is recommended when using wildland collected seed. Most seeds are dormant and require pre-chilling stratification to germinate. Seeding often results in rodents collecting and caching the seeds. The best method for establishment is by transplanting containerized seedlings or dormant fall seeding with seed that is two to three years old at a depth of 1/2 to 1 inch. Recommended transplant rate is 200 shrubs per acre. Average seeds per ft^2 at 1 lb. rate 0.4. Pure stand seeding rate is 1.0 lb./ac. Not recommended for pure stands. Recommended rate in mix is approximately 1/4 pound PLS per acre.

Bitterbrush, Desert *Purshia glandulosa*

Desert bitterbrush is generally shorter than antelope bitterbrush and evergreen rather than deciduous. It is most common in pinyon-juniper, blackbrush and sagebrush communities in warmer southern regions of the Intermountain West. It is more tolerant of heat and drought than antelope bitterbrush. No releases have been made. Seeds are largely dormant and require pre-chilling to germinate. Seeding often results in rodents collecting and caching the seeds. The best method for establishment is by transplanting containerized seedlings or dormant fall seeding with seed that is two to three years old at a depth of 1/2 to 1 inch. Average seeds per ft^2 at 1 lb. rate 0.4. Pure stand seeding rate is 1.0 lb./ac. Not recommended for pure stands. Recommended rate in mix is approximately 1/4 pound PLS per acre.

Buffaloberry, Silver *Shepherdia argentea*

A native shrub to short tree up to 16 feet tall native to western North America. It is a deciduous shrub, often forming thickets, with dense ascending to erect thorny branches that are silvery-white when young. Roots are shallow, extensive, well branched and capable of fixing nitrogen. It readily suckers and is not considered palatable to livestock. Wildlife utilize the foliage and berries for food and the plant for cover. It prefers well drained to seasonally wet medium to course textured soils in the 12-20 inch precipitation zones. It is drought tolerant, winter hardy, intolerant of shade, and has good saline tolerance and fair fire tolerance due to its sprouting ability. It is used primarily for wildlife cover, food, access barrier, diversity in rangeland, critical areas and as a windward shrub in windbreaks. It is sometimes confused with Russian olive, an invasive species in the habitats that silver buffaloberry occupies. 'Sakakawea' is the only released cultivar. Hard seed coats require 20-30 minutes of acid scarification and 60-90 days of

cold stratification at 68-86^0 F before planting. It is not recommended for seeding and should be established with bareroot or container stock.

Ceanothus or Snowbrush *Ceanothus velutinus*

A native of the Intermountain West, this low growing (2 to 3 feet) decumbent evergreen shrub occurs in juniper, ponderosa pine, mountain brush, and aspen communities on well-drained, medium-textured soils, often rocky and shallow; also weakly acid to weakly basic and mostly non-saline soils. It commonly establishes in areas where snowbanks or drifts occur during the winter. It has moderate shade tolerance, fair drought tolerance, and good browsing tolerance. Sought out by big game and livestock. Can be seeded in conjunction with other species. *Ceanothus* species have been shown to have both hard seedcoats and embryo dormancy. Hot water treatments soften the hard seed coat and pre-chilling generally solves embryo dormancy. Should be seeded on a firm seedbed at 1/4-1/2 inch deep in the fall. Use in game range revegetation mixtures in sagebrush, mountain brush, and juniper communities. Spreading habit, somewhat fire tolerant, and attractive foliage and flowers makes this species potentially useful in seedings or plantings for stabilizing disturbed soils and for roadside beautification. Average seeds per ft^2 at 1 lb. rate 2.2. Mixed stand seeding rate 1/4 lb./ac. Not recommended for pure stands.

Chokecherry *Prunus virginiana*

A native shrub, 5-25 feet tall, common in moist sites such as drainages, ditches, and road shoulders and in cool and moist foothill, mountain, and canyon habitats with 12-30 inches annual precipitation. Adapted to a wide range of soil textures except dense clay; it is intolerant of poor drainage and prolonged spring flooding and high water tables. More common in silty or moderately acidic, moderately basic, and weakly saline soils. It is an aggressive root and sucker sprouting species after fire. Moderate tolerance of grazing; used extensively by livestock and big game. It can concentrate cyanic acid and be poisonous to livestock following drought and freezing weather and when animals are grazing new twigs and leaves. It has good potential on disturbed sites as an ornamental and as a windbreak or shelterbelt specie. Can be transplanted and broadcast or drill seeded in the fall because seed needs pre-chilling to break embryo dormancy. Seed should be placed about 1/2-1.0 inch deep. Fall seeding is preferred. Average seeds per ft^2 at 1 lb. rate 0.1. Mixed stand seeding rate 1/4 lb./ac. Not recommended for pure stands.

Cinquefoil, Shrubby *Dasiphora floribunda* or *Potentilla fruiticosa*

A native, deciduous shrub, very hardy, 1 to 3 feet in height, with attractive leaves and bright yellow flowers. It is primarily used for landscaping, erosion control, and native site rehabilitation where naturally adapted. It prefers full sun locations in the 18 inch plus precipitation zone and is found on a variety of soils that are well drained, but may be saturated or have a high watertable early in the growing season. Plant 1-2 year old container or bareroot stock available through nurseries. It is not recommended for seeding.

Clematis, Western *Clematis ligusticifolia*

A native, fast growing, vigorous climbing, dioecious, vine with both male and female plants. Commonly found along streams it has abundant clusters of showy white flowers that show from July into August. Seed appears cotton-like in fall when mature. It is adapted to moist but well-drained soils, can tolerate droughty periods, and prefers full sun to partial shade. It typically occurs in areas that receive between 10-20 inches of effective precipitation. However, studies conducted by Pullman PMC show that it will grow in sites that receive as little as 7 inches of effective precipitation. It is a good ground cover for erosion control, good plant for top of streambanks, may be useful as a screen, and provides habitat for some wildlife species. It is a layering plant, which makes it useful for stabilizing steep roadcuts. Can be invasive and becomes a pest when it climbs adjacent plants effecting their health and obscuring their beauty. 'Trailar' is a cultivar released by the Pullman PMC that originates from plants in Walla Walla county, Washington. Plant container or bareroot stock available through nurseries. It is not recommended for seeding.

Currant, Golden and Wax Currant *Ribes aureum* and *Ribes cereum*

Fast growing native shrubs, that may, under favorable conditions, reach 10 feet in height. They grow in several forms and produce considerable foliage. Grows in 12-inch precipitation areas, but performs best where the precipitation exceeds 15 inches, especially in the juniper and mountain brush zones. Golden current is an excellent erosion control plant, because it spreads both vegetatively and by seed. Golden is used in conservation plantings and has fairly good saline tolerance. Golden is an attractive shrub that requires little maintenance; it is frequently used in recreational plantings around campgrounds, roadways, etc. They provide food (berries) and cover for upland game and year around browse for big game and livestock. The seed of most Ribes species are highly dormant and require prolonged pre-chilling and a wide range of diurnal temperatures to germinate. Transplanting seedlings is best method of establishment. Average seeds per ft^2 at 1 lb. rate 5.4 to 5.8. Not recommended for pure stands. Mixed stand seeding rate 1/4 lb./ac. Transplants of container or bareroot stock materials are also very successful.

Dogwood, Redosier *Cornus sericea* or *C. stolonifera*

A medium sized, deciduous native shrub, with bright red twigs and stoloniferous root system. Dogwood prefers moist sites and is commonly found along perennial streams. White flowers appear in clusters in late May to mid June followed by white berries in the fall. Birds utilize the berries. It is utilized as a riparian, streambank, wildlife and windbreak plant. A redosier dogwood release from New York is 'Ruby'. Three Selected Class Germplasm have been released by Pullman PMC: Harrington (MLRA B7 and B8); Cheney (MLRA B9 and B10); and Wallowa (MLRA E43 and E44). Dogwood is not recommended for seedings. Plant container, bareroot stock, or cuttings. Cuttings will only root at "cut" locations, so scarring bark on portion of cutting to be under the soil will promote rooting at multiple locations along cutting. Rooting of dogwood cuttings can be improved by applying thiram as a fungicide treatment.

Elderberry, Blue and Red *Sambucus nigra* and *Sambucus racemosa*

Native, medium shrubs with broad crowns, straight trunks, 3 to 13 feet in height, with showy clusters of small yellowish white flowers, and pale blue to red fruit. Elderberry is common along banks, washes of streams, fencerows, rocky pastures, and other drier riparian locations on well-drained moist soils at mid elevations. It is most common in the 18 inch plus precipitation zones, but is found in lower precipitation areas where sub-surface moisture is available. Birds readily utilize the fruit and livestock and wildlife commonly browse the stems. Young seedlings can be transplanted at 1 to 2 years of age. 'Blanchard' blue elderberry is a release. Elderberry is not recommended for seedings and should be established or planted with container stock.

Hawthorn, Black or Douglas *Crataegus douglasii* or *C. douglasii var. douglasii*

An erect native shrub to small tree to 33 feet tall. Branches are zigzagging stems, armed with stout 1-inch thorns and reddish brown in color aging to dirty gray. Habitat it generally drier riparian zones on clay loam to sandy loam soils at mid elevations. Watertable is commonly within 40 inches of surface in spring or runoff events, but drops later in the growing season. This species is tolerant of flooding and saturated poorly drained soils. Hawthorn is in the Rose family and is an alternate host to apple cedar rust. This disease can cause damage to the plant and mask its aesthetics in years favoring fungal diseases. Young seedlings can be transplanted at 1 to 2 years of age. There are no releases. Hawthorn is not recommended for seedings and should be established or planted with container stock.

Kinnikinnick (Bearberry) *Arctostaphylos uva-ursi*

A native, creeping, small (to 12-inch) shrub. It has small, shinny, leathery, dark green leaves, red stems, and small pinkish flowers and red berries in the fall. It is adapted to a variety of soils and is most common in sunny open to semi-shaded forested areas in the north and intermountain west. Use as a ground cover. Young seedlings can be transplanted at 1 to 2 years of age. Plants can also be established from vegetative clones from mother plants. It is not recommended for seedings and should be established or planted with container stock.

Kochia, Forage *Kochia prostrata*

A semi-evergreen perennial sub-shrub introduced from southern Eurasia. On many desert and semidesert ranges, in Russia, it is considered a valuable forage shrub often associated with crested wheatgrass. It has been seeded in the Western United States for many years as a forage and reclamation plant on semiarid locations.

Forage kochia is adapted to basic soils but not suitable for neutral or acid soils. Successful plantings have occurred on soils ranging from sandy loam to heavy clay, with the most successful plantings on heavier soils. This shrub develops a fibrous root system with a large deep taproot, and has been established in areas that receive 5 to 27 inches of annual precipitation.

Forage kochia has demonstrated its adaptability to the juniper, basin big sagebrush, Wyoming big sagebrush, and greasewood-shadscale habitats. Important characteristics: ability to establish and persist on disturbed harsh soils, high salinity and drought tolerance, tolerance of extreme temperatures (-25^{o}C to 104^{o}C), low oxalate levels (lower than winterfat and fourwing saltbush), ability to spread slowly from seed, high seed production, moderate shade tolerance, fair palatability for livestock and big game, food and cover for upland game birds, good fire tolerance, compatibility with other perennials, competitiveness with annuals, and ability to increase fall and winter forage quality of perennial grass stands. The lower one-third of the plant remains green and succulent year around. The upper stems and seed stalks turn brown to red and dry after seed shatter (November to December).

Protein content during winter (upper dry stems 6%, lower green stems 8-9%) is higher than what occurs in antelope bitterbrush and true mountain mahogany. Summer protein content has been found to be over 13%. Sheep, and deer find this shrub palatable year around. When established in annual communities such as halogeton or cheatgrass, forage kochia can compete with annuals by reducing their dominance, density, forage, and seed production. In perennial communities, this shrub fills in interspaces but has not been observed to reduce the density of established perennials.

It is compatible in mixtures with drought tolerant grasses. Direct seeding on rangeland is best accomplished in the fall or winter by broadcasting on top of disturbed or undisturbed soil. Seed viability is generally limited to one year and use of fresh seed with a current germination analysis is highly recommended. If drill seeded, seed should not be seeded deeper than 1/16-inch. Seeding can be in combination with other perennial species. One cultivar, 'Immigrant' has been released. Average seeds per ft^{2} at 1 lb. rate 9.0. Recommended full seeding rate 1 lb./ac. It is not recommended in pure stands. Recommended rates in mix is approximately 1/40 of a pound PLS per acre.

Mountain Mahogany *Cercocarpus species*

Two species of mountain mahogany are excellent native wildland shrubs for several purposes. Curleaf mountain mahogany (*C. ledifolius*) is an evergreen shrub or small tree up to 23 feet tall. True mountain mahogany (*C. montanus*) is a deciduous shrub generally less than 10 feet tall. Both species commonly grow in rocky, mountainous habitats in shallow soils, although true mountain mahogany, will also grow in more moist fertile soils of canyon bottoms. They prefer 14-24 inches annual precipitation. These species are not tolerant of fire. Both are valuable browse plants for game animals and livestock. Curlleaf mountain mahogany is mainly browsed in the winter, whereas true mountain mahogany is utilized year around. Both are among the most palatable of shrubs to all classes of browsing animals. Both species are difficult to establish because their seedlings are vulnerable to herbaceous competition and browsing animal damage. Seed is also extremely dormant and requires prolonged pre-chilling. They are compatible in native species mixtures. They should be seeded at 0-1/2 inch depth. 'Montane' is a widely adapted variety of true mountain mahogany. There is no released variety of curleaf mountain mahogany. Average seeds per ft^{2} at 1 lb. rate 1.2. Mixed stand seeding rate 1/4 lb./ac. Not recommended for pure stands.

Oregongrape (Barberry) *Mahonia spp.*

A native, deciduous, evergreen, creeping, spiny shrub with spreading roots. Oregongrape commonly has yellow flowers and blue-black fruit. It is winter-hardy and grows in full sun to semi-shade commonly in forested areas. It is adapted to a wide range of soils, but prefers moist, well-drained sites receiving 15 inches or more precipitation. It is most commonly used in conservation, erosion control, landscaping, and wildlife plantings. Plant at 1/4-1/2 inch depth.

Average seeds per ft^2 at 1 lb. rate 1.0. Mixed seeding rate is 1/4 lb./ac. Not recommended for pure stands. Young seedlings can be transplanted at 1 to 2 years of age.

Rabbitbrush, Green *Chrysothamnus viscidiflorus*

Green rabbitbrush is a native shrub that usually grows from 12 to 40 inches tall, but varying from dwarf forms to types over 10 feet tall. Green rabbitbrush is composed of numerous subspecies and shows considerable morphological variation in size, stem, leaf, and flower characteristics. A common plant on plains, valleys, and foothills, it grows best in openings within the sagebrush, juniper and ponderosa pine zones in loamy, sandy, gravelly, to clay-alkaline soils. It vigorously invades disturbed sites such as burned areas and overgrazed rangelands but gives way to other plants as the plant community matures. Its has deep roots, heavy litter, and ability to establish on severe sites. It establishes well when seeded with grasses and forbs. Green rabbitbrush is browsed in the fall and heaviest during the winter. Control of established, unwanted stands is often difficult. Average seeds per ft^2 at 1 lb. rate 17.9. Not recommended for pure stands. Can be difficult to establish by seeding. Recommended rate in mixes is approximately 1/40 of a pound PLS per acre.

Rabbitbrush, Rubber *Ericameria nauseosus* or *Chrysothamnus nauseosus*

Rubber rabbitbrush is a native shrub usually 12 to 80 inches tall, but varying from dwarf forms to types over 10 feet tall. Rubber rabbitbrush is composed of numerous subspecies (>20) and shows considerable morphological variation in size, stem, leaf, and flower characteristics. A common plant on plains, valleys, and foothills, it grows best in openings within the sagebrush, juniper and ponderosa pine zones in loamy, sandy, gravelly, to clay-alkaline soils. It vigorously invades disturbed sites such as burned areas, roadcuts, and overgrazed rangelands but gives way to other plants as the plant community matures. It is an excellent plant for controlling erosion because of its deep roots, heavy litter, and ability to establish on severe sites. It is used to seed mine disturbances, roadways and big game ranges. It establishes well when seeded with grasses and forbs. The value of rubber rabbitbrush as browse varies greatly between subspecies and populations. In general, the white to grayish subspecies are more palatable to livestock and big game than green subspecies. Some populations have excellent nutritive quality characteristics. Rubber rabbitbrush is browsed little in the summer, more in the fall, and heaviest during the winter. Some populations of this species may have potential as a source of industrial chemicals (rubber, resin, etc.). Control of established, unwanted stands is often difficult. Can be difficult to establish from seed. Average seeds per ft^2 at 1 lb. rate 15.9. Not recommended for pure stands. Recommended rate in mixes is approximately 1/40 of a pound PLS per acre.

Rose, Woods *Rosa woodsii*

A long-lived native shrub that grows from 2-6 feet tall. Roots are shallow and much branched with plants spreading from rhizomes. It is common in well drained loamy to sandy soils on plains, foothills, and mountain sites. Tolerant of moderately acid to weakly basic but mostly non-saline soils. Most abundant in disturbed soils and open communities with reduced competition. Aggressive pioneer in abandoned fields, fence lines, disturbed sites, gullies, riparian areas and land cuts and fills. Common in 12 to over 20 inches annual precipitation. Foliage moderately palatable to livestock and big game. Provides good cover and winter food for birds and small mammals, for erosion control, and as an ornamental. Rated high potential for roadside and critical site stabilization and beautification. Can be transplanted, drilled, or broadcast seeded 1/2 inch deep. Fall seeding is recommended. Spring seeding requires a cold to warm to cold stratification before seeds will germinate. Average seeds per ft^2 at 1 lb. rate 1.1. Mix seeding rate 1/4 lb./ac. Not recommended for pure stands. Young seedlings can be transplanted at 1 to 2 years of age.

Sagebrush, Big *Artemisia tridentata species (A. t. tridentata, A. t. vaseyana and A. t. wyomingensis)*

Big sagebrush with its 4 major subspecies (basin, Wyoming, mountain, spicate) is a widely occurring, landscape dominating native shrub ranging in height from 1 to 15 feet. The lower forms generally have several main stems arising from the base; the tall forms often have a single trunk. Big sagebrush grows in a variety of soils on arid plains, valleys, and foothills to mountain slopes in the 8-18 inch rainfall areas. It is frequently associated with such shrubs as

shadscale, rubber rabbitbrush, green rabbitbrush, fourwing saltbush, spiny hopsage, gray horsebrush, winterfat, broom snakeweed, antelope bitterbrush, snowberry, and serviceberry. Big sagebrush is one of the more nutritious shrubs on western winter game ranges. Palatability of the different populations of this shrub to mule deer, sheep, and other animals varies widely. It is one of the best shrubs available for use in revegetation of depleted winter game ranges in the Intermountain West. Big sagebrush establishes rapidly from direct broadcast seeding on disturbed surfaces. It is useful for stabilizing washes, gullies, roadcuts, and other raw, exposed sites. It is widely seeded on big game improvement projects. Plants spread well by natural seeding and furnish considerable browse soon after seeding. Big sagebrush is aggressive and persistent and sometimes forms closed stands, which require control measures to improve species diversity. 'Hobble Creek' is a robust, palatable form of mountain big sagebrush adapted to areas with 14 inches or more precipitation and deeper soils. 'Gordon Creek' is a release of Wyoming big sagebrush adapted to 10-14 inches precipitation. Wildland seed collection is a common practice and Source Identified seed is recommended when using wildland collected seed. Use of freshly harvested seed is also recommended. Seed at 0-1/8 inch depth. Average seeds per ft^2 at 1 lb. rate; Basin 39, Mountain 45, Wyoming 39. Not recommended for pure seedings. Recommended rates in mixes are approximately 1/40 of a pound PLS per acre.

Sagebrush, Black *Artemisia nova*

Black sagebrush is a small spreading, aromatic native shrub commonly 6 to 12 inches tall and occasionally to 30 inches tall. It has a dull grayish-tomentose vesiture that causes most populations to appear darker than big sagebrush. It grows in dry, stony, shallow soils often over a caliche layer that receive 8-18 inches of precipitation. Usually these soils are calcareous or are derived from limestone parent materials. Individual populations of black sagebrush are differentially palatable to wildlife and livestock. In general, black sagebrush is considered excellent winter forage for sheep, antelope, and deer. It is an aggressive natural spreader from seed and can be easily established by broadcast seeding. Because it usually grows on shallow dry rocky sites, it is usually not a candidate for plant control. 'Pine Valley Ridge' is the only release. Wildland seed collection is a common practice and Source Identified seed is recommended when using wildland collected seed. Use of freshly harvested is also recommended. Seed at 0-1/8 inch depth Average seeds per ft^2 at 1 lb. rate 20.8. Not recommended for pure stands. Recommended rates in mix are approximately 1/40 of a pound PLS per acre.

Saltbush, Fourwing *Atriplex canesens*

Fourwing saltbush is an upright native shrub from 1 to 6 feet tall depending on site conditions and genotype. It occurs as pistillate (female), staminate (male), or more rarely monoecious (female and male) bushes. The species grows in a variety of soil types from valley bottoms and plains to mountainous areas. It is well suited to deep, well-drained sandy soil, sand dunes, gravelly washes, mesas, ridges, and slopes, but vigorous plants have been found in heavy clays as well. It is frequently found intermixed with numerous shrub and grass species. It is primarily found in the 8-16 inch precipitation zones. Fourwing saltbush is one of the most valuable forage shrubs in arid rangelands because of its abundance, accessibility, palatability, size, evergreen habitat, nutritive value, rate of growth, and large volume of foliage. Its leaves, stems, and utricles provide browse in all seasons. It withstands extremely heavy browsing and often appears to be stimulated by use. Research indicates that some ecotypes of this species may resprout following fire. This species is also one of the most important shrubs for use in rehabilitation of depleted rangelands and in soil stabilization projects. It can be established by direct seeding and by bare root and container transplanting. Fall seeding results in the best stands. The cultivar 'Rincon' is a strain best adapted to the warmer-southern big sagebrush and juniper zones but also does well in the more mesic portions of salt desert shrub areas. Another cultivar is 'Wytana', a natural hybrid of fourwing saltbush and Gardner saltbush, with lower stature. It is best adapted to higher elevation northern great plain on clayey saline soils. The most recent release by Aberdeen PMC, Snake River Plains Germplasm has better cold tolerance than Rincon and is recommended for southern Idaho, northern Nevada and northern Utah. Wildland seed collection is a common practice and Source Identified seed is recommended when using wildland collected seed. Plant at 1/4-3/4 inch depth. Average seeds per ft^2 at 1 lb. rate 1.2. Not recommended for pure stands. Recommended rate in mixes is approximately 1/4 of a pound PLS per acre - dewinged.

Saltbush, Gardner or Nuttall *Atriplex gardneri* or *A. nuttallii*

Gardner saltbush is a low growing perennial shrub that is widespread throughout the Intermountain West including salt desert shrublands. It is usually found on saline heavy textured soils in drier sites than sagebrush or fourwing saltbush, but may be in association with them and is most common in areas receiving 6-12 inches of precipitation. On adapted sites, this species establishes and grows rapidly where few other species exist. It is sensitive to over grazing and many sites that historically supported this species are now lost. It produces excellent browse in all seasons for wildlife and livestock. Wildland seed collection is a common practice and Source Identified seed is recommended when using wildland collected seed. Plant at 1/4-3/4 inch depth. Average seeds per ft^2 at 1 lb. rate 2.6. Not recommended for pure stands. Recommended rate in mixes is approximately 1/4 of a pound PLS per acre. It is best to plant Gardner saltbush in separate rows from other species.

Serviceberry, Saskatoon *Amelanchier alnifolia*

Serviceberry is an erect deciduous native shrub 3 to 15 feet tall. It is an important shrub in the juniper zone, less so in the big sagebrush zone, and most productive and common in sloping moist habitats within the ponderosa pine and just below the mixed conifer zone. It prefers areas that receive 14-30 inches of precipitation. Serviceberry is a valuable browse plant due to its fair-to-high palatability and ready availability to livestock and big game. It is browsed by cattle after mid-summer when the more palatable grasses and forbs have been grazed or have dried up. Big game use it chiefly in the fall and winter. The fleshy fruits are sought by a wide variety of birds and mammals. It resprouts following fire. Utah serviceberry (A. utahensis) is a similar species differing in its drier habitat, more pubescent and smaller leaves, and less succulent fruits. Seedlings and young plants grow slowly and can be suppressed by grasses and broadleaf herbs. Once established, serviceberry withstands very heavy browsing. Three Selected Class Germplasm have been released by Pullman PMC: Okanogan (MLRA B7 and B8); Kendrick (MLRA B9 and B10); and Newport (MLRA E43 and E44). Plant at 1/4-1/2 inch depth. Should be seeded in the fall to break dormancy and allow seedcoat to soften. Average seeds per ft^2 at 1 lb. rate 1.9. Not recommended for pure stands. Recommended rate in mix is approximately 1/4 of a pound PLS per acre.

Silverberry *Elaeagnus commutata*

Silverberry is a multi-stemmed, suckering, deciduous native shrub 4-8 feet tall with an erect habit and slender sometimes twisted branched thicket former. New stems are initially light to medium brown and becoming dark gray with age. Leaves are alternate, oval to ovate, entire, and covered on both sides with silvery-white scales, the bottom sometimes with brown spots. The flowers are highly fragrant, yellow, and trumpet shaped. Fruit is silvery colored and often persists until late December. Late fall planting is recommended. It is most common in the mountain foothills and well-drained riparian zones of the northern Rocky Mountains receiving 14 inches or more precipitation. It tolerates drought, high pH and saline soils. A low incidence of big game browse has been observed and thus it may be a good species to consider in riparian zone revegetation. It is sometimes confused with silver buffaloberry and the invasive introduced species Russian olive. Two source-identified germplasm, Pondera and Dupuyer Source Identified Germplasm have been released for use east of the continental divide in Montana. They may also be adapted to mountainous riparian areas west of the continental divide in Idaho. Plant at 0-3/4 inch depth. Seeds are dormant and require pre-chilling for germination. Average seeds per ft^2 at 1 lb. rate 0.1. Not recommended for pure stands. Recommended rate in mix is approximately 2 pounds PLS per acre. Young seedlings can be transplanted at 1 to 2 years of age.

Snowberry, Common and Mountain *Symphoricarpos albus* and *S. oreophilus*

Snowberry is native, deciduous, 1-5 feet tall, spreading shrub found throughout the western United States. Common snowberry is mostly found in the northern bunchgrass regions and mountain snowberry is most common in the sagebrush regions. They have small pink to white flowers and showy white berries. They reproduce by both seed and rhizomes. They resprout following fire, but mountain snowberry is less tolerant and a weaker sprouter. They are eaten readily by wildlife and sheep, but are less desirable to cattle. They like a wide range of soils except loose sandy soils, tolerate full sun, but prefer partial shading. They are generally found in the 14 inch and above precipitation zones.

They commonly form a monoculture in the moist-dry zone of riparian areas. Uses include conservation, erosion control, wildlife and plantings on upper terraces of riparian areas. They can be transplanted, drilled, or broadcast seeded from 0 to 1/2 inch deep. Very difficult to germinate because of hard seed coat and embryo dormancy that requires warm stratification. Transplanting seedlings recommended. Pullman PMC has released the Selected Class Germplasm Okanogan. Average seed per ft^2 at 1 lb. rate is 1.7. Not recommended in pure stands on upland sites. Recommended rates in mixes is approximately 1/4 of a pound PLS per acre. Young seedlings can be transplanted at 1 to 2 years of age.

Snow Buckwheat *Eriogonum niveum*

Snow buckwheat is a perennial half-shrub that grows on rocky or gravelly hillsides in areas that receive 7-18 inches precipitation. It usually is less than 2.5 feet tall. The foliage is silvery and very pubescent. The flowers are white and showy, and are an excellent source of late season nector for bees. The seeds mature in late fall and seedlings emerge in early spring. It is an excellent erosion control plant for mine spoils and rocky road cuts. Many insects are attracted to it and they are important food sources for small birds. Wildlife also use it for cover and forage. It has great ornamental appeal and is an ideal plant for xeriscapes. The Pullman PMC released 'Umatilla' snow buckwheat in 1991 and commercial seed production is underway. Average seed per ft2 at 1 lb. Rate is 11.5. Not recommended in pure stands. Recommended seeding rates in mixes is 1/2 pound of PLS per acre.

Sumac, Skunkbush *Rhus trilobata*

This native shrub grows from 2-7 feet tall and can be found on most well drained soil textures. It is common on hot, dry, shallow rock, foothills and in well-drained soils. Well adapted to 10 to 20 inches annual precipitation. Grows best on coarse-textured or disturbed soils and somewhat open communities. It is very drought tolerant. Good fire and grazing tolerance. Has good potential as a stabilizer species on disturbed sites and as a windbreak species. Livestock and big game make some use of this shrub as forage. It is an excellent cover species for big game and upland game birds. It can be transplanted or direct seeded. Establishment is very slow by seed. 'Bighorn' is the only released variety. Seed may require scarification and pre-chilling to improve germination. Transplanting seedlings recommended. Average seeds per ft^2 at 1 lb. rate 0.5. Not recommended for pure stands. Recommended rate in mixes is approximately 1/4 of a pound PLS per acre. Young seedlings can be transplanted at 1 to 2 years of age.

Syringa (Mockorange) *Philadelphus lewisii*

A native loosely branched medium to tall shrub (3 to 10 feet) with showy sweet scented white flowers. Syringa is the Idaho State flower. Habitat is mostly in foothills and montane zone in ponderosa pine and Douglas fir forests and in dry, rocky, well drained, moderately shaded, moist canyon bottoms and streamside areas. Deer and elk utilize it primarily during winter. It requires 18 inches of annual precipitation. Can be used on upper banks of riparian zones and for landscaping. Plant container or bareroot stock available through nurseries. Two Selected Class Germplasm have been released by Pullman PMC: Colfax (MLRA B9) and St. Maries (MLRA E43). It is not recommended for seeding.

Winterfat *Krascheninnikovia lanata* or *Ceratoides lanata* or *Eurotia lanata*

Winterfat is an erect or spreading native sub-shrub that shows wide variation in stature from dwarf forms less than 8 inches in height to larger forms to 4 feet in height. The dwarf forms are herbaceous above with a woody base; taller forms tend to be woody throughout. Winterfat is most abundant on lower foothills, plains, and valleys with dry saline to alkaline soils that receive 7 inches or more precipitation. Winterfat is a superior nutritious winter browse for livestock and big game. Sheep, cattle, antelope, elk, deer, and rabbits utilize winterfat. Even though it is relatively tolerant to browsing, over grazing has greatly reduced and even eliminated winterfat in some areas. Winterfat seed maintains viability for relatively short periods of time (6 months to 2 years) without special treatment. Seeds require an after-ripening period for maximum germination and germinate best at warm temperatures (77 to 80^{o}F). Winterfat may be established by seed or by transplanting in 9 inch or greater rainfall areas (attempts to establish winterfat in lower rainfall zones commonly fails). Young seedlings are generally vulnerable to spring frosts. The upright variety, 'Hatch',

is best adapted to southern ranges and produces rapid growth. The most recent release by Aberdeen PMC, Northern Cold Desert Germplasm has better cold tolerance than past releases and is recommended for southern Idaho, northern Nevada and northern Utah. Bridger PMC released Open Range Selected Germplasm in 2002 for use in the Northern Rocky Mountains and Great Plains. Wildland seed collection is a common practice and Source Identified seed is recommended when using wildland collected seed. Average seeds per ft^2 at 1 lb. rate 2.8. Not recommended for pure stands. Recommended rates in mix are approximately 1/40 of a pound PLS per acre.

Table 1
PLANT ADAPTATION and SEEDING RATES
Plant Materials Technical Note No. 24

Common Name	Longevity	Seedling Vigor	Character	Seeds/Lb	1 lb/Acre Seeds/ft^2	Precip	Soil	Depth	PLS Rate
GRASSES									
Bentgrass, Redtop	Long	Slow-Med.	Sod	4,990,000	115	+18	wet	0-1/4	0.5
Bluegrass, Big	Medium	Slow-Med.	Bunch	925,000	21	+ 9	cl-sl	0-1/4	2
Bluegrass, Canby	Long	Slow-Med.	Bunch	925,000	21	+ 9	c-sl	0-1/4	2
Bluegrass, Canada	Long	Slow-Med.	Sod	1,600,000	36	+18	cl-sl	1/4-1/2	1
Bluegrass, Kentucky	Long	Slow-Med.	Sod	2,200,000	50	+18	cl-sl	0-1/4	2-4 sod
Bluegrass, Sandberg	Long	Slow-Med.	Bunch	925,000	21	+ 8	l-cl	0-1/4	2
Brome, Meadow	Long	Med.-Rapid	Bunch	93,000	2	+14	c-sl	1/4-1/2	10
Brome, Mountain	Short	Med.-Rapid	Bunch	80,000	2	+16	c-sl	1/4-1/2	10
Brome, Smooth	Long	Very Rapid	Sod	145,000	3	+14	cl-sl	1/4-1/2	6
Canarygrass, Reed	Long	Med.-Rapid	Sod	506,000	12	+18	c-sl	1/4-1/2	4
Dropseed, Sand	Long	Slow	Bunch	5,298,000	122	+ 7	fsl-s	0-1/4	0.5
Fescue, Hard	Long	Slow	Bunch	560,000	13	+14	c-sl	0-1/4	4
Fescue, Idaho	Long	Very Slow	Bunch	450,000	10	+16	cl-sl	1/4-1/2	4
Fescue, Red	Long	Slow	Sod	614,000	14	+18	c-sl	0-1/4	4
Fescue, Sheep	Long	Slow	Bunch	680,000	16	+10	c-sl	0-1/4	4
Fescue, Tall	Long	Medium	Bunch	205,000	5	+18	saline	1/4-1/2	5
Foxtail, Creeping	Long	Slow	Sod	750,000	17	+18	c-l	1/8-1/4	3
Hairgrass, Tufted	Long	Slow	Bunch	2,500,000	57	+18	c-sl	0-1/4	1
Junegrass, Prairie	Medium	Slow-Med.	Bunch	2,315,000	53	12-20	sil-s	1/4-1/2	1
Needlegrass species	Long	Slow	Bunch	180,000	3-4	8-20	cl-sl	1/4-1/2	6
Orchardgrass	Long	Medium	Bunch	540,000	12	+16	c-sl	1/4-1/2	4
Ricegrass, Indian	Long	Medium	Bunch	235,000	5	+10	l-s	1/2-3	6
Ryegrass, Perennial	Short	V. Rapid	Bunch	247,000	6	+15	cl-sl	1/4-1/2	5
Sacaton, Alkali	Long	Slow-Med.	Bunch	1,700,000	39	+10	wet	1/8-1/2	2
Squirreltail, B.	Long	Medium	Bunch	192,000	4	+8	cl-sl	1/4-1/2	7
Switchgrass	Long	V. Slow	Sod	426,000	10	+16	sil-sl	1/4-1/2	4
Timothy	Long	Medium	Bunch	1,230,000	28	+18	c-sl	1/8-1/4	3
Wheatgrass, Beardless	Long	Medium	Bunch	145,000	3	+12	c-sl	1/4-1/2	7
Wheatgrass, Bluebunch	Long	Medium	Bunch	139,000	3	+12	cl-sl	1/4-1/2	7
Wheatgrass, Crested AGCR	Long	Rapid	Bunch	175,000	4	+10	c-sl	1/4-1/2	5
Wheatgrass, Crested AGDE2	Long	Rapid	Bunch	165,000	4	+8	c-sl	1/4-1/2	5
Wheatgrass, Crested X	Long	Rapid	Bunch	165,000	4	+9	c-sl	1/4-1/2	5

Table 1 Plant Materials Technical Note No. 24

Common Name	Longevity	Seedling Vigor	Character	Seeds/Lb	1 lb/Acre Seeds/ft^2	Precip	Soil	Depth	PLS Rate
GRASSES									
Wheatgrass, Intermediate	Long	Rapid	Sod	80,000	2	+13	cl-sl	1/4-1/2	8
Wheatgrass, Newhy	Long	Medium	Sod	139,000	3	+14	saline	1/4-1/2	8
Wheatgrass, Pubescent	Long	Rapid	Sod	80,000	2	+11	l-s	1/4-1/2	8
Wheatgrass, Siberian	Long	Medium	Bunch	160,000	4	+8	c-sl	1/4-1/2	6
Wheatgrass, Slender	Short	Rapid	Bunch	135,000	3	+10	c-sl	1/2-3/4	6
Wheatgrass, Snake River	Long	Medium	Bunch	139,000	3	+8	c-sl	1/4-1/2	7
Wheatgrass, Streambank	Long	Medium	Sod	135,000	3	+8	c-l	1/4-1/2	6
Wheatgrass, Tall	Long	V. Rapid	Bunch	78,000	2	+14	saline	1/4-3/4	10
Wheatgrass, Thickspike	Long	Medium	Sod	135,000	3	+8	l-s	1/4-1/2	6
Wheatgrass, Western	Long	Medium	Sod	115,000	3	+12-14	cl-sl	1/4-1/2	6
Wildrye, Altai	Long	Slow	Bunch	73,000	2	+14	saline	1/4-1/2	10
Wildrye, Basin	Long	Slow	Bunch	130,000	3	+8	sil-sl	1/4-3/4	7
Wildrye, Beardless	Long	V. Slow	Sod	150,000	4	+14	saline	0-1/4	6
Wildrye, Blue	Medium	Medium	Bunch	145,000	3	+16	cl-sl	1/4-1/2	7
Wildrye, Canada	Short	Rapid	Bunch	115,000	3	+15	l-s	1/4-1/2	7
Wildrye, Mammoth	Long	V. Slow	Sod	55,000	1	+12	ls-s	1/4-1/2	15
Wildrye, Russian	Long	Slow	Bunch	170,000	4	+8	c-sl	1/4-1/2	6

Common Name	Longevity	Vigor	Character	Hydrologic Regime	Rate of Spread	Precip	Flood Tolerance	Planting Method
GRASS-LIKE								
Bulrush, Alkali	Long	Rapid	Sod	to 6" depth	Medium	wetland	High	plants
Bulrush, Hardstem	Long	Rapid	Sod	to 36" depth	Rapid	wetland	High	plants
Cattail	Long	Rapid	Sod	to 12" depth	Rapid	wetland	High	plants
Rush, Baltic	Long	Rapid	Sod	Seasonally Saturated	Medium	wetland	High	plants
Sedge, Beaked	Long	Rapid	Sod	Seasonally Saturated	Rapid	wetland	High	plants
Sedge, Nebraska	Long	Rapid	Sod	Seasonally Saturated	Medium	wetland	High	plants
Sedge, Water	Long	Rapid	Sod	to 3"depth	Medium	wetland	High	plants
Spikerush, Creeping	Long	Rapid	Sod	to 6" depth	Rapid	wetland	High	plants
Threesquare, Common	Long	Rapid	Sod	to 6" depth	Rapid	wetland	High	plants

Table 1 Plant Materials Technical Note No. 24

Common Name	Longevity	Seedling Vigor	Character	Seeds/Lb	1 lb/Acre Seeds/ft^2	Precip	Soil	Depth	PLS Rate
FORBS and LEGUMES									
Alfalfa	Medium	Medium	Erect	200,000	5	+14	sil-sl	1/8-1/2	5
Aster	Medium	Slow	Erect	800,000	18	+12	cl-sil	0-1/2	2
Balsamroot, Arrowleaf	Long	V. Slow	Erect	55,000	1	+10	sil-sl	0-1/3	20
Burnet, Small	Medium	Medium	Erect	42,000	1	+14	c-sl	1/4-1/2	20
Clover, Alsike	Short	Medium	Erect	700,000	16	+18	wet	1/8-1/4	3
Clover, Red	Short	Medium	Erect	275,000	6	+18	sil-sl	1/4-1	6
Clover, Strawberry	Short	Medium	Prostrate	300,000	7	+18	wet/saline	1/8-1/4	4
Clover, White	Med.-Long	Medium	Erect	800,000	18	+18	wet/cl-sil	1/8-1/4	3
Crownvetch	Long	Medium	Prostrate	98,000	2	+15	sil-sl	1/4-1/2	13
Flax, Blue	Short	Slow-Med.	Erect	278,000	6	+10	sil-sl	0-1/8	4
Globemallow	Long	Slow	Erect	750,000	17	+7	saline	1/8-1/4	3
Milkvetch, Cicer	Long	Slow	Erect	130,000	3	+15	c-l	1/4-1/2	7
Penstemon, Venus	Medium	V. Slow	Erect	1,090,000	25	+16	cl-sl	0-1/8	2
Penstemon, Firecracker	Short	V. Slow	Erect	315,000	7	+10	cl-sl	0-1/8	4
Penstemon, Palmer	Medium	V. Slow	Erect	294,000	7	+10	cl-sl	0-1/8	4
Penstemon, Rocky Mtn.	Medium	V. Slow	Erect	286,000	7	+18	cl-sl	0-1/8	4
Sagewort, Louisiana	Short-Med.	Medium	Erect	3,750,000	86	+12	cl-sl	0-1/4	1
Sainfoin	Medium	Slow-Med.	Erect	18,500	0.4	+14	sil-s	1/4-3/4	34
Sweetclover	Short	Med.-Rapid	Erect	262,000	6	+9	c-sl	1/8-1/2	4
Sweetvetch species	Medium	Slow	Erect	70,000	2	+10	cl-sl	1/8-3/4	18
Trefoil, Birdsfoot	Long	Slow	Erect	375,000	9	+18	c-s	1/4-1/2	5
Yarrow, Western	Medium	Slow	Prostrate	4,124,000	95	+8	cl-sl	0-1/4	0.25

Table 1 Plant Materials Technical Note No. 24

Common Name	Longevity	Seedling Vigor	Character	Seeds/Lb	1 lb/Acre Seeds/ft^2	Precip	Soil	Depth	PLS Rate
SHRUBS									
Bitterbrush, A.	Long	Slow	Shrub	15,400	0.4	+10	cl-sl	1/2-1.0	1.0 (1/4*)
Buffaloberry, Silver	Long	Slow	Shrub	40,000	0.9	12-20	sc	1/2	plants
Ceanothus/Snowbrush	Long	Slow	Shrub	94,000	2.2	+16	sil-s	1/4-1/2	1.0 (1/4*)
Chokecherry	Long	Slow	Shrub	4,790	0.1	+12	sil-s	1/2-1.0	1.0 (1/4*)
Cinquefoil, Shrubby	Long	Slow	Shrub	1,000,000	23.0	+18	wet-all	surface	plants
Clematis	Long	Slow	Creeping Vine	315,000	7.2	+10	moist	-----	plants
Current, Golden	Long	Slow	Shrub	233,000	5.4	+12	sil-sl	1/16-1/4	1.0 (1/4*)
Current, Wax	Long	Slow	Shrub	251,000	5.8	+12	sil-sl	1/16-1/4	1.0 (1/4*)
Dogwood, Redosier	Long	Slow	Shrub	18,500	0.4	+16	moist	-----	cuttings
Elderberry, Blue/Red	Medium	Slow	Shrub	205,000	4.7	+18	gravelly	-----	plants
Hawthorn, Black	Long	Slow	Sm. Tree	22,600	0.5	+12	cl-sl	0-1/4	plants
Kinnikinnick	Long	Slow	Creeping Shrub	40,000	0.9	+18	cl-sl	-----	plants
Kochia, Forage	Long	Slow	Half-Shrub	395,000	9.0	+8	cl-sl	0-1/16	1.0 (1/40*)
Mountain Mahogany	Long	Slow	Shrub	48,000	1.1	+14	rocky	0-1/2	1.0 (1/4*)
Oregongrape	Long	Slow	Creeping Shrub	45,000	1.0	+15	moist	1/4-1/2	1/4*/plants
Rabbitbrush, Green	Long	Slow	Shrub	782,000	17.9	+10	sil-s	surface	<1.0 (1/40*)
Rabbitbrush, Rubber	Long	Slow	Shrub	693,000	15.9	+10	sil-s	surface	<1.0 (1/40*)
Rose, Woods	Long	Slow	Shrub	50,000	1.1	+12	l-sl	1/2	1.0 (1/4*)
Sagebrush, Big spp.	Long	Slow	Shrub	1,700,000	39.0	8-18	cl-sl	0-1/8	<1.0 (1/40*)
Sagebrush, Black	Long	Slow	Shrub	907,000	20.8	+10	limy	0-1/8	<1.0 (1/40*)
Saltbush, Fourwing	Long	Slow	Shrub	52,000	1.2	8-16	l-s	1/4-3/4	1.0 (1/4*)
Saltbush, Gardner	Long	Slow	Shrub	114,000	2.6	6-16	l-s	1/4-3/4	0.5 (1/4*)
Serviceberry	Long	Slow	Shrub	82,000	1.9	+14	sil-sl	1/4-1/2	1.0 (1/4*)
Silverberry	Long	Slow	Shrub	3,800	0.1	+14	sil-sl	0-3/4	2.0 (plants)
Snowberry	Long	Slow	Shrub	76,000	1.7	+14	sil-sl	0-1/2	1.0 (1/4*)
Snow Buckwheat	Medium	Slow	Half-Shrub	500,000	11.5	+7	rocky	0-1/4	0.5*
Sumac, Skunkbush	Long	Slow	Shrub	20,300	0.5	+14	rocky	1/2-1.0	1.0 (1/4*)
Syringa (Mockorange)	Long	Slow	Shrub	8,000,000	183.7	+18	moist	-----	plants
Winterfat	Long	Slow	Half-Shrub	123,000	2.8	+7	limy	0-1/8	<1.0 (1/40*)

* This rate is the recommended mix rate per acre and not the 100% pure seed rate per acre. Recommended rates are based on targeting the establishment of 400 plants per acre for optimal wildlife habitat in a seed mix.

Soil: vfsl = very fine sandy loam; fsl = fine sandy loam; sl = sandy loam; l = loam; sil = silty; lfs = loamy fine sand; ls = loamy sand; cl = clay loam; s = sand; c = clay; sc = sandy clay; sic = silty clay; wet = saturated; moist = moist-well drained; limy = high calcium content; rocky = 2" plus rock; gravel = 1/8-2" rock.

TABLE 2
RECOMMENDED RELEASES
PLANT MATERIALS TECHNICAL NOTE NO. 24

COMMON NAME	RECOMMENDED RELEASES	COMMON NAME	RECOMMENDED RELEASES
GRASSES			
Bentgrass, Redtop	'Streaker' and 'Golf Star' - turf grasses	Bluegrass, Big	'Sherman'
Bluegrass, Canby	'Canbar'	Bluegrass, Canada	'Canon', Foothills Germ., 'Rubens' and 'Talon'
Bluegrass, Kentucky	multiple - turfgrass	Bluegrass, Sandberg	'High Plains'
Brome, Meadow	'Fleet', 'Montana', 'MacBeth', 'Paddock' and 'Regar'	Brome, Mountain	'Bromar' and Garnet Germplasm
Brome, Smooth	'Lincoln' and 'Manchar'	Canarygrass, Reed	'Palaton', 'Rise' and 'Venture'
Dropseed, Sand	None	Fescue, Hard	'Durar'
Fescue, Idaho	'Joseph', 'Nezpurs' and 'Winchester'	Fescue, Red	multiple - turfgrass
Fescue, Sheep	'Bighorn' and 'Covar'	Fescue, Tall	'Alta', 'Fawn' 'Forager' and 'Johnstone' & turf grasses
Foxtail, Creeping	'Dan', 'Garrison', 'Mountain' and 'Retain'	Hairgrass, Tufted	'Norcoast' and 'Peru Creek'
Junegrass, Prairie	'Barkoel'	Needlegrass species	'Lodorm' and 'Green Stipagrass' green needlegrass
Orchardgrass	'Latar', 'Paiute' and 'Potomac' + others	Ricegrass, Indian	'Nezpar', 'Paloma', Ribstone Germplasm & 'Rimrock'
Ryegrass, Perennial	multiple - short-lived and high producing	Sacaton, Alkali	None for northern states
Squirreltail, B.	Fish Creek, Sand Hollow, and Toe Jam	Switchgrass	'Blackwell', 'Dakotah', 'Forestburg' and 'Sunburst'
Timothy	'Climax', 'Mohawk' and many others	Wheatgrass, Beardless	'Whitmar'
Wheatgrass, Bluebunch	'Anatone', 'Goldar' and 'P7'	Whtgrs, Crested AGCR	'Douglas', 'Ephraim', 'Kirk', 'Parkway', 'Ruff','Roadcrest'
Whtgrs, Crested AGDE	'Nordan' and 'Summit'	Wheatgrass, Crested X	'Hycrest' and 'CD II'
Wheatgrass, Intermediate	'Amur', 'Oahe', 'Reliant', 'Rush' and 'Tegmar'	Wheatgrass, Newhy	'Newhy'
Wheatgrass, Pubescent	'Greenleaf', 'Luna', and 'Manska'	Wheatgrass, Siberian	'P-27' and 'Vavilov'
Wheatgrass, Slender	'Pryor', 'Revenue' and 'San Luis' (southern variety)	Wheatgrass, Snake River	'Secar'
Wheatgrass, Streambank	'Sodar'	Wheatgrass, Tall	'Alkar', 'Jose', 'Largo' and 'Platte'
Wheatgrass, Thickspike	'Bannock', 'Critana', 'Elbee' and 'Schwendimar'	Wheatgrass, Western	'Arriba', 'Barton', 'Flintlock', 'Rodan' and 'Rosana'
Wildrye, Altai	'Eejay', 'Pearl' and 'Prairieland'	Wildrye, Basin	'Magnar' and 'Trailhead'
Wildrye, Beardless	'Shoshone'	Wildrye, Blue	'Arlington'
Wildrye, Canada	Mandan	Wildrye, Mammoth	'Volga'
Wildrye, Russian	'Bozoisky-Select', 'Cabree', 'Mankota' and 'Swift'		
GRASS-LIKE			
Bulrush, Alkali	Releases Not Commercially Available	Bulrush, Hardstem	Releases Not Commercially Available
Cattail	None	Rush, Baltic	Releases Not Commercially Available
Sedge, Beaked	Releases Not Commercially Available	Sedge, Nebraska	Releases Not Commercially Available
Sedge, Water	None	Spikerush, Creeping	Releases Not Commercially Available
Threesquare, Common	Releases Not Commercially Available		

TABLE 2
RECOMMENDED RELEASES
PLANT MATERIALS TECHNICAL NOTE NO. 24

COMMON NAME	RECOMMENDED RELEASES	COMMON NAME	RECOMMENDED RELEASES
FORBS-LEGUMES			
Alfalfa	multiple varieties available	Aster	None
Balsamroot, Arrowleaf	None	Burnet, Small	'Delar'
Clover, Alsike	'Aurora'	Clover, Red	'Big Bee', 'Dollard', 'Kenland', 'Redman' and 'Reddy'
Clover, Strawberry	'Salina'	Clover, White	'Ladino', 'Grassland Huia', 'Kent Wild', 'New York'
Crownvetch	'Chemung', 'Emerald' and 'Penngift'	Flax, Blue	'Appar'
Globemallow	None	Milkvetch, Cicer	'Lutana', 'Monarch' and 'Windsor'
Penstemon species	'Bandera', 'Cedar', 'Clearwater' & 'Richfield Selection'	Sagewort, Louisiana	'Summit'
Sainfoin	'Eski', 'Melrose' 'Renumex' and 'Remont'	Sweetclover	'Madrid'
Sweetvetch, Utah	'Timp'	Trefoil, Birdsfoot	'Empire' and 'Maitland'
Yarrow	Eagle Germplasm, Great Northern Germplasm		
SHRUBS			
Bitterbrush, A.	'Fountain Green', 'Lassen' and 'Maybell'	Buffaloberry, Silver	'Sakakawea'
Ceanothus or Snowbrush	None	Chokecherry	'Schubert'
Cinquefoil	None	Clematis	'Trailar'
Current, Golden	None	Dogwood, Redosier	'Ruby', and Harrington, Cheney, Wallowa Germ.
Dogwood, Silky	'Indigo'	Elderberry, Blue	'Blanchard'
Hawthorn, Black	None	Kinnikinnick	None
Kochia, Forage	'Immigrant'	Mountain Mahogany	'Montane' mtn. mahogany
Oregongrape	None	Rabbitbrush, Green	None
Rabbitbrush, Rubber	None	Rose, Woods	None
Sagebrush, Basin Big	None	Sagebrush, Mountain Big	'Hobble Creek'
Sagebrush, Wyoming Big	'Gordon Creek'	Sagebrush, Black	'Pine Valley Ridge'
Saltbush, Fourwing	Snake River Plains Germ., 'Rincon', and 'Wytana'	Saltbush, Gardner	None
Serviceberry	Kendrick, Okanogan, and Newport Germplasms	Silverberry	None
Snowberry	Okanogan Germplasm	Snow Buckwheat	Umatilla
Sumac, Skunkbush	'Bighorn'	Syringa (Mockorange)	Colfax Germplasm and St. Maries Germplasm
Winterfat	Northern Cold Desert Germ, Open Range Germ, and ‘Hatch'		

REFERENCES

Cornforth, B., L. St. John and D. Ogle. *Seed Production Standards for Conservation Plants in the Intermountain West.* USDA-NRCS, Boise, Idaho. December 2001. 15p.

Ensign, R. D. and H. L. Harris. *Idaho Forage Crop Handbook*. Idaho Agricultural Experiment Station. Bull. 547, May 1990.

Hafenrichter, A. L. et. al. *Grasses and Legumes for Soil Conservation in the Pacific Northwest and Great Basin States*, USDA-SCS Handbook No. 339, April 1968

Heath, Maurice E., Robert F. Barnes and Darrel S. Metcalfe. *Forages - The Science of Grassland Agriculture*, Iowa State University Press, 1985

Hoag, J.C. *Riparian planting zones*. View from a wetland, No. 5 (1998-1999). Interagency Riparian/Wetland Project, Plant Materials Center, USDA-NRCS, Aberdeen, ID. 1999.

Hoag, J.C., M.E. Sellers, and M. Zierke. 1995. *Wetland plant propagation tips*. View from a wetland, No. 1 (1994 1995). Interagency Riparian/Wetland Project, Plant Materials Center, USDA-NRCS, Aberdeen, ID.

Hoag, J.C., S. Wyman, G. Bentrup, l. Holzworth, D. Ogle, J. Carleton, F. Berg, and b. Leinard. *Users Guide to Description, Propagation and Establishment of Wetland Plant Species and Grasses for Riparian Areas in the Intermountain West*. USDA-NRCS, Boise, ID and Bozeman, MT. ID-TN 38, February 2001. 50p.

Holzworth, L., J. Moseley, D. Cash, D. Koch, and K. Green. *Dryland Pastures in Montana and Wyoming*, Cooperative Extension Service - USDA NRCS. Montana State University. EB 19. Revised September 2000. 28p.

Holzworth, Larry K. and Loren E. Wiesner. *Grass and Legume Seed Production in Montana and Wyoming*, Montana and Wyoming Soil Conservation Districts and USDA-SCS Special Report No. 12, 1985.

Jensen, Kevin, H. Horton, R. Reed, and R. Whiteside. *Intermountain Planting Guide*. USDA - ARS. AG 510. 2001.

Montana State University and USDA-Natural Resources Conservation Service. 1990. *Montana Interagency Plant Materials Handbook.*. Montana State University Extension Service EB 69, Bozeman, MT.

Ogle, D., J.C. Hoag, and J. Scianna. 2000. Technical Note 32: *Users guide to description, propagation and establishment of native shrubs and trees for Riparian Areas in the Intermountain West*. USDA-NRCS, Boise, ID and Bozeman, MT. ID-TN 32, Feb. 2000. 22p.

Sharp, W. Curtis. *Grass Varieties in the United States*, Agricultural Research Service - USDA, Agricultural Handbook No. 170, Nov. 1994

Smith, Dale, Raymond Bela, and Richard P. Walgebach, *Forage Management* (5th Edition), 1986.

Thornburg, Ashley A. *Plant Materials for Use on Surface-mined lands in Arid and Semiarid Regions*. SCS - USDA, SCS-TP-157 January 1982

USDA-NRCS 2002. PLANT Database (http://plants.usda.gov/plants)

Wambolt, Carl. *Montana Range Seeding Guide*. Cooperative Extension Service, Montana State University, Bulletin 347, May 1976.

Young, James A. and Cheryl G.Young. Seeds of Woody Plants of North America. Disocorides Press, Portland, Oregon. 1992.

United States Department of Agriculture
NRCS Natural Resources Conservation Service
Plant Guide

MEADOW BROME

Bromus biebersteinii

Roemer & J.A. Schultes

plant symbol = BRBI2

Contributed by: USDA, NRCS, Idaho State Office

University of Wyoming

Alternate Names
Bromus erectus, Bromus riparius

Uses
Grazing/Hayland: The primary use of meadow brome is for forage production. It is used for pasture, hay and haylage. It is highly palatable to all classes of livestock and wildlife. Meadow brome is one of the best forage grasses for use in the Northwestern states under intensive rotational grazing systems.

Erosion control: Because of its dense network of roots, meadow brome provides good erosion control on those soils to which it is adapted. Rhizomes of meadow brome are much shorter than those of smooth brome. Because of this, smooth brome is commonly a better choice for erosion control plantings.

Wildlife: Meadow brome is used in grass-legume mixes for nesting, broad rearing, escape and winter cover in upland wildlife and conservation plantings. It is excellent forage for big game animals and waterfowl, particularly geese.

Status
Consult the PLANTS Web site and your State Department of Natural Resources for status (e.g. threatened or endangered species, state noxious status, and wetland indicator values).

Description
Bromus biebersteinii, meadow brome, is native to southwestern Asia near Turkey. It is a long-lived, rapid developing, leafy, introduced, cool season grass that spreads by short rhizomes. The numerous long, light-green leaves are dominantly basal, lax, and mildly pubescent. The numerous erect stems appear earlier in the growing season than smooth brome. The awned florets are produced in large, terminal panicles. The presence of awns, hairy leaves and stems, and lack of aggressive rhizomes can distinguish meadow brome from smooth brome. When grown under irrigation, it can reach 2-6 feet in height. It is very productive in close spaced, one-foot rows. Meadow brome is not invasive. Meadow brome has 93,000 seeds per pound.

Adaptation
Meadow brome can be grown under dryland conditions in 14+ annual precipitation regions of the foothills, mountains and irrigated areas throughout the West. Areas of greatest adaptability in the West are the sagebrush-grass, pinyon-juniper, ponderosa pine, aspen and Douglas fir communities. Meadow brome is one of the earliest species to initiate growth in the spring and makes tremendous growth during cool conditions. Due to deep roots and tiller base, it is capable of strong summer growth and regrowth following grazing or haying. It makes rapid recovery following mowing or grazing even during the hot periods of the year.

Unlike meadow brome, smooth brome regrowth initiates from its crown and thus never achieves rapid recovery or regrowth following grazing or haying. Smooth brome does not grow well under hot summer temperatures.

Rhizomes of meadow brome are much shorter than smooth brome resulting in fewer problems with stands becoming sodbound, which is common in smooth brome.

Meadow brome is very winter hardy. It produces well in areas with spring frost such as high mountain valleys. In areas with significant spring frost and little snow cover, meadow brome is a much better species selection than orchardgrass.

Meadow brome performs well on soil textures ranging from shallow to deep, coarse gravely to medium textured, well to moderately well drained, and moderately acidic to weakly saline to alkali. It performs best on fertile, moderately deep to deep, well-drained soils. It does not grow well in saline soils and wet areas with high water tables. It is also sensitive to flooding and commonly dies if inundated for more than 10 days. It has the ability to establish and persist in areas that receive as little as 14 inches of annual precipitation, but performs best with 16 inches or more rainfall or irrigation. It prefers full sun, but will tolerate semi-shady areas or areas with reduced light.

In an Alberta, Canada yield trial meadow brome had impressive pasture-hay yield performance:

Species	Cultivar	Yield (lbs/ac.)
Meadow brome	Regar	10810 (5.4 ton)
	Fleet	10684 (5.3 ton)
	Paddock	10442 (5.2 ton)
Smooth brome	Manchar	8665 (4.3 ton)
Orchardgrass	---------	8709 (4.4 ton)
Meadow foxtail	Garrison	9177 (4.6 ton)

* Fertilized after each cutting for an annual average of 220 lb/ac N and 55 lb/ac P

The forage yields of the meadow brome releases in this study are not significantly different. These yields may be an indicator of production under irrigated conditions. Average yields under dryland conditions are estimated to be about 50 percent of those listed above.

Establishment

A clean, firm, weed-free seedbed is recommended. Dry land and erosion control seedings should be made in the late fall or very early spring when soil moisture is not limited. Irrigated seedings should be made in early to mid spring. On dryland, do not seed later than May 15th or a failure may occur because of drought and hot summer conditions before the grass is well established. A deep furrow or double disc drill with press wheels may be used. Meadow brome does not flow uniformly through a drill unless it is diluted with rice hulls or other dilutent. For dryland and irrigated land a seeding rate of 10 pounds Pure Live Seed (PLS) per acre is recommended (20 seeds per square foot). If broadcast or planted for critical area treatment, double the seeding rate to 20 pounds PLS per acre or 40 seeds PLS per square foot. Meadow brome is very compatible with legumes such as alfalfa, cicer milkvetch, birdsfoot trefoil, sainfoin, and clover species. When planting with legumes, alternate row planting is recommended due to differences in seedling vigor. Use 6 to 8 pounds PLS of meadow brome seed per acre when planting in alternate rows with a legume. Adjustments in seeding rate should be made when seeding in mixtures. Seeding depth should be 1/4 to 1/2 inch.

When seeding for seed increase, seed should be treated with a fungicide (most seed company's can treat seed) to reduce potential head smut problems common in bromes. Irrigated seed production plantings should be in at least 24-inch rows and preferably 36-inch rows. Seed at 4.5 to 5 pounds per acre. Dryland seed yields are commonly 150 to 200 pounds Pure Live Seed per acre and irrigated seed yields are commonly 450 to 600 pounds Pure Live Seed per acre. Seed matures fairly evenly and is ready for harvest in mid-July to early August. The preferred method of harvest is to windrow crop in the firm dough stage and then combine in about 7 days once seed has matured in windrow. Direct combining is also acceptable, but the seed crop must be monitored closely and harvested when seed is mature and before seed shatter occurs. The seed should be dried to 12 percent moisture in bins and 15 percent moisture in sacks before storing.

Regar meadow brome seed production fields are only productive for about two to three seed crops and seed production beyond 2 to three years are normally not economical. Proper row culture (tillage) and ripping may help to extend the stands productive life. Fleet, Paddock, Montana and MacBeth releases were selected for a longer seed production life and higher seed production the third production year compared to Regar.

Management

Under dryland conditions the new planting should not be grazed until late summer or fall of the second growing season. The plants may be severely damaged or pulled out by overgrazing especially in the seedling year due to poorly rooted seedlings. Under irrigated conditions the new planting should not be grazed until late summer or fall of the first growing

season. Meadow brome establishes roots very slowly and plants may be severely damaged by grazing too soon. Harvesting for hay during the establishment year will be most beneficial to eliminate grazing damage.

Do not graze in the spring until forage is 8 to 12 inches high and remove animals from pasture when 3 to 4 inch stubble height remains. A 3 to 4 week rest period between grazing is recommended. Use no more than 60% of the annual growth during the winter season or 50% during the growing season. This plant responds well to rotation-deferred grazing systems. To maintain long-lived stands, the grass should be allowed to periodically mature and produce seed for continuation of the stand.

Meadow brome responds very well to good fertility management. One strategy to even out the forage production is to fertilize the stand after the first and second cutting or grazing periods to boost late spring and summer production. Apply fertilizer based on soil tests. Fertilizer nutrient rates need to be balanced rates of nitrogen and phosphorus to maintain optimum stands of grasses and legumes. Nitrogen will favor the grass while phosphorus will favor the legume.

Forage production can be restored and stands may benefit from ripping if sodbound conditions occur. Care should be taken to avoid excessive tillage because stands may be damaged.

Pests and Potential Problems

Silvertop and head smut are the most common problems in brome grass seed production. Meadow brome seed should be treated with a labeled fungicide if planting is intended for seed production to avoid head smut problems.

Seed shatter is also a common seed production problem that can be avoided by windrowing the field, curing seed in the swath for 5-7 days, and then combining the seed.

Although hybridization with smooth brome can be obtained under controlled greenhouse crosses, hybrids appear not to occur under field conditions due to an earlier (6-10 days) flowering period for meadow brome.

Cultivars, Improved, and Selected Materials

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

Fleet meadow brome was developed by the Agriculture Canada Research Station, Saskatoon, Saskatchewan, and it was released in 1987. Fleet was formed as a synthetic of plants from Eurasian sources including Regar. Fleet is similar to Regar in having a restricted creeping root habit and abundant basal leaves. Fleet also has varying degrees of pubescence similar to Regar. Regrowth following clipping or grazing and fall greenness are also similar to Regar. Forage yields are also similar to Regar, but Fleet may produce higher seed yields

MacBeth PVP (pending) meadow brome was developed at Montana State University and released as a public cultivar under PVP, Title V option in 2001. MacBeth has similar forage yields to Regar, Fleet and Paddock, with a slight yield advantage in Montana dryland trials. A major advantage for MacBeth is its excellent seed yield potential. At three test locations, MacBeth averaged 135 percent higher seed yields than Regar in the third year of production.

Montana PVP (pending) meadow brome was developed at Montana State University and licensed exclusively to a private seed company. It is a protected cultivar under PVP, Title V option and was released in 2001. Montana has similar forage yields to Regar, Fleet and Paddock. The major attribute for Montana is its improved seed yield potential over Regar and Paddock. At three test locations, Montana averaged 35 percent high seed yields than Paddock and 167 percent higher seed yields than Regar in the third year of production.

Paddock meadow brome was selected by the Agriculture Canada Research Station, Saskatoon, Saskatchewan, Canada and released in 1987. It was developed from and introduction from Krasnodar, USSR in 1969. Paddock has a similar habit of growth to Regar and Fleet. Leaves are slightly wider than Regar and forage yields are similar to Fleet and Regar. Paddock seed yields are greater than Regar seed yields.

Regar meadow brome was selected from a collection made near Zek, in Kars Province in Turkey in 1949 and made available to the Aberdeen Plant Materials Center in 1957 by the USDA Regional Plant Introduction Station. It was released in 1966 by the Aberdeen, Idaho Plant Materials Center and the Idaho Agricultural Experiment Station. Regar seed germinates readily, seedling vigor is good and seedlings establish rapidly. Leaves are numerous, dominantly basal, mildly pubescent, and light green. Seed stalks are erect and extend above the leaf mass in an open panicle. Regar heads and matures 7 to 10

days earlier than smooth brome. Regar greens up early in the spring and remains green late into the fall.

Prepared By:
Dan Ogle, Plant Materials Specialist
USDA-NRCS, Idaho State Office, Boise, Idaho

Loren St. John, Manager
USDA-NRCS, Plant Materials Center, Aberdeen, Idaho

Larry K. Holzworth, Plant Materials Specialist
USDA-NRCS, Montana State Office, Bozeman, Montana

Dr. Kevin B. Jensen, USDA-ARS, Forage and Range Research Laboratory, Utah State University, Logan, Utah

Species Coordinator:
Dan Ogle, Plant Materials Specialist
USDA-NRCS, Idaho State Office, Boise, Idaho

16aug02 lsj; 30sept02 lkh; 24jan03 kbj; 3feb03 dgo

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

United States Department of Agriculture
NRCS Natural Resources Conservation Service
Plant Guide

SMALL BURNET

Sanguisorba minor Scop.

plant symbol = SAMI3

Contributed By: USDA, NRCS, Idaho State Office & the National Plant Data Center

Robert Mollenbrock
USDA, NRCS, Weed Science Institute

Alternative Names
This species is recognized as having the following subspecies occurring in the U.S.: *Sanguisorba minor* ssp. *muricata*.

Uses
Grazing/rangeland: Small burnet is noted to have good to excellent forage value for livestock and wildlife during all seasons. It stays green throughout the growing season and into winter until heavy snow cover occurs, providing forage and seed to livestock and wildlife. It provides excellent diversity to the seeded plant community.

Erosion control/reclamation: Small burnet is noted for value in mixes for erosion control and beautification.

Wildlife: Small burnet is considered very desirable forage for elk, deer, antelope and birds either as herbage or seed. Birds use the seed in fall, winter and spring. It also provides cover for selected small bird species. It provides diversity to the plant community.

Ethnobotanic: The leaves of small burnet can be added to salads, ice drinks, vinegar, butter, and cream cheese to add a fresh, pleasant, cucumber-like flavor.

Status
This is an introduced plant. Consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status, such as state noxious status and wetland indicator values.

Description
General: Rose Family (Rosaceae). Small burnet *Sanguisorba minor* is an introduced, hardy, herbaceous, relatively long-lived, evergreen, non-leguminous, perennial forb. It is usually a branched caudex (thick base of stems) with a prominent taproot and sometimes-weakly rhizomatous.

Small burnet plants have alternate pinnately compound leaves. Leaflets are mostly 9 to 17, oval to oblong, 4 inches long and coarsely serrate. Total height varies from 6 inches on droughty sites to approximately 25 inches on irrigated sites. The flowers are sessile and closely packed in head-like to elongate spikes, which are 3 to 8 inches long. The flowers are mostly imperfect, the lower ones staminate and the upper ones pistillate with no petals and about 12 stamen which are filiform. Native burnet species have two to four stamens. The seed is an achene, oblong, about 4 to 5 mm long, woody, papillate-warty, between and along rather prominent ridges which are four in number.

Distribution
For current distribution, consult the Plant Profile page for this species on the PLANTS Web site.

Adaptation
Small burnet does best on well-drained soils and infertile to disturbed soils. It can be planted and will establish in 12 inches or more rainfall areas, but generally does not persist in areas with less than 14 inches annual precipitation. It has excellent cold

winter and drought tolerance. It tolerates weakly saline to weakly acidic sites. Small burnet is not tolerant of poor drainage, flooding or high water tables. It is usually used in open areas, but will tolerate semi-shaded conditions. It is considered fire resistant due to leaves and stems staying green with relatively high moisture content during the fire season.

Establishment
Planting: Small burnet should be seeded with a drill at a depth of 1/4 to 3/4 inch into a firm seedbed or broadcast using seed dribblers or aerial applications. Small burnet is not recommended for single species seedings. The full seeding rate (not recommended) for this forb is 20 pounds Pure Live Seed (PLS) per acre or 20 PLS per square foot. When used as a component of a mix, adjust to percent of mix desired. In most cases a rate of 2 to 5 pounds per acre would be adequate in mixtures with other species. For mine lands and other harsh critical areas, double the seeding rate component of small burnet.

The best seeding results are obtained from seeding in late fall to very early spring (because of grass component of mix) on heavy to medium textured soils and in late fall on medium to light textured soils. Late summer (August - mid September) seeding is not recommended unless site is irrigated. Mulching, irrigation and weed control all benefit stand establishment. Seedling vigor is excellent, but the plant establishes slowly. Germination normally occurs the first growing season if adequate moisture is available. Full flowering should not be expected until at least the second growing season.

Stands may require weed control measures during establishment. Because small burnet is a broadleaf, use of 2,4-D is not recommended. Mow weeds at or prior to their bloom stage. Grasshoppers and other insects may also damage new stands and pesticides may be needed. Be sure to read and follow pesticide labels.

Management
Growth of small burnet begins in early spring and flowers appear in late May through June. The plant establishes slowly and should not be grazed until at least the second growing season. Small burnet plants have been known to persist for more than 20 years on western rangelands. As with other species, the life of the plant can be prolonged if it is permitted to set seed occasionally.

Weed control and removal of very competitive species may improve establishment. Damage from wildlife and rodents may occur and they may need to be controlled. Disease problems are minimal with small burnet.

Seed Production
Small burnet should be seeded in 30 inch rows at the rate of 12 pounds PLS per acre or 42 inch rows at the rate of 10 pounds PLS per acre (25 to 30 seeds per linear foot of row) to allow mechanical weed control. It should be seeded in early spring (April - May).

Hand rouging within row and cultivation between rows may be required after plants have reached 2 to 3 inches in height. Split applications of nitrogen in spring and fall and application of phosphorus in fall will enhance production following the establishment year. For optimum production, do not stress plants for moisture during late bud stage, pollination and re-growth.

Bees are very active in seed fields when plants are in full bloom and therefore it is considered a good nectar producer.

Seed is generally harvested in mid to late August by direct combining with platform set high enough to get most of the seed while leaving as much green material as possible. Seed development occurs progressively from the bottom of plant to the top and is mature when dry and seed is hard and dark in color. Harvest when approximately 80 percent of seed clusters are ripe. Seed shatter is not a serious problem with this species. Seed should be allowed to dry to 12 percent moisture content if stored in bins to 15 percent if stored in sacks and stored in a cool dry area. Seed retains viability for several years under these conditions.

Seed yields of 500 to 600 pounds per acre can be expected under irrigated conditions and 150 to 200 pounds per acre under dryland conditions. Seed production under dryland conditions is not recommended below 14 inches of average annual rainfall.

Environmental Concerns
Small burnet establishes and can spread relatively quickly via seed distribution. Generally, it is not considered "weedy" or an invasive species, but can spread into adjoining vegetative communities under ideal climatic and environmental conditions. There have been reports of it having invasive weedy characteristics in Wyoming.

Control: Contact your local agricultural extension specialist or county weed specialist to learn what

control methods works best in your area and how to use them safely. Read and follow 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.

Eradication can be accomplished by:

1. Seed Fields: Use 2 qt Roundup and 1 pt 2,4-D to kill seed fields and then plow field.
2. Pasture situation: A tank mix of Escort, Banvel, 2,4-D and a surfactant. The addition of 2,4-D should make the mix hot enough to kill small burnet.
3. Pasture situation: A mix of Stinger (0.5-1.5 pt) and 2,4-D (1-2 pt).

Specific information should be obtained through your local agricultural extension office.

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

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

'Delar' small burnet is a cultivar release from seed originating from European sources. The name 'Delar' denotes pleasing or alluring after the attractive green lush appearance of the plant. Aberdeen Plant Materials Center selected the released Delar for outstanding seed and forage production, good cold tolerance, and palatability for both livestock and wildlife. The Natural Resources Conservation Service and the University of Idaho Agricultural Experiment Station released it in 1981.

'Delar' is a hardy, relatively long-lived, evergreen, non-leguminous, introduced, perennial forb from 6 inches tall on droughty sites to approximately 25 inches tall on irrigated sites. It is well adapted to sunny flatlands to open slopes, well-drained soils from moderately basic to weakly acidic, 14 to 20 inch rainfall areas, at 1,000 to 6,000 feet elevation. It will easily establish at the lower rainfall zones, but normally does not persist below 14 inches. It is not tolerant of shade, poor drainage, flooding, or high water tables. It performs well, seeded in mixtures with other species. Its intended uses are erosion control, reclamation, rangeland improvement, wildlife forage, and site diversity. Certified seed is readily available through commercial sources and Breeder seed is maintained by Aberdeen Plant Materials Center.

Alternative native *Sanguisorba* species that might be considered include the following: *Sanguisorba annua* (prairie burnet), *Sanguisorba canadensis* (Canadian burnet), *Sanguisorba menziesii* (Menzies' burnet), *Sanguisorba occidentalis* (western burnet), and *Sanguisorba officinalis* (common burnet). Check PLANTS for the species that occur in your area.

References

Holzworth, L. 2000. *Personal communication*. Plant Materials Specialist. USDA, NRCS, Montana State Office, Bozeman, Montana.

USDA, NRCS 2000. *The PLANTS database*. Version: 000510. <http://plants.usda.gov>. National Plant Data Center, Baton Rouge, Louisiana.

Prepared By

Daniel G. Ogle, Plant Materials Specialist
USDA, NRCS, Idaho State Office, Boise, Idaho.

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

J. Scott Peterson
USDA, NRCS, National Plant Data Center, Baton Rouge, Louisiana

Species Coordinator

Daniel G. Ogle
USDA, NRCS, Idaho State Office, Boise, Idaho.

Edited 18jan01 jsp; 23sept02 lsj; 23sept02 dgo

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>.

IDAHO FESCUE

Festuca idahoensis

Elmer

plant symbol = FEID

Contributed By: USDA, NRCS, Idaho and Washington State Office

Alternate Names
Bluebunch fescue

Uses
Grazing/rangeland/wildlife: Idaho fescue is rated as fair to good forage for all types of domestic livestock (Stubbendieck, J. et al., 1992). It is good year-round forage for elk and is grazed in spring by deer. Idaho fescue begins senescence later in the growing season than most other rangeland plants. Therefore, it is particularly useful for late-season grazing. The "Range Plant Handbook" prepared by the USDA, Forest Service includes a lengthy discussion on Idaho fescue use as rangeland forage (USDA, Forest Service, 1988). We reprint this discussion below.

"Idaho fescue is abundant and sometimes the dominant plant on extensive areas. It usually ranks with the choicest forage plants, and in Montana and possible elsewhere is, everything considered, probably the best forage grass. However, it may not quite merit first rank in palatability in some sections. It produces a fair amount of seed of comparatively high viability and maintains itself well on the range if given a reasonable opportunity. Idaho fescue excels many of its associated forage species in ability to withstand heavy grazing and trampling, although it will succumb to continued grazing abuse. All classes of livestock relish it in the spring, as well as later in the season where it grows on north slopes or in cooler, moister sites and where the herbage remains tender. Under such conditions it is often grazed more closely than other associated grasses. As the season advances, the plants tend to become somewhat tough and harsh, and less succulent, with a proportionate decrease in palatability for sheep, especially ewes and lambs; to some extent this is true for horses and cattle also. However, if more inviting forage is not available, livestock will graze this species throughout the season and thrive. Moreover, the plant cures well on the ground and makes a good or very good fall forage, being readily grazed by all classes of livestock until late in the season, while it also produces a good aftermath, which is much relished. When accessible it is also a good forage for winter use."

Borman et al. (1991) compared eleven perennial grasses for their ability to suppress growth of resident annuals in southwest Oregon. Both Idaho fescue and orchardgrass (*Dactylis glomerata* var. Berber), which begin growth early in the spring, suppressed annuals more effectively than grasses which initiate growth later in the spring. The grasses in this study that initiated growth later in the spring compared to Idaho fescue, are California oatgrass (*Danthonia californica*), prairie junegrass (*Koeleria macrantha*), tall wheatgrass (*Thinopyrum elongatum*), intermediate wheatgrass (*Thinopyrum intermedium*), tall fescue (*Lolium arundinaceum*), perennial ryegrass (*Lolium perenne*), and Rush intermediate wheatgrass (*Thinopyrum intermedium* var. Rush. The authors suggest that, for reseeding in the southern Oregon foothills, land managers should select grass species, which initiate the earliest spring growth and maintain some growth though out the winter.

Moderate continuous grazing (33% current herbage used) did not reduce vigor of Idaho fescue in a 5-year grazing study (Ratliff and Reppert, 1974). However, they further reported that continuous grazing unduly subjects the plants to heavy pressure during dry years. Jacobs and Sheley (1996) compared several Idaho fescue defoliation frequencies and defoliation levels (percent of aboveground biomass removed) for the ability of Idaho fescue to interfere with spotted knapweed (*Centaurea maculosa* Lam.) emergence and growth. As the Idaho fescue defoliation frequency and defoliation level decreased spotted knapweed emergence and growth also decreased. The authors suggest that moderate grazing intensity and infrequent grazing will minimize spotted knapweed invasions by maximizing soil water use by Idaho fescue.

Idaho fescue produces an extensive deep root system. Therefore, it is an excellent erosion control grass for cutover forest areas (Hafenrichter et al., 1968). Plants that develop root-mycorrhizal associations are more tolerant of adverse soil conditions. Ho (1987) identified mycorrhizal Idaho fescue plants growing in an alkali dry lake bed. This alkaline environment (pH 9.2 to 10.5) is not a typical Idaho fescue habitat. Mycorrhiza innoculation may hold promise for increasing the vigor and range of adaptation of Idaho fescue.

Erosion control/reclamation: Idaho fescue is fairly drought resistant, stands are persistent, and it is adapted to stabilization of disturbed soils. It does not compete well with aggressive introduced grasses. Its drought tolerance, combined with extensive root systems and good seedling vigor, make this species ideal for reclamation in areas receiving 14 to 20 inches annual precipitation.

Status
Consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status, such as state noxious status and wetland indicator values.

Description
Festuca idahoensis Elmer, Idaho fescue is a native, perennial, cool-season grass. Idaho fescue culms are erect, 0.3 to 1.0 m tall, glabrous and glaucous, sparsely leaved with most leaves basal. The fine narrow leaves usually have a bluish green to green color. The leaf sheaths are flattened, keeled, either glabrous or scabrous; the basal sheaths are short, open and wider than the blade. The sheath collars are indistinct and the auricles are either small or absent. The blades are involute, 5 to 25 cm long, filiform, firm, elongate, scabrous, often glaucous, glabrous abaxially and pubescent adaxially. The ligule has a ciliate membrane, less than 2 mm long, and is truncate. The inflorescence is a panicle, 7 to 15 cm long, narrow, dense, with branches ascending and lower branches spreading. The spikelets are 4 to 7 flowered, 8 to 14 mm long, with rachilla joints visible; the lemma is 5 to 7 mm long, somewhat laterally compressed at maturity, and scabrous to glabrous. The lemma is awned from the tip, 2 to 5 mm long, and straight. The glumes are unequal, lanceolate and acute; the first glume is 1-nerved, 3 to 5 mm long; and the second glume faintly 5-nerved, 4 to 4.5 mm long. Idaho fescue begins growth early in the spring and its seeds mature by midsummer. It reproduces from both seeds and tillers.

Distribution
The range of Idaho fescue extends to California, Colorado, Idaho, Montana, Nevada, Oregon, South Dakota, Utah, Washington, and Wyoming. Idaho fescue is one of the most common and widely distributed grasses in the Western States. However, it is either rare or absent in the southern portions of the Southwest. For current distribution, consult the Plant Profile page for this species on the PLANTS Web site.

Adaptation
Idaho fescue occupies very diversified habitats. Collections show altitudinal variation in Idaho fescue habitat extending from 300 m to 4,000 m (984 ft. to 13,120 ft.). Although it may be found at any elevation between these extremes, it is most prevalent from about 1,524 to 2439 m (5,000 to 8,000 ft.) in Montana, from 2,341 to 3049 m (7,000 to 10,000 ft.) in Utah and Colorado, and from 915 to 2,341 m (3,000 to 7,000 ft.) in California and the Northwest.

It grows on all exposures and under a wide variety of soil conditions. It prefers silt loam or sandy loam soils and is occasionally found on loamy sand soils. Common habitats are exposed benchlands, hillsides and ridges, parks, meadows, forestlands, and open ponderosa and lodgepole pine stands. Idaho fescue is tolerant of weakly saline, weakly alkaline, and acidic soil conditions.

It has excellent cold tolerance, moderate drought tolerance, and moderate shade tolerance. It is not as drought tolerant as sheep fescue and its drought tolerance is similar to that of hard fescue. It is fairly tolerant of fire in autumn, but requires 2 to 3 years to fully recover after burning. It is not tolerant of high water tables or flooding. Its frequent associates include bluegrass, mountain brome, geranium,

western yarrow, mountain big sagebrush, antelope bitterbrush, ponderosa pine, bluebunch wheatgrass and slender wheatgrass. In the mountains of Idaho, Montana, and Wyoming it seems to be replaced by bluebunch wheatgrass and needlegrass (*Hesperostipa, Nassella*) as moisture decreases or overgrazing increases.

Establishment

Natural establishment: Idaho fescue produces a fair amount of seed of comparatively high viability and maintains itself well on rangeland if given a reasonable opportunity (USDA, Forest Service, 1988).

Planting: One PLS pound of Idaho fescue seed contains approximately 425,000 to 460,000 seeds and a broadcast planting of one pound of Idaho fescue seed results in a seeding distribution of approximately 10.1 seeds per square foot (USDA, NRCS, 1996). The recommended pure stand seeding rate is 4 (PLS) pounds per acre for rangeland seedings. Planting 6 to 8 pounds per acre will provide dense cover for erosion control (Ensign et al. 1984). Idaho fescue is normally recommended as a component in seeding mixtures with other native species.

Idaho fescue seed is not highly germinable compared to alternative forage or competing weeds (Evans and Young, 1972). Cold temperature (2 º C constant) germination of 18 percent pales in comparison to cheatgrass, which had 76 percent germination under the same conditions (Evans and Young 1972, Young et al. 1981). Proper weed control coupled with good seedbed preparation is needed to achieve dense stands of Idaho fescue.

Idaho fescue initiates growth in March through April and matures in mid to late summer. With adequate moisture, Idaho fescue will produce a moderate amount of regrowth following seed maturity. Late fall plantings are most successful. Plant early in the spring if fall planting is not possible. Seeded stands require 2 to 3 years to establish, but are very competitive once established. Recommended planting depth is 0.25 to 0.50 inches in fine to medium-textured soil and no more than 0.75 inches in coarse-textured soil. Conduct a soil analysis before planting; if the soil test indicates less than 6 ppm of phosphorus, then apply 60 pounds per acre of P_2O_5 (Ensign et al. 1984). Idaho fescue does not require or respond to heavy nitrogen applications. Primary pests of Idaho fescue are grasshoppers, rodents and fungi that produce damping-off diseases of seedlings.

Management

Idaho fescue is susceptible to overgrazing. Idaho fescue should not be grazed by livestock during the growing season every 3 to 4 years. This will promote vigor and seed production and encourage the development of a strong root system, which is beneficial in reducing soil erosion and weed competition. Also, deferred grazing during the growing season supplies dry forage for autumn and winter use.

At least 50 percent (by weight) of Idaho fescue annual growth should remain following grazing, or a stubble height of about 2 to 3 inches.

Following fire, protect Idaho fescue from grazing for two full growing seasons. Because palatability increases significantly following fire, an n additional year's deferment may be needed to achieve full plant recovery and to re-establish a suitable stubble height. A less palatable residue is desirable to prevent livestock from grazing too closely.

Seed Production

Commercial seed production fields of Idaho fescue usually yield no seed the first (establishment) year, a limited amount of seed the second year, a large amount of seed the third year, and either a low or adequate amount of seed the fourth year (personal communication with Grasslands West Company, Clarkston, Washington, U.S.A.).

For seed production, plant Idaho fescue seed in early autumn in a firm, weed-free, fertile soil at a depth of 0.25 inches. Row spacing of 30 to 36 inches is recommended to facilitate weed control and rouging of off-types. Plant 4 PLS (pure live seed) pounds of seed per acre for these row plantings (Ensign et al. 1984).

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

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

Idaho fescue characteristically has poor seed production and weak seedling vigor (Hafenrichter et al. 1968). Therefore, the University of Idaho initiated a breeding program in 1950 to produce Idaho fescue cultivars with improved seed set, larger seed size (seedling vigor), and improved germination percentage.

The University of Idaho Agricultural Experiment Station developed two Idaho fescue cultivars

'Joseph' and 'Nezpurs' (Ensing, 1984). The experiment station released both cultivars for certification in 1983. Both Joseph and Nezpurs are synthetic cultivars selected through three cycles of phenotypic recurrent selection. The base population used for recurrent selection consisted of seed derived from inter-crossing 89 native ecotypes collected from northwestern states of the U.S. and Canada.

Joseph is a 13-clone synthetic cultivar. Joseph exhibited 18 percent better seed set, 37 percent larger seeds, and 14 percent better germination compared to the base population. "It has uniform, robust plants ranging from 72 to 80 cm in height. Joseph is 12 to 18 cm taller than 'Covar' sheep fescue (*Festuca ovina* L.) and approximately equal in height to 'Durar' hard fescue (*Festuca ovina* var. *duriuscula*) (Table 1). The culms are erect with basal growth and produce 46 percent more forage production than Covar or Durar. Seed production of Joseph is 30 percent more than Covar, but 40 percent less than Durar" (Ensing, 1984).

'Nezpurs' is a 90-clone synthetic cultivar. Nezpurs exhibited 30 percent more seed set, 29 percent larger seed size, and 11 percent better germination than the original collections. Nezpurs is more variable than Joseph.

Both cultivars are adapted to Idaho, Washington, Oregon, Montana and Colorado rangeland and open forestland with elevation between 300 and 2700 m (984 to 8856 ft.) and annual precipitation between 35 and 76 cm (14 to 30 in).

Winchester Source Germplasm is a source-identified release that was made by Jerry Benson (Benson Farms Inc.). It originates from near Winchester, Idaho (approx. elev. 4000', ~18 in MAP). It is identical to P-6435, an accession collected and evaluated by the Pullman PMC. Winchester germplasm displays a fairly high degree of phenotypic variability because no effort was made to refine the germplasm by removing off-types. It is well suited for plantings that require germplasm that has not been genetically manipulated.

Table 1. Comparative data for 'Joseph' and 'Nezpurs' Idaho fescue with selected other fine leaf fescues. [∂]

Cultivar - common name	Plant height	Growth habit	Maturity	Basal growth	Forage
	(cm)	(type)	(date)	(score)	(g)
Joseph - Idaho fescue	72 to 80	Erect[1]	5/11[2]	7.0[3]	718[4]
Nezpurs - Idaho fescue	55 to 70	Erect	5/10	6.3	194
Covar - sheep fescue	60 to 62	Very erect	5/12	6.0	68
Durar - hard fescue	62 to 75	Very erect	5/11	6.8	334
Cascade - chewing red fescue	80 to 85	Semi-erect	5/16	9.0	426
Dawson - creeping red fescue	55 to 68	Semi-erect	5/18	8.9	299

[1] At maturity.
[2] At 50 percent heading date.
[3] 1=little, 9=abundant.
[4] Representative space plants 1980-1981.

[∂] Reprinted from Ensign et al. 1984.

Sources

Seed of 'Joseph' Idaho fescue is produced and sold by Grasslands West, Clarkston, Washington, U.S.A

Seed of 'Nezpurs' Idaho fescue is produced by David R. Mosman Ranch Inc., Mosman Road, Rt. 2 Box 43, Craigmont, Idaho, USA, (208) 937-2552.

Seed of Winchester germplasm Idaho fescue is produced and sold by Benson Farms Inc., 1145 Jefferson Ave, Moses Lake, WA, USA, (509) 756-6348

References

Borman, M.M., W.C. Krueger, and D.E. Johnson. 1991. Effects of established perennial grasses on yields of associated weeds. J. Range Manage. 44:318-322.

Ensign, R.D. 1984. Registration of Joseph and Nezpurs Idaho Fescue. Crop Sci. 24:617-618.

Ensign, R.D., V.G. Hickey, and T.J. Bakken. 1984. Joseph and Nezpurs Idaho fescue: forage grasses for the Intermountain Northwest. Cooperative Extension Service, Current Information Series No. 736, University of Idaho Agricultural Experiment Station, Moscow.

Evans, R.A. and J.A. Young. 1972. Microsite requirements for establishment of annual rangeland weeds. Weed Sci. 20:350-356.

Hafenrichter, A.L., and J.L. Schwendiman, H.L. Harris, R.S. MacLanchlan, and H.W. Miller. 1968. Grasses and legumes for soil conservation in the Pacific Northwest and Great Basin States. USDA Handbook No. 339, Washington, D.C.

Ho, I. 1987. Vesicular-arbuscular mycorrhizae of halophytic grasses in the Alvord Desert of Oregon. Northwest Sci. 61-148-151.

Jacobs, J.S. and R.L. Sheley. 1997. Relationships among Idaho fescue defoliation, soil water, and spotted knapweed emergence and growth. J. Range Manage. 50:258-262.

Ratliff, R.D. and J.N. Reppert. 1974. Vigor of Idaho fescue grazed under rest-rotation and continuous grazing. J. Range Manage. 27:447-449.

Stubbendieck, J., S.L. Hatch, and C.H. Butterfield. 1992. North American range plants. University of Nebraska Press, Lincoln, NE.

USDA, Forest Service. 1988. Range plant handbook. Dover Publications Inc., New York.

USDA, NRCS, 1996. A vegetative guide to selected native grasses of California. Technical note PM-40, NRCS California State Office, Davis, CA.

Young, J.A., R.A. Evans, R.E. Eckert, and R.D. Ensign. 1981. Germination-temperature profiles for Idaho and sheep fescue and Canby bluegrass. Agron. J. 73:716-720.

Prepared By

Daniel G. Ogle, Plant Materials Specialist, USDA, NRCS, Boise, Idaho

James Henson, USDA, NRCS, National Plant Data Center, Baton Rouge, Louisiana

Mark Stannard, Team Leader, USDA, NRCS, Plant Materials Center, Pullman, Washington

Loren St. John, Team Leader, USDA, NRCS, Plant Materials Center, Aberdeen, Idaho

Dr. Thomas A. Jones
USDA, ARS, Forage and Range Laboratory, Logan, Utah

Species Coordinator

Mark Stannard, Team Leader, USDA, NRCS, Plant Materials Center, Pullman, Washington

Edited 05dec00 jsp; 02july02 ms; 20 sept02 lsj; 30sept02 taj; 30sept02 dgo

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

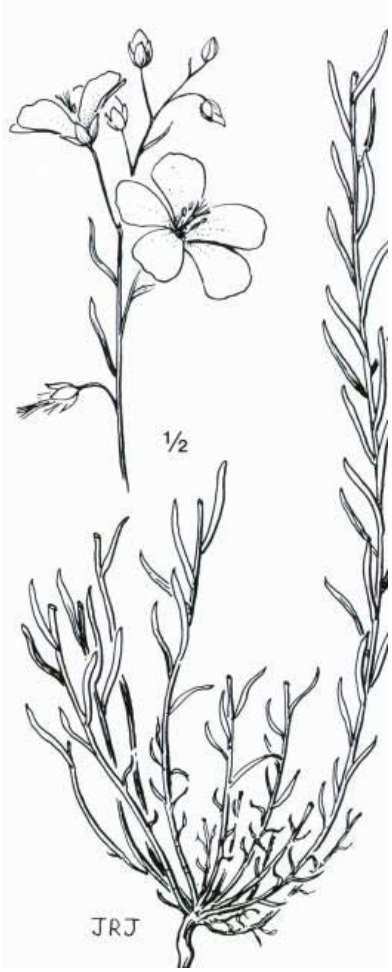
United States Department of Agriculture
NRCS Natural Resources Conservation Service
Plant Guide

BLUE FLAX
Linum perenne L.
plant symbol = LIPE2

LEWIS FLAX
Linum lewisii Pursh
plant symbol = LILE3

Contributed By: USDA, NRCS, Idaho State Office & National Plant Data Center

Alternate Names
Prairie flax



Jeanne R. Janish
Cronquist et al. (1997)

Linum lewisii var. *lewisii*; see description for identification differences with *Linum perenne*.

Uses
Ethnobotanic: Cultivated flax (*Linum usitatissimum*) is grown both for fiber (flax) and seed oil (linseed). Linseed oil may cause skin irritation upon contact.

Ingestion causes difficulty of breathing, paralysis, and convulsions (Russell et al. 1997).

Grazing/rangeland: Blue and Lewis flax are noted to have fair forage value for livestock and wildlife during spring and winter. They stays green throughout the growing season providing some forage value. Birds use the seed and capsules in fall and winter. All species provide diversity to the seeded plant community.

Erosion control/reclamation: All flax species are noted for their value in mixes for erosion control and beautification values.

Wildlife: Flax is considered desirable forage for deer, antelope, and birds, either as herbage or seed. They may also provide some cover for selected small bird species. They provide diversity to the plant community.

Status
Consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status, such as, state noxious status and wetland indicator values.

Description
General: Flax Family (Linaceae). *Linum perenne* is introduced from Eurasia. *Linum lewisii* is a comparable U.S. native plant. In general, flax is an annual or short-lived, semi-evergreen perennial forb, sometimes semi-woody at base with attractive flowers ranging from white to blue to yellow to red in color. Common to the western United States. Blue flax is considered a woody subshrub in the PLANTS database (USDA, NRCS 2000). According to Cronquist et al. (1997), "the only significant difference between *Linum lewisii* and the Eurasian *Linum perenne* appears to be that the former is homostylic, and the latter heterostylic."

Flax plants have many narrow, small, alternate (rarely opposite), simple and entire leaves that are sessile (lacking stalks) on the stems. The perfect and regular, generally showy flowers are borne in racemes or cymes. The sepals, petals, and stamens

are five, the fruit a capsule, and the seeds in most species are mucilaginous when wet.

Distribution
For current distribution, consult the Plant Profile page for this species on the PLANTS Web site.

Adaptation
Flax species do best on well-drained soils. Most ecotypes do well on infertile, disturbed soils. They have excellent cold winter and drought tolerance. They will tolerate weakly saline to weakly acidic sites. They are usually found in open areas, but will tolerate semi-shaded conditions. They are fire resistant due to leaves and stems staying green with relatively high moisture content during most of the fire season.

Establishment
Planting: Flax should be seeded with a drill or broadcast at a depth of 1/4 inch or less into a firm seedbed. The ideal seeding depth is 1/8 inch. Flax is not recommended for single species seedings. The full seeding rate (not recommended) for these forbs is 4 pounds Pure Live Seed (PLS) per acre or 24 PLS per square foot. When used as a component of a mix, adjust to percent of mix desired. For mined lands and other harsh critical areas, doubling the seeding rate component of flax is not required.

The best seeding results are obtained from seeding in late fall to very early spring (because of grass component of mix) on heavy to medium textured soils and in late fall on medium to light textured soils. Late summer (August - mid September) seeding is not recommended. Dormant fall seedings (preferred seeding period for flax) will pre-chill seed and reduce seed dormancy which may be present. Mulching, irrigation, and weed control all benefit stand establishment. Seedling vigor is good, but not as good as most grasses. Germination normally occurs the first growing season, but may not occur until the second growing season. Full flowering should not be expected until at least the second growing season.

Stands may require weed control measures during establishment. Because flax is a broadleaf plant, use of 2,4-D is not recommended. Mow weeds at or prior to their bloom stage. Grasshoppers and other insects may also damage new stands and pesticides may be needed.

Management
Growth of flax begins in early spring and flowers appear in mid May through early July depending on species. Weed control and removal of very competitive species may improve chance of establishment. Damage from wildlife and rodents may occur and they may need to be controlled. Disease problems are minimal with flax, however fungus problems have been noted for some native species.

Environmental Concerns: Flax species establish relatively quickly and easily via seed under favorable climatic conditions. They are not rhizomatous or considered "weedy" or invasive species, but could spread into adjoining vegetative communities under ideal climatic and environmental conditions. They coexist with other species and add biodiversity to those plant communities. ‘Appar’ blue flax seed normally germinates the first growing season following planting under favorable temperatures if moisture is available and it generally does not maintain a viable seed-bank. Native flax accessions tested maintain a portion of seed, which does not germinate the first growing season, as a viable seed-bank.

Seed Production
Flax should be seeded in 24 inch rows at the rate of 2.5 pounds PLS per acre or 36 inch rows at the rate of 1.5 pounds PLS per acre (25 to 30 seeds per linear foot of row) to allow mechanical weed control. It should be seeded in early spring (April - May).

Hand rouging within row and cultivation between rows may be required. Split applications of nitrogen in spring and fall and application of phosphorus in fall will enhance production. For optimum production, do not stress plants for moisture during late bud stage, pollination and re-growth.

Seed is generally harvested in late July to mid-August by wind-rowing before seed shatter and combining with pickup attachment once green stems have dried. Seed is mature when capsules are dry and seed is hard and dark in color. Flowering is indeterminate with mature capsules and the possibility of some flowers present at harvest period. Some seed will shatter once capsules open. Seed should be allowed to dry to 12 (bins) to 15 (sacks) percent moisture and then stored in a cool dry area. Seed retains viability for several years under these conditions.

Seed yields of 600 to 700 pounds per acre can be expected under irrigated conditions and 200 to 300 pounds per acre under dryland conditions. Seed production under dryland conditions is not recommended below 14 inches of average annual rainfall.

Cultivars, Improved and Selected Materials (and area of origin)
Foundation and registered seed is available for each variety through the appropriate state Crop Improvement Association or commercial sources to grow certified seed.

'**Appar'** blue flax (*Linum perenne*) is a selected release from seed originally collected in the Black Hills of South Dakota. 'Appar' was selected by the Forest Service Forest and Range Experiment Station and Aberdeen Plant Materials Center for outstanding vigor, beauty, and competitiveness with grasses prevalent on sites where it was collected. The Natural Resources Conservation Service, University of Idaho Agricultural Experiment Station, Utah Division of Wildlife Resources, and the Forest Service Forest and Range Experiment Station released 'Appar' in 1980. 'Appar' was released as native flax (*Linum lewisii*), but was later determined to be a naturalized introduced species from European origins. 'Appar' was named in honor of A. Perry Plumber, Forest Service (retired) who collected the original material. 'Appar' is a hardy, relatively short-lived, introduced perennial forb, 12 to 36 inches tall, with deep blue flowers that bloom profusely for about six weeks beginning in mid May. It is well adapted to sunny open slopes, well-drained soils from moderately basic to weakly acidic, 10 to 18 inch rainfall areas, at 1,000 to 6,000 feet elevation. It has some shade tolerance, but is not tolerant of poor drainage, flooding, or high water tables. It does well seeded in mixtures with other species. Its intended uses are erosion control, reclamation, highway right-of-ways, homes, gardens, parks, diversity, and beautification. Certified seed is readily available through commercial sources and breeder seed is maintained by Aberdeen Plant Materials Center.

Maple Grove Germplasm Lewis flax (*Linum lewisii*) is a recent (2003) Germplasm release of a native collection from the Maple Grove, Utah area. Maple Grove was selected by the Forest Service Forest and Range Experiment Station and Aberdeen Plant Materials Center for outstanding vigor, beauty, and competitiveness with grasses prevalent on sites where it was collected. The Natural Resources Conservation Service, University of Idaho Agricultural Experiment Station, Utah Division of Wildlife Resources, and the Forest Service Forest and Range Experiment Station released Maple Grove in 2003. Maple Grove is a hardy, relatively short-lived, native perennial forb, 12 to 36 inches tall, with light blue flowers that bloom profusely for about six weeks beginning in mid May. It is well adapted to sunny open slopes, well-drained soils from moderately basic to weakly acidic, 10 to 18 inch rainfall areas, at 1,000 to 6,000 feet elevation. It has some shade tolerance, but is not tolerant of poor drainage, flooding, or high water tables. It does well seeded in mixtures with other species. Its intended uses are erosion control, reclamation, highway right-of-ways, homes, gardens, parks, diversity, and beautification. Foundation seed should be available in 2004 through the Aberdeen, Idaho Plant Materials Center.

There are numerous flax species native to the U.S. that may be available through native plant nurseries and seed companies. These include the following: *Linum alatum* (TX & LA), *Linum arenicola* (FL), *Linum aristatum* (UT & AZ to TX), *Linum berlandieri* (CO to LA), *Linum catharticum* (northeast US), *Linum compactum* (MT & ND to NM & TX), *Linum intercursum* (Atlantic states), *Linum lewisii* (central & west US), *Linum medium* (east & central US), and *Linum virginianum* (east & midwest US). Please check the PLANTS database for other native flax species.

References

Cronquist, A., N.H. Holmgren, & P.K. Holmgren 1997. *Intermountain flora. Vol. 3, Part A. Subclass Rosidae (except Fabales)*. The New York Botanical Garden, Bronx, New York.

Mosquin, T. 1971. *Biosystematic studies in the North American species of Linum, section Adenolinum (Linaceae)*. Canadian Journal of Botany 49:1379-1388.

Rogers, C.M. 1968. *Yellow-flowered species of Linum in Central America and western North America*. Brittonia 20:107-135.

_____, 1979. *A new combination in Linum*. Phytologia 41:447-448.

_____, 1984. *Linaceae*. N. American Fl. II. 12:1-58.

Russell, A.B., J.W. Hardin, & L. Grand 1997. *Poisonous plants of North Carolina*. North Carolina State University, Raleigh, North Carolina.

USDA, NRCS 2000. *The PLANTS database*. Version: 000419. <http://plants.usda.gov>. National Plant Data Center, Baton Rouge, Louisiana.

Prepared By

Daniel G. Ogle
USDA, NRCS, Idaho State Office, Boise, Idaho

Loren St. John
USDA, NRCS, Plant Materials Center, Aberdeen, Idaho

J. Scott Peterson
USDA, NRCS, National Plant Data Center, Baton Rouge, Louisiana

Species Coordinator
Daniel G. Ogle
USDA, NRCS, Idaho State Office, Boise, Idaho.

Edited 05dec00 jsp; 03july02 dgo; 09july02 lsj

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

United States Department of Agriculture
NRCS Natural Resources Conservation Service
Plant Guide

ORCHARDGRASS

Dactylis glomerata L.

plant symbol = DAGL

Robert H. Mohlenbrock
USDA NRCS 1995
Northeast Wetland Flora
@ USDA NRCS PLANTS

Contributed by: USDA NRCS Plant Materials Program

Alternate Names
Cocksfoot

Uses
Grazing/Hayland: The primary use of orchardgrass is for forage production. It is used for pasture, hay and silage. It is highly palatable to all classes of livestock. Orchardgrass is one of the best forage grasses for use in the Northern states under intensive rotational grazing systems.

Erosion control: Because of its dense network of non-rhizomatous roots, orchardgrass provides good erosion control on those soils to which it is adapted.

Wildlife: Elk and deer find orchardgrass highly palatable and will utilize it most of the year. Orchardgrass is sometimes used in grass-legume mixes for nesting brood rearing, and escape and winter cover in upland wildlife and conservation plantings. However, upland birds and waterfowl prefer taller grasses that develop sparser stands such as basin wildrye and tall wheatgrass.

Status
Consult the PLANTS Web site and your State Department of Natural Resources for status (e.g. threatened or endangered species, state noxious status, and wetland indicator values).

Description
Dactylis glomerata, orchardgrass, is a long-lived, introduced, cool season bunchgrass. Under dryland conditions, it usually develops distinct clumps and flower culms 15 to 18 inches tall. Leaves usually stand less than 12 inches in height. When grown under irrigation or in moist-fertile situations, it attains a much larger stature and grows in a more closed stand. Orchardgrass is one of the earliest species to initiate growth in the spring and makes tremendous growth during cool conditions. Due to deep roots (most within 2 feet of the surface) it is also capable of strong summer growth when conditions are favorable (i.e. somewhat cool). Under extremely hot conditions, orchardgrass will have a bigger production slump than meadow brome. Orchardgrass has 540,000 seeds per pound.

Adaptation
Orchardgrass is found from Maine to the Gulf Coast states and from the Atlantic Coast to the Pacific Coast. It is common throughout the Appalachian Mountains and is especially well-adapted to Maryland, Pennsylvania, West Virginia, Virginia, Kentucky, and Tennessee. It is also found in the high-rainfall regions of the western mountains and in irrigated areas throughout the West. Areas of greatest adaptability in the West are soils that had supported the sagebrush, grass, pinyon-juniper, ponderosa pine, aspen and Douglas fir communities.

Orchardgrass is winter hardy and is adapted to moderate to well-drained basic to acidic soils. It will not tolerate soils that are saturated for extended periods of time. It produces best in areas with very little frost in the spring. Spring frost will not kill orchardgrass, but it does reduce overall production. In areas with significant spring frost such as

mountain valleys, meadow brome is a better species selection.

Orchardgrass performs well on soil textures ranging from clay to gravely loams and on shallow to deep soils. It does not grow well in saline soils and areas with high water tables within the rooting zone. It has the ability to establish and persist in areas that receive as little as 16 inches of annual precipitation, but performs best with 18 inches of rainfall.

Orchardgrass performs best in a pH range of 5.8 – 7.5, but will tolerate pH as high as 8.5. It is adapted to shady areas or areas with reduced light.

Establishment
A clean, firm, weed-free seedbed is recommended. Dryland and erosion control seedings should be made in the late fall or very early spring. Irrigated seedings should be made in early to mid spring. Do not seed after the spring moisture period is well advanced or a failure may occur because of dry seedbed conditions and hot summer temperatures before the grass is well established. A deep furrow or double disc drill with press wheels may be used, however, orchardgrass is easily established with common agricultural drills. The recommended seeding rate for orchardgrass is 4 pounds pure live seed (PLS) per acre. If broadcast seeded or planted for critical area treatment, double the seeding rate. Adjustments in seeding rate should be made when seeding in mixtures. Seeding depth should be 1/4 to 1/2 inch.

Management
Under dryland conditions the new planting should not be grazed until late summer or fall of the second growing season. The plants may be severely damaged by overgrazing especially in the seedling year. Under irrigated conditions the new planting should not be grazed until late summer or fall of the first growing season. The plants may be severely damaged by grazing too soon.

Use no more than 60% of the annual growth during the winter season or 50% during the growing season. Close grazing in the fall is consistently associated with winterkill. This plant responds well to rotation-deferred grazing systems. Periodically the grass should be allowed to mature and produce seed for continuation of the stand.

Orchardgrass responds very well to good fertility management. It is one of the most responsive pasture grasses to nitrogen applications. One strategy to even out the forage production is to fertilize the stand after the first and second cutting or grazing period to boost late spring and summer production. Apply fertilizer based on soil tests.

Seed Production
When planting for seed increase, recommended row spacing is 28 to 40 inches. Seeding rate is 1.5 to 2 pounds PLS per acre to seed 25 to 30 PLS per linear foot of row. Irrigated seed yields are commonly 250 to 300 pounds per acre. Seed matures evenly and is ready for harvest in mid-July. Windrowing followed by combining is the preferred method of harvest. When direct combining the seed should be dried to 12 percent moisture in bins and 15 percent moisture in sacks before storing.

Pests and Potential Problems
Brown stripe, scald, rust and leaf spot are the most prevalent and destructive disease in orchardgrass. Resistance to these varies among cultivars. Japanese and green June beetle larvae feed on orchardgrass roots; sawflies feed on their tops. Little is known, however, about the economic loss caused by these insects.

Orchardgrass does not spread vegetatively and is much less invasive than many other grasses. Seeds can collect on animal coats and be transported long distances. Watering and bedding areas are typical sites where orchardgrass may colonize.

Orchardgrass seed is a common contaminant of turfgrass seed. While mowing prevents further spread, individual orchardgrass plants persist and lower the aesthetic value of the turf.

Cultivars, Improved, and Selected Materials (and area of origin)
There are many orchardgrass releases available. Consult local experts to select the best release for your area. Orchardgrass cultivars fall into two types: early maturing and late maturing. The late maturing cultivars are more common. The most common releases used in the Intermountain West are described below.

'Latar' was released in 1957 and is still commonly seeded in pasture and hayland plantings. It has a low lignin (fiber) content and digestibility is very high. It matures 10 to 14 days later than common orchardgrass and is usually in the pre-bloom stage when alfalfa is at the optimum growth stage for cutting hay. Therefore a mixture of 'Latar' and alfalfa makes a high quality hay. Forage yields of 'Latar' are at least as much per acre as the earlier maturing varieties and forage quality is generally superior. The venerable old 'Latar' has lost some of

its market-share to newer cultivars, which exhibit disease tolerance and winter hardiness. 'Latar' Breeder seed is maintained by the Pullman, Washington Plant Materials Center.

'Paiute' is a cultivar that produces an abundance of basal leaves and leafy upright stems. Its intended use is for forage production on arid lands. 'Paiute' is considered somewhat more drought tolerant than other varieties of orchardgrass. However, it generally does not perform well below 16-inch rainfall areas. At very high elevations (6500 feet plus), it may perform well at slightly lower rainfall amounts. It matures too early to be compatible with alfalfa. 'Paiute' Breeder and Foundation seed is maintained by the Aberdeen, Idaho Plant Materials Center.

'Potomac' is a productive, persistent, rust-resistant cultivar that produces good yields but matures too early to be compatible with alfalfa for hay. When alfalfa is ready to cut, 'Potomac' is too mature to produce good quality hay. When seeded in a monoculture, 'Potomac' often produces very high yields. This variety should be used where early maturity is needed and as a single species hay. Oregon Foundation Seed and Plant Materials Project and Washington Crop Improvement Station maintain Breeder and Foundation seed.

Control

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 and follow 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.

Prepared By:
USDA NRCS Plant Materials Program

Tony Bush, Rose Lake Plant Materials Center, USDA NRCS, East Lansing, Michigan

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

Loren St. John, Manager, Plant Materials Center, USDA-NRCS, Aberdeen, Idaho

Mark Stannard, Manager, Plant Materials Center, USDA-NRCS, Pullman, Washington

Dr. Kevin B. Jensen, USDA-ARS, Forage and Range Research Laboratory, Utah State University, Logan, Utah

Species Coordinator:
Mark Stannard, Manager, Plant Materials Center, USDA-NRCS, Pullman, Washington

10Aug00 jlk; 24septo2 lsj; 22oct02 ms; 24jan03 kbj; 03jan03 dgo

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

United States Department of Agriculture
NRCS Natural Resources Conservation Service
Plant Guide

EATON'S or FIRECRACKER PENSTEMON

Penstemon eatonii Gray

plant symbol = PEEA

Contributed By: USDA, NRCS, Idaho State Office & National Plant Data Center

Loren St. John
Aberdeen PMC

Alternate Names
Eaton's beardtongue, firecracker penstemon, *Penstemon eatonii* ssp. *eatonii*, *Penstemon eatonii* ssp. *exsertus*, *Penstemon eatonii* ssp. *undosus*

Uses
Grazing/rangeland: Firecracker penstemon provides erosion control, plant diversity and beautification. It is not noted for having value as forage. 'Cedar' Palmer's penstemon (*Penstemon palmeri*) and 'Bandera' Rocky Mountain penstemon (*Penstemon strictus*) are the only released penstemons noted to have any forage value. 'Cedar' leaves stay green throughout the growing season providing some forage value. All other varieties are considered fair to poor palatability and considered to be only incidental forage value. All species provide diversity to a seeded plant community.

Erosion control/reclamation: Penstemon has value in mixes for erosion control and beautification values.

Wildlife: Penstemons are considered desirable forages for deer, antelope, and birds either as herbage or seed. They may also provide some cover for selected small bird species. They provide diversity and beauty to the plant community.

Status
Consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status, such as, state noxious status, and wetland indicator values.

Description
General: Figwort Family (Scrophulariaceae). Penstemon or beardtongues are perennial forbs or sub-shrubs to shrubs with attractive flowers. They are short to long-lived. Eaton's or firecracker penstemon is a short-lived perennial herbaceous forb with red flowers. It is recognized as having three subspecies: *P. eatonii* ssp. *eatonii*, *P. eatonii* ssp. *exsertus*, and *P. eatonii* ssp. *undosus*. Cronquist et al. (1984) provides a key separating *eatonii* from *undosus* and notes the key characteristics for *exsertus*.

Penstemons have opposite, entire, or toothed leaves. They have several stalked flowers or flower clusters that are borne in the axils of the upper leaves or leaflike bracts. The tubular corolla is strongly to distinctly two-lipped at the mouth with a two-lobed upper lip and a three-lobed lower lip. There are 4 anther-bearing (fertile) stamens and a single sterile stamen or staminodia that is often hairy at the tip. The fruit is a many-seeded capsule. Eaton's or firecracker penstemon is 4-10 dm tall with erect stems.

Distribution
Eaton's or firecracker penstemon is found in the southwestern U.S. from Colorado to California. Penstemons are common to the western United States. Except for one minor species, the genus *Penstemon* does not occur naturally outside of North America. For current distribution, consult the Plant Profile page for this species on the PLANTS Web site.

William S. Moye
Cronquist (1984)

Adaptation
Penstemons do best on well-drained soils. Most ecotypes do well on infertile, disturbed soils. They have excellent cold winter and drought tolerance. They will tolerate weakly saline to weakly acidic sites. They are usually found in open areas, but will tolerate semi-shaded conditions. They are not tolerant of fire, but they are fire resistant due to leaves staying green with relatively high moisture content during the fire season. Eaton's or firecracker penstemon is found on dry slopes and flats in sagebrush, pinyon-juniper, mountain mahogany, and ponderosa pine communities (Cronquist et al. 1984).

Establishment
Planting: These species should be seeded with a drill or broadcast at a depth of 1/4 inch or less into a firm seedbed. Ideal seeding depth is 1/8 inch. Penstemons are not recommended for single species seeding. The full seeding rate (not recommended) for Firecracker penstemon is 4 pounds Pure Live Seed (PLS) per acre or 28 PLS per square foot (varies somewhat by species). When used as a component of a mix, adjust to percent of mix desired. For mine lands and other harsh critical areas, doubling the seeding rate component of penstemon is not required.

The best seeding results are obtained from seeding in very early spring (because of grass component of mix) on heavy to medium textured soils and in late fall on medium to light textured soils. Late summer (August - mid September) seeding is not recommended. Dormant fall seedings (preferred seeding period for penstemons) will pre-chill seed and reduce seed dormancy which is very strong in some species. Mulching, irrigation, and weed control all benefit stand establishment. Seedling vigor is good, but not as good as most grasses. Germination may not occur until the second growing season. Flowering should not be expected until at least the second growing season.

Stands may require weed control measures during establishment. Because penstemons are broadleaf, use of 2,4-D is not recommended. Mow weeds at or prior to their bloom stage. Grasshoppers and other insects may also damage new stands and pesticides may be needed.

Management
Growth of penstemon begins in early spring and flowers appear from early summer through early fall depending on species. Weed control and removal of very competitive species may improve chance of establishment. Damage from wildlife and rodents may occur and they may need to be controlled. Disease problems are minimal except under irrigation. Under irrigation, fusarium wilt and rhizoctonia root rot can be a problem.

Environmental Concerns: Penstemon species establish and spread slowly via seed distribution. They are not considered "weedy" or invasive species, but can spread into adjoining vegetative communities under ideal climatic and environmental conditions. They coexist with other native species and add biodiversity to those plant communities.

Seed Production
Firecracker penstemon should be seeded in at least 36-inch rows at the rate of 1.3 pounds PLS per acre (target 30 pure live seeds per linear foot) to allow mechanical weed control. The use of weed barrier material may be an alternative to allow closer spacing, reduce weeds and conserve soil moisture. It should be seeded in late fall or early winter unless seed is artificially stratified under cool moist conditions. The Richfield Selection of firecracker penstemon requires stratification. Transplants by dividing the base of older plants or from greenhouse starts can also be successfully used to establish seed fields.

Seed is generally harvested by hand stripping or by combine. Seed is mature when capsules are dry and seed is hard and dark in color. Flowering is indeterminate with mature capsules and flowers present at harvest period. Multiple harvest periods (by hand) may be necessary to maximize seed collection. Some seed will shatter once capsules open, but the capsule is upright and tends to hold seed very well. Seed can be separated from the capsule by use of a hammer mill or barley debearder followed by air screening. Cleaned seed should be allowed to dry and then stored in a cool dry area. An after-ripening period of 3 to 4 months is required. Seed retains viability for several years under these conditions.

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

Foundation and registered seed is available for each variety through the appropriate state Crop Improvement Association or commercial sources to grow certified seed.

Richfield Selected Germplasm Firecracker penstemon is a selected release germplasm from seed originally collected near Richfield, Utah. 'The Richfield Selection Germplasm' of firecracker penstemon was selected by Aberdeen, Idaho Plant Materials Center and was released in 1994. It is an erect, native, perennial, cool-season sub-shrub to shrub with a fibrous root system and decumbent to reclining stems. The leaves are large and slightly pubescent. The flowers are in racemes on 24 to 36 inch tall, upright stems. It has bright red tubular flowers, blooming from early to late summer. It is adapted to full sunlight, well to moderately well drained soils, 10 to 16 inch rainfall areas, at 3,300 to 8,000 feet elevation. It does not do well in poorly drained soils. Its intended uses are for erosion control, diversity, and beautification. Certified seed is available and Generation (G) 0 and G1 seed is maintained by Aberdeen PMC.

A number of other penstemons are seeded primarily for soil stabilization on depleted, disturbed, and erosive areas for erosion control and as ornamentals. These include low penstemon (*Penstemon humilis*), Rydberg penstemon *(Penstemon rydbergii*), and thickleaf penstemon (*Penstemon pachyphyllus*). There are a number of ornamental penstemon that have been released as cultivars. Check the PLANTS database for the names of native penstemons in your state, then check with your area native plant nurseries for their availability.

References

Cronquist, A., A.H. Holmgren, N.H. Holmgren, J.L. Reveal, & P.K. Holmgren 1984. *Intermountain flora. Volume Four. Subclass Asteridae (except Asteraceae).* The New York Botanical Garden, Bronx, New York.

Crosswhite, F.S. 1967. *Revision of Penstemon section Habroanthus (Scrophulariaceae). I: Conspectus, II: series Speciosi, and III: series Virgati*. American Midland Naturalist 77:1.41.

Holmgren, N.H. 1971. *A new species of Penstemon from Nye Co., Nevada*. Aliso 7:351-356.

_____, 1978a. *An overlooked new species of Penstemon (Scropulariaceae from the Great Basin*. Brittonia 30:334-339.

_____, 1978b. *Three new species of Penstemon (Scrophulariaceae from the Intermountain region*. Brittonia 30:416-425.

_____, 1979a. *Nomenclatural changes in some Intermountain penstemons (Scrophulariaceae).* Brittonia 31:104-107.

_____, 1979b. *New penstemons (Scrophulariaceae) from the Intermountain region*. Brittonia 31:217-242.

Keck, D.D. 1932. *Studies in Penstemon. A systematic treatment of the section Saccanthera*. Univ. Calif. Publication in Botany 16:367-426.

_____, 1937a. *Studies in Penstemon IV. The section Ericopsis*. Bulletin of the Torrey Botanical Club 64:357-381.

_____, 1937b. *Studies in Penstemon V. The section Peltanthera*. American Midland Naturalist 18:790-829.

_____, 1938. *Studies in Penstemon VI. The section Autator*. Bulletin of the Torrey Botanical Club 65:233-255.

_____, 1940. *Studies in Penstemon VII. The subsections Gairdneriani, Deusti, and Arenarii of the Graciles, and miscellaneous new species*. American Midland Naturalist 23:594-616.

_____, 1945. *Studies in Penstemon-VIII. A cyto-taxonomic account of the section Spermunculus.* American Midland Naturalist 33:128-206.

Pennell, F.W. 1920. *Penstemon*. IN: *Scrophulariaceae of the central Rocky Mountain states*. Contributions U.S. Natl. Herbarium 20:325-381.

USDA, NRCS 2000. The PLANTS database. Version: 000502. <http://plants.usda.gov>. National Plant Data Center, Baton Rouge, Louisiana.

Prepared By
Daniel G. Ogle
USDA, NRCS, Idaho State Office, Boise, Idaho

Loren St. John
USDA, NRCS, Plant Materials Center, Aberdeen, Idaho

J. Scott Peterson
USDA, NRCS, National Plant Data Center, Baton Rouge, Louisiana

Species Coordinator
Daniel G. Ogle
USDA, NRCS, Idaho State Office, Boise, Idaho

Edited 19sep00 jsp; 31julyo2 lsj; 24sept02 dgo

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

United States Department of Agriculture
NRCS Natural Resources Conservation Service
Plant Guide

VENUS PENSTEMON

Penstemon venustus Dougl. ex Lindl.

plant symbol = PEVE2

Contributed By: USDA, NRCS, Idaho State Office & National Plant Data Center

Loren St. John
Aberdeen Plant Materials Center

Alternate Names
Venus beardtongue, lovely penstemon, alpine penstemon.

Uses
Grazing/rangeland: Venus penstemon provides erosion control, plant community diversity and beautification. It is not noted for having value as forage. 'Cedar' Palmer's penstemon (*Penstemon palmeri*) and 'Bandera' Rocky Mountain penstemon (*Penstemon strictus*) are the only released penstemons noted to have any forage value. 'Cedar' leaves stay green throughout the growing season providing some forage value. All other releases are considered fair to poor palatability and considered to have only incidental forage value. All species provide diversity to a seeded plant community.

Erosion control/reclamation: Penstemon has value in mixes for erosion control and beautification.

Wildlife: Penstemons are considered desirable forages for deer, antelope, and birds either as herbage or seed. They may also provide some cover for selected small bird species. They provide diversity and beauty to the plant community.

Status
Consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status, such as, state noxious status, and wetland indicator values.

Description
General: Figwort Family (Scrophulariaceae). Penstemon or beardtongues are perennial forbs or sub-shrubs to shrubs with attractive flowers. They are short to long-lived. Penstemons have opposite, entire, or toothed leaves. They have several stalked flowers or flower clusters that are borne in the axils of the upper leaves or leaflike bracts. The tubular corolla is strongly to distinctly two-lipped at the mouth with a two-lobbed upper lip and a three-lobbed lower lip. There are 4 anther-bearing (fertile) stamens and a single sterile stamen or staminodia that is often hairy at the tip. The fruit is a many-seeded capsule.

Venus penstemon is a long-lived native, herbaceous to woody subshrub 3 to 8 dm high. The leaves are finely serrulate or toothed, elliptic to lanceolate. The corolla light violet to violet-purple with the staminode white-hirsute toward the tip (Abrahms 1951). An identification key, line drawing, and description are available in Abrams (1951).

Distribution
This species is found from Utah and California to Washington. Except for one minor species, the genus *Penstemon* does not occur naturally outside of North America. For current distribution, consult the Plant Profile page for this species on the PLANTS Web site.

Venus penstemon Andrea Wolfe
@ Penstemon Website

Adaptation
Penstemons do best on well-drained soils. Most ecotypes do well on infertile, disturbed soils. They have excellent cold winter and drought tolerance. They will tolerate weakly saline to weakly acidic sites. They are usually found in open areas, but will tolerate semi-shaded conditions. They are not tolerant of fire, but they are fire resistant due to leaves staying green with relatively high moisture content during the fire season. Venus penstemon is found on rocky slopes in the transition and Canadian zones (Abrams 1951).

Establishment
Planting: These species should be seeded with a drill or broadcast at a depth of 1/4 inch or less into a firm seedbed. Ideal seeding depth is 1/8 inch.

Penstemons are not recommended for single species seeding. The full seeding rate (not recommended) for this forb-shrub is 2 pounds Pure Live Seed (PLS) per acre or 50 PLS per square foot (varies somewhat by species). When used as a component of a mix, adjust to percent of mix desired. For mine lands and other harsh critical areas, doubling the seeding rate component of penstemon is not required.

The best seeding results are obtained from seeding in very early spring (because of grass component of mix) on heavy to medium textured soils and in late fall on medium to light textured soils. Late summer (August - mid September) seeding is not recommended. Dormant fall seedings (preferred seeding period for penstemons) will pre-chill seed and reduce seed dormancy which is very strong in some species. Mulching, irrigation, and weed control all benefit stand establishment. Seedling vigor is good, but not as good as most grasses. Germination may not occur until the second growing season. Flowering should not be expected until at least the second growing season.

Stands may require weed control measures during establishment. Because penstemons are broadleaf, use of 2,4-D is not recommended. Mow weeds at or prior to their bloom stage. Grasshoppers, penstemon borers and other insects may also damage new stands and pesticides may be needed.

Management
Growth of penstemons begins in early spring and flowers appear from early summer through early fall depending on species. Weed control and removal of very competitive species may improve chance of establishment. Damage from wildlife and rodents may occur and they may need to be controlled. Disease problems are minimal except under irrigation. Under irrigation, soil-borne fusarium wilt and rhizoctonia root rot can be a problem.

Environmental Concerns: *Penstemon* species establish and spread slowly via seed distribution. They are not considered "weedy" or invasive species, but can spread into adjoining vegetative communities under ideal climatic and environmental conditions. They coexist with other native species and add biodiversity to those plant communities.

Seed Production
Venus penstemon should be seeded in at least 36-inch rows at the rate of 1 pound PLS per acre (target 50 pure live seeds per linear foot) to allow mechanical weed control. The use of weed barrier material may be an alternative to allow closer spacing, reduce weeds and conserve soil moisture. It should be seeded in late fall or early winter unless

seed is artificially stratified under cool moist conditions.
"The Clearwater Selection Germplasm" of Venus penstemon requires a short period of stratification. Transplants by dividing the base of older plants or from greenhouse starts can also be successfully used to establish seed fields.

Seed is generally harvested by hand stripping or by combine. Seed is mature when capsules are dry and seed is hard and dark in color. Flowering is indeterminate with mature capsules and flowers present at harvest period. Multiple harvest periods (by hand) may be necessary to maximize seed collection. Some seed will shatter once capsules open, but the capsule is upright and tends to hold seed very well. Seed can be separated from the capsule by use of a hammer mill or barley de-bearder followed by air screening. Cleaned seed should be allowed to dry and then stored in a cool dry area. An after-ripening period of 3 to 4 months is required. Seed retains viability for several years under these conditions.

Cultivars, Improved and Selected Materials (and area of origin)
Foundation and Registered seed is available for each variety through the appropriate state Crop Improvement Association or commercial sources to grow certified seed.

The Clearwater Selection Germplasm of Venus penstemon (*Penstemon venustus*) was selected by Aberdeen, Idaho Plant Materials Center and was released in 1994 from seed originally collected in the Clearwater River drainage, Idaho. It is a native, perennial cool-season forb to sub-shrub with a strong taproot and woody base. The leaves are oblong and sharply serrate. It is 1 to 2 feet tall and the flowers appear in one or more narrow terminal panicle, 12 to 20 inches long. The flowers are bright lavender to purple or purple-violet. It flowers from early to mid summer. It is best adapted to full sunlight, well to moderately well drained soils, 20 to 35 inch rainfall areas, at 1,000 to 6,000 feet elevation. It is not adapted to poorly drained soils. Its intended uses are for erosion control, diversity, and beautification. Certified seed is available and Generation 0 and G1 seed is maintained by Aberdeen PMC.

Other penstemons available commercially include the following: 'Bandera' (*Penstemon strictus*) Rocky Mountain penstemon was developed from seed originally collected in Torrance County, New Mexico. 'Cedar' (*Penstemon palmeri*) Palmer penstemon was developed from seed originally collected near Cedar City in Iron County, Utah. The Richfield Germplasm Firecracker penstemon (*Penstemon eatonii*) is a selected class release from seed originally collected near Richfield, Utah.

A number of other penstemons are seeded primarily for soil stabilization on depleted, disturbed, and erosive areas for erosion control and as ornamentals. These include low penstemon (*Penstemon humilis*), Rydberg penstemon *(Penstemon rydbergii*), and thickleaf penstemon (*Penstemon pachyphyllus*). There are a number of ornamental penstemon that have been released as cultivars. Check the PLANTS database for the names of native penstemons in your state, then check with your area native plant nurseries for their availability.

References

Abrams, L. 1951. *Illustrated flora of the Pacific States*. Volume III. Geraniaceae to Scrophulariaceae. Stanford University Press, Stanford, California. 866 pp.

Cronquist, A., A.H. Holmgren, N.H. Holmgren, J.L. Reveal, & P.K. Holmgren 1984. *Intermountain flora. Volume Four. Subclass Asteridae (except Asteraceae)*. The New York Botanical Garden, Bronx, New York.

Crosswhite, F.S. 1967. *Revision of Penstemon section Habroanthus (Scrophulariaceae). I: Conspectus, II: series Speciosi, and III: series Virgati*. American Midland Naturalist 77:1.41.

Holmgren, N.H. 1971. *A new species of Penstemon from Nye Co., Nevada*. Aliso 7:351-356.

_____, 1978a. *An overlooked new species of Penstemon (Scropulariaceae from the Great Basin*. Brittonia 30:334-339.

_____, 1978b. *Three new species of Penstemon (Scrophulariaceae from the Intermountain region*. Brittonia 30:416-425.

_____, 1979a. *Nomenclatural changes in some Intermountain penstemons (Scrophulariaceae).* Brittonia 31:104-107.

_____, 1979b. *New penstemons (Scrophulariaceae) from the Intermountain region*. Brittonia 31:217-242.

_____, 1979c. *Subgeneric and sectional names for Intermountain Penstemon (Scrophulariaceae)*. Brittonia 31:358-364.

_____, 1980. *A new Penstemon (Scrophulariaceae) from northwestern Arizona*. Brittonia 32:326-329.

Keck, D.D. 1932. *Studies in Penstemon. A systematic treatment of the section Saccanthera*. Univ. Calif. Publication in Botany 16:367-426.

_____, 1937a. *Studies in Penstemon IV. The section Ericopsis*. Bulletin of the Torrey Botanical Club 64:357-381.

_____, 1937b. *Studies in Penstemon V. The section Peltanthera*. American Midland Naturalist 18:790-829.

_____, 1938. *Studies in Penstemon VI. The section Autator*. Bulletin of the Torrey Botanical Club 65:233-255.

_____, 1940. *Studies in Penstemon VII. The subsections Gairdneriani, Deusti, and Arenarii of the Graciles, and miscellaneous new species*. American Midland Naturalist 23:594-616.

_____, 1945. *Studies in Penstemon-VIII. A cyto-taxonomic account of the section Spermunculus.* American Midland Naturalist 33:128-206.

Pennell, F.W. 1920. *Penstemon*. IN: *Scrophulariaceae of the central Rocky Mountain states*. Contributions U.S. Natl. Herbarium 20:325.381.

USDA, NRCS 2000. *The PLANTS database*. Version: 000502. <http://plants.usda.gov>. National Plant Data Center, Baton Rouge, Louisiana.

Wolfe, A. 2000. *Penstemon website*. Version: 000427. The Ohio State University, Columbus, Ohio. <http://www.biosci.ohio-state.edu/~awolfe/>.

Prepared By
Daniel G. Ogle
USDA, NRCS, Idaho State Office, Boise, Idaho

Loren St. John
USDA, NRCS, Plant Materials Center, Aberdeen, Idaho

J. Scott Peterson
USDA, NRCS, National Plant Data Center, Baton Rouge, Louisiana

Species Coordinator
Daniel G. Ogle
USDA, NRCS, Idaho State Office, Boise, Idaho.

Edited 18sep00 jsp; 25july02 lsj; 24sept02 dgo

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>.

United States Department of Agriculture
NRCS Natural Resources Conservation Service
Plant Guide

INDIAN RICEGRASS

Achnatherum hymenoides (Roemer & J.A. Schultes) Barkworth

plant symbol = ACHY

Contributed By: USDA, NRCS, Idaho State Office

@ Grass Images
Bioinformatics Working Group
Texas A&M University

Alternate Names
Oryzopsis hymenoides, Stipa hymenoides

Uses
Ethnobotanic: The nutritious seed of Indian ricegrass was one of the staple foods of American Indians.

Grazing/rangeland/hayland: Indian ricegrass is highly palatable to livestock and wildlife. It is preferred forage for cattle, horses, and elk in all seasons. It is considered a preferred forage for sheep, deer, and antelope in spring and a desirable forage for sheep, deer, and antelope in late fall and winter. It reaches its peak production from mid-June through mid-July and holds its nutrient value well at maturity. It is not considered valuable as a hay species.

Erosion control/reclamation: One of the greatest values of Indian ricegrass is to stabilize sites susceptible to wind erosion, and it is well adapted for the stabilization of disturbed sandy soils in mixes with other species. Indian ricegrass and needle-and-thread grass are often early-seral or pioneer species that establish naturally on disturbed sandy sites. Indian ricegrass is also one of the first species to establish on cut-and-fill slopes.

Indian ricegrass does not compete well with aggressive introduced grasses during the establishment period. It is very compatible with slower-developing native grasses, such as Snake River wheatgrass (*Elymus wawawaiensis*), bluebunch wheatgrass (*Pseudoroegneria spicata*), thickspike wheatgrass (*Elymus lanceolata* ssp. *lanceolata*), streambank wheatgrass (*Elymus lanceolatus* ssp. *psammophila*), western wheatgrass (*Pascopyrum smithii*), and needlegrass species (*Nassella* spp. and *Hesperostipa* spp.). Drought tolerance, combined with a fibrous root system and fair-to-good seedling vigor, make Indian ricegrass desirable for reclamation in areas receiving 8 to 14 inches annual precipitation.

Wildlife: Forage value is mentioned in the grazing/rangeland/hayland section above. Due to the abundance of plump nutritious seed, Indian ricegrass is considered an excellent food source for birds, such as mourning doves, pheasants, and songbirds. Rodents collect the seed for winter food supplies. It is considered good cover for small animals and birds.

Beautification: Due to its attractive seed heads, Indian ricegrass is recommended for roadside, campground, and other low-rainfall locations for beautification. It can also be used in floral arrangements.

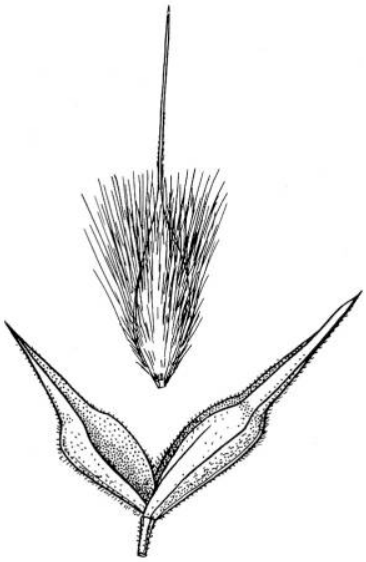
Status
Consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status, such as state noxious status, and wetland indicator values.

Description
General: Grass Family (Poaceae). Indian ricegrass grows 8 to 30 inches tall. It has many tightly rolled, slender leaves, growing from the base of the bunch giving it a slightly wiry appearance. The ligule is about 6 mm long and acute. It has a wide spreading panicle inflorescence with a single flower at the end

of each hair-like branch. Seeds are round to elongated, black or brown, and generally covered with a fringe of short, dense, white callus hairs. Indian ricegrass has fair-to-good seedling vigor. Seeds of most accessions are very slow to germinate due a thick hull and embryo dormancy.

Distribution

Indian ricegrass is a widely distributed, short to medium-lived, native, cool-season bunchgrass generally found in the plains, foothills, mountains, and intermountain basins of the western United States. It favors dry and primarily loamy-sandy-gravelly sites. For current distribution, consult the Plant Profile page for this species on the PLANTS Web site.



B&W
Texas A&M University

Adaptation

Indian ricegrass is very winter hardy and has a broad climatic adaptation. It can be found at elevations from 2,000 to 10,000 feet. It grows best in areas with average annual precipitation of 8 to 14 inches. It has been seeded in areas with as low as 6 inches of rainfall and reproduced. It is also found on sites with precipitation well above 14 inches. It prefers sandy coarse-textured soils in its southern areas of adaptation and can be found on sands, fine sandy loams, silt loams, clay loams, gravelly, rocky, to shale areas in the mid-northern areas of its adaptation. It does well on hot, dry southern exposures. In Colorado, Utah, Nevada, and locations to the south, 'Nezpar' does best above 6500 feet elevation and 'Paloma' does best below 6500 feet elevation. 'Nezpar' and 'Rimrock' are considered the best selections for seedings in the northern range of adaptation.

Indian ricegrass is often an early seral or pioneer species, establishing seedlings in open or disturbed sites and on sandy soils. It is relatively short-lived for a perennial grass and reproduces by seed.

It does not tolerate poorly drained soils, extended periods of inundation, winter flooding, or shading. It is tolerant of weakly saline and sodic conditions, but prefers neutral soils. It can tolerate fire late in the growing season and when the plant is dormant without serious damage.

Species often associated with Indian ricegrass include the big sagebrush complex (*Artemisia tridentata*), saltbush species (*Atriplex* spp.), winterfat (*Krascheninnikovia lanata*), juniper species (*Juniperus* spp.), needle-and-thread (*Hesperostipa comata*) and other needlegrasses, bluebunch wheatgrass, Snake River wheatgrass, thickspike wheatgrass, streambank wheatgrass, western wheatgrass, and blue grama (*Bouteloua gracilis*).

Establishment

Planting: This species should be seeded with a deep furrow drill at a depth of 1/2 to 1 inch on medium to fine-textured soils and 1 to 3 inches on coarse-textured soils. A deeper planting depth puts the seed in contact with moist soil conditions, which aids in the stratification process and makes the seed less likely to be dug up by rodents. Use of older seed up to 4 to 6 years of age may have improved germination and should be planted at 1/2 to 1-inch depth. Research has shown that mechanical scarification of the seed improves germination of dormant seed lots (Jones and Nielson, 1992a).

The seeding rate recommended for Indian ricegrass is 6 pounds Pure Live Seed (PLS) per acre or 30 PLS seeds per square foot. If used as a component of a mix, adjust to percent of mix desired. For rangeland mixtures, approximately 30 to 50 percent of the mix or 2 to 3 pounds PLS/acre should be considered. For mine lands and other harsh critical areas, the seeding rate should be doubled. Two separate seeding operations may be necessary when planting seed mixes, because most species should be planted at shallower depths than the depths recommended for Indian ricegrass. This means that Indian ricegrass should be planted first, followed by the seeding operation for the rest of the mix.

The best seeding results are obtained from dormant seeding in late fall on medium to light-textured soils.

Dormant fall seeding may improve germination of dormant seeds. Spring and summer seedings are not recommended. Seedling vigor is fair to good, but the seed may have a high percentage of hard seed and stands may take 2 to 5 years to fully establish. Indian ricegrass responds well to light irrigation and light fertilization.

Stands may require weed control measures during establishment. Bromoxynil may be applied at the 3-4 leaf stage for early suppression of young broadleaf weeds and application of 2,4-D should not be made until plants have reached the 4-6 leaf stage or later. Mow when weeds are beginning to bloom to reduce weed seed development. Grasshoppers and other insects may damage new stands and use of pesticides may be required. All herbicides and pesticides should be applied according to the label.

Management

Indian ricegrass establishes slowly and new seedings should not be grazed before the late summer or fall of the second growing season. It makes its initial growth in early spring and matures seed by mid-summer.

New stands should not be grazed until the plants are producing seed. Indian ricegrass benefits from grazing use if it is moderately grazed in winter and early spring. Livestock should be removed while there is still enough growing season moisture to allow recovery, growth, and production of seed. Stands will deteriorate under heavy spring grazing. The third and fourth years following establishment may be critical to stand survival. Reproduction is dependent on seed production and quality seed in the soil bank must be available as mature plants begin to die out of the stand. Grazing management with rest or deferment schedules that allow plants to produce seed every 2 to 3 years is recommended. By the eighth or ninth year following establishment, the seed bank should be adequate, with a wide variation of low dormancy to hard seed to ensure long-term stand survival with proper grazing management.

Environmental Concerns

Indian ricegrass is relatively short-lived and spreads via seed distribution. It is not considered "weedy" or an invasive species, but can spread into adjoining vegetative communities under the proper management, climatic, and environmental conditions. Most seedings do not spread from original plantings, or if they do spread, the rate of spread is not alarming. Indian ricegrass is self-pollinated, but may occasionally cross with native needlegrass species (Jones 1990). These natural crosses generally produce sterile hybrids.

Seed Production

Seed production of Indian ricegrass has been very successful under cultivated conditions. Row spacing of 24 inches under irrigation or high precipitation (> 16 inches annual precipitation) to 36 inches on dryland is recommended. Seeding rates for seed production range from 3.0 pounds PLS per acre on dryland to 4.0 pounds PLS per acre under irrigated conditions. Cultivation will be needed for weed control and to maintain row culture.

Seed fields are productive for about five years. Field moisture during the fall, soil fertility, and plant re-growth determine the yield the succeeding year. Birds will feed on seed and wind can shatter seed from inflorescence prior to harvest.

Average production of 100 to 150 pounds per acre can be expected under dryland conditions in 14-inch plus rainfall areas. Average production of 200 to 300 pounds per acre can be expected under irrigated conditions.

Harvesting can be completed by direct combining in the hard-dough stage or by windrowing followed by combining. Windrowing helps to ensure a more complete threshing. Indian ricegrass is so indeterminate that windrowing allows final curing in

the swath prior to combining. Windrowing also reduces the risk of loss of seed from wind. It is very difficult to thrash all the seed if direct combined, and it may be beneficial to re-thrash windrows after a few days for seed not threshed in the first operation. Seed heads have moderate to high rates of shatter and require close scrutiny of maturing stands. Seed is generally harvested from early July to early August. Seed must be dried immediately after combining (moisture content should be 12 percent in bins/15 percent in sacks).

Cultivars, Improved and Selected Materials
Foundation and registered seed is available through the appropriate state Crop Improvement Association or commercial sources to grow certified seed.

'Nezpar' Indian ricegrass was originally collected in 1935 from a site south of White Bird, Idaho by the Pullman, Washington Plant Materials Center (PMC) staff. It was selected from 152 accessions for its vegetative characteristics and low seed dormancy by the Aberdeen, Idaho PMC and released in 1978. It is adapted to the Northwest and Intermountain regions where precipitation averages 8 inches or above. It has survived in some plantings with 6 inches annual rainfall. It prefers gravelly to loamy to sandy soils. It is noted for its large erect plant type, robust stems, abundant leaves, medium to small dark nearly hairless elongated seeds (< 50 percent dormant seeds), and good to excellent seedling vigor. Certified seed is available and Breeder seed is maintained by Aberdeen PMC.

'**Paloma**' Indian ricegrass was collected in 1957 west of Pueblo, Colorado at about 5000 feet elevation on medium soils. It was selected by Los Lunas, New Mexico PMC and released cooperatively by the PMC and New Mexico Agricultural Extension Service in 1974. It is adapted to the Southwestern Regions of the Western United States. It is considered very drought tolerant, has good seedling vigor, forage, seed yields, and is long lived. Paloma has good regrowth and spring recovery. It is considered the best Indian ricegrass cultivar for the Southwestern Regions of the Western United States. Certified seed is available, and Breeder seed is maintained by Los Lunas PMC.

'**Rimrock**' Indian ricegrass was collected in 1960 from a native site averaging 10 to 14 inches of precipitation, north of Billings, Montana, at about 3600 feet elevation on sandy soils. The Bridger PMC; ARS, Logan, Utah; and the Montana and Wyoming Agricultural Experiment Stations released Rimrock in 1996, primarily because of its ability to retain mature seed better than Nezpar or Paloma. The more acute angle of glumes on Rimrock as compared to Nezpar and Paloma helps it to retain seed longer and reduces seed shatter caused by wind or rain. Certified seed is available and Bridger PMC maintains Breeder seed.

Ribstone germplasm Indian ricegrass was developed from an accession collected in 1993 north of Taber, Alberta, Canada on a sandy soil by USDA-ARS and Ducks Unlimited Canada. Ribstone was released by USDA-ARS, the Utah Agricultural Experiment Station, and Ducks Unlimited Canada in 2002. Its parental accession was selected for more acute angle of the glumes (similar to Rimrock) to reduce seed shattering. Ribstone's intended use is for southeastern Alberta and adjacent portions of Saskatchewan and Montana. Early-generation seed for propagation is available from Ducks Unlimited Canada and USDA-ARS (Logan, UT) maintains G-2 seed.

References

Alderson, J. and W.C. Sharp 1994. *Grass varieties in the United States*. Agriculture Handbook No. 170. USDA, SCS, Washington, D.C.

Cronquist, A., A. H. Holmgren, N. H. Holmgren, J. L. Reveal, and P. K. Holmgren 1977. *Intermountain flora*. Vol. 6. The New York Botanical Garden. Columbia University Press, New York, New York.

Hitchcock, A. S. 1950. *Manual of the grasses of the United States*. USDA, Washington, DC.

Jones, Thomas A. 1999. *Personal communication.* Geneticist, USDA, ARS, Forage and Range Research Laboratory, Logan, Utah.

Jones, T. A. 1990. A viewpoint on Indian ricegrass: Its present status and future prospects. J. Range Manage. 43:416-420.

Jones, T. A., and D. C. Nielson. 1992a. Germination of prechilled mechanically scarified and unscarified Indian ricegrass seed. J. Range Manage. 45:175-179.

Jones, T. A., and D. C. Nielson. 1992b. High seed retention of Indian ricegrass PI 478833. J. Range Manage. 45:72-74.

Powell, A.M. 1994. *Grasses of the Trans-Pecos and adjacent areas*. University of Texas Press, Austin, Texas.

Texas A&M University 1997. *Grass images*. <http://www.csdl.tamu.edu/FLORA/image/poacr2ba.htm>. Version: 000417. Bioinformatics Working Group, College Station, Texas.

USDA, Forest Service 1996. *Fire effects information system*. Version: 000417. <http://www.fs.fed.us/database/feis/>. Rocky Mountain Research Station, Fire Sciences Laboratory, Missoula, Montana.

USDA, NRCS 2000. *The PLANTS database*. Version: 000417. <http://plants.usda.gov>. National Plant Data Center, Baton Rouge, Louisiana.

Prepared By

Daniel G. Ogle, Plant Materials Specialist
USDA, NRCS, Boise, Idaho

Loren St. John, Team Leader
USDA, NRCS, Plant Materials Center, Aberdeen, Idaho

Dr. Thomas A. Jones
USDA, ARS, Forage and Range Laboratory, Logan, Utah

Species Coordinator

Daniel G. Ogle, Plant Materials Specialist
USDA, NRCS, Boise, Idaho

Edited: 30nov00 jsp; 20sept02 lsj; 30sept02 taj; 30sept02 dgo

United States Department of Agriculture
NRCS Natural Resources Conservation Service
Plant Guide

FOURWING SALTBUSH

Atriplex canescens (Pursh) Nutt.

plant symbol = ATCA2

Contributed By: USDA, NRCS, Idaho State Office

Loren St. John
Aberdeen PMC

Alternate Names
Chamise, chamize, chamiso, white greasewood, saltsage, fourwing shadscale, and bushy atriplex

Uses
Rangeland/Grazing: fourwing saltbush is highly palatable browse for most livestock and big game. It is used primarily in the winter at which time it is high in carotene and averages about four percent digestible protein. The leaves may be as high as 18 percent total protein. It is grazed by all classes of livestock except horses.

Wildlife: fourwing saltbush provides excellent browse for deer season long. It is a good browse plant for bighorn sheep, antelope, and elk in fall and winter. It is also a food source and excellent cover for sharptail grouse, gray partridge (Huns), sage grouse, and other upland birds, rabbits, songbirds, and small mammals.

Erosion Control: fourwing saltbush makes excellent screens, hedges, and barriers. It is especially useful on saline-sodic soils. It has excellent drought tolerance. It has been planted in highway medians and on road shoulders, slopes, and other disturbed areas near roadways. Because it is a good wildlife browse species, caution is recommended in using it in plantings along roadways. Its extensive root system provides excellent erosion control.

Reclamation: fourwing saltbush is used extensively for reclamation of disturbed sites (mine lands, drill pads, exploration holes, etc,). It provides excellent species diversity for mine land reclamation projects.

Status
Consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status, such as state noxious status and wetland indicator values.

Description
Fourwing saltbush is a polymorphic species varying from deciduous to evergreen, depending on climate. Its much-branched stems are stout with whitish bark. Mature plants range from 1 to over 8 feet in height, depending on ecotype and the soil and climate. Its leaves are simple, alternate, entire, linear-spatulate to narrowly oblong, canescent (covered with fine whitish hairs) and ½ to 2 inches long. Its root system is branched and commonly very deep (to 20 feet) when soil depth allows.

Fourwing saltbush is mostly dioecious, with male and female flowers on separate plants. Male flowers are red to yellow and form dense spikes at the ends of the branches. The female flowers are axillary and nondescript. However, some monecious plants may be found within a population. Fourwing saltbush plants can exhibit hermaphroditic characteristics (male and female parts in one flower). The seed is contained in utricles that turn a dull yellow when ripe and may remain attached to the plant throughout winter.

Fourwing saltbush derives its name from the four membranous 'winged' capsules, which encompass the seed. It is most commonly called fourwing saltbush, but is also known as chamise, chamize, chamiso, white greasewood, saltsage, fourwing shadscale, and bushy atriplex.

Distribution
Fourwing saltbush (*Atriplex canescens* (Pursh) Nutt. is one of the most widely distributed and important

native shrubs on rangelands in the western United States including the Intermountain, Great Basin, and Great Plains regions. Its natural range extends from below sea level to above 8,000 feet elevation. For current distribution, consult the Plant Profile page for this species on the PLANTS Web site.

Adaptation

Fourwing saltbush is adapted to most soils but is best suited to deep, well drained; loamy to sandy to gravely soils. It is sometimes found growing in dense clay soils. It is very tolerant of saline soil conditions and somewhat tolerant of sodic soil conditions. Under saline conditions plants take up salts and accumulates it in the plants scurfy leaf coverings.

Fourwing saltbush has high tolerance to boron. It does not tolerate high water tables or late winter inundation. It is extremely drought tolerant and has fair shade tolerance. It is not very tolerant of fire, but may resprout to some degree if fire intensity is not too severe. Its ability to tolerate extreme cold conditions varies with ecotype.

Fourwing saltbush most commonly grows in areas that receive 8 to 14 inches annual precipitation. It can be found from sea level to 8,000 feet elevation. Depending on ecotype, fourwing saltbush grows in association with bluebunch wheatgrass, basin wildrye, bottlebrush squirreltail, Indian ricegrass, Sandberg bluegrass, sand dropseed, blue grama, galleta, black grama, alkali sacaton, inland saltgrass, globemallow, greasewood, rabbitbrush, shadscale, Nuttall or Gardner saltbush, winterfat, bud sagebrush, black sagebrush, low sagebrush, Wyoming big sagebrush, and basin big sagebrush.

Establishment

Planting: Fourwing saltbush begins growth in mid to late spring. Seed matures 3 to 4 months after flowering. It typically spreads via seed distribution, but may also root sprout following wildfire or layer if covered with sand. Stands typically take three to four years to establish, but once established the plants are fairly competitive with other species. Fourwing saltbush can be established by transplanting in early spring, direct seeding in late fall, early winter or very early spring.

An adapted cultivar/release or local seed source should be used to ensure the ecotype is compatible with the site. Seed should be after-ripened for ten months and dewinged prior to planting. On moist fine soils, seed should be planted ½ inch deep. On sandy to coarse gravely soils, plant up to ¾ inch deep. Seeding rates of 0.25 to 0.50 pounds per acre is recommended for rangeland seeding mixtures (3 to 7 percent of the seeding mix). Dewinged seed is preferred because seed flow through a drill and planting depth can be controlled more easily. There is no prechilling requirement for fourwing saltbush seed. See Seed Production section for additional planting recommendations

Seedling vigor is generally outstanding and depending on ecotype, young plants may reach heights of 18 inches by the end of the first growing season.

Management

Fourwing saltbush is palatable to cattle, sheep and deer season long. It provides nutritious winter browse on many areas and is a good fall and winter browse plant for bighorn sheep, antelope, and elk.

In new plantings, utilizing good seedbed and weed control techniques should enhance establishment and reduce competition with other plants. In interseedings plant competition should be reduced by chemical, scalping, furrowing or other techniques that help control existing vegetation and weeds. Animals utilizing the area should be removed from new plantings for at least two growing seasons or until plants are well established and reproducing. Irrigation may be needed for transplants on harsh sites to ensure establishment. Young seedings are not tolerant of excessive insect, rabbit, and rodent damage and plantings may require control measures if severe damage appears.

In established plantings, deferred rotation grazing systems are recommended for fourwing saltbush management. Plants can be grazed from late spring through winter, but plant health is best maintained if used primarily as a winter browse. Fourwing saltbush tolerates browsing very well, but will decrease in abundance under continuous close browsing. Proper use of fourwing saltbush as browse is approximately 40 - 50 percent of current year's growth.

Excessive use results in damage or loss of plants from breakage of brittle branches. During dry periods, branches and stems may be brittle and trampling by livestock may damage plants. Damaged plants generally recover if rested, but production will be reduced until fully recovered. No injury to livestock results from grazing this plant. However, it can cause bloat and scours in spring if it is the primary dietary source. Rabbits, rodents, and grasshoppers utilize fourwing saltbush and may

damage stands under severe conditions requiring pest control measures.

Environmental Concerns
Fourwing saltbush is native, long-lived, and spreads primarily by seed distribution. It is not considered "weedy", but could slowly spread into adjoining vegetative communities under ideal climatic and environmental conditions. This species is well documented as having beneficial qualities and no negative impacts on wild or domestic animals.

Seed Production
Establishing plants in a greenhouse and transplanting to the field will result in the most satisfactory stands for seed production. (Note: studies are underway to determine the feasibility or success of propagating fourwing saltbush from stem cuttings)

Plant spacing should be 6 to 8 feet within row and 8 to 10 feet between rows. Planting one male plant for every 5 female plants is recommended. Transplanting into weed barrier fabric can also improve plant establishment, seed production, weed control, and moisture conservation. Transplanting is recommended in the spring prior to summer heat. Full seed production is usually reached the third year following transplanting.

Plantings can also be established with seed. A minimum of 15 to 20 Pure Live seeds per linear foot of drill row should be planted. Hand seeding in late fall or very early spring may also be an option. Plant 5 to 10 seeds in a close group at desired spacing. Thin plants to desired spacing and ratio of male to female plants when fruiting starts (about 3 years). Full seed production may be reached the fourth year following direct seeding.

Fourwing saltbush requires an equivalent of 10 to 14 inches annual precipitation for seed production. Irrigation may only be needed for establishment and during drought years to ensure a seed crop. If irrigation is available, irrigate to promote vegetative growth. Make sure soil moisture is adequate at early flowering, during seed set and early maturation. Irrigate to field capacity prior to fall freeze-up. Expected seed yields may range from 200 to 400 pounds per acre. Fertilization is not generally recommended unless soil tests indicate severe nutrient deficiencies. Rabbits and rodents can damage stands and may destroy seedlings. Insects such as grasshoppers and Mormon crickets infrequently damage stands beyond recovery.

Seed generally ripens in late August and September and can be harvested from mid September through December. Harvesting seed is best accomplished for woody ecotypes by hand stripping. Mechanized harvesting has been used on Wytana, but seed requires additional conditioning to properly dry and clean out excessive trash (leaves, stems, other inert matter). Harvested seed is usually threshed (dewinged) by processing seed through a hammermill (1500 rpm) equipped with a ¼ inch screen and then running seed through a fanmill to the desired grade.

Dewinging may hasten after-ripening of seed resulting in shorter viability of seed. Seed can be stored and remain viable for 6 to 10 years. The dewinging process greatly enhances the ability of the seed to flow through planting equipment. Removing the hull that surrounds the embryo can injure the seed resulting in reduced viability, seedling vigor, and stand establishment. One must be extremely careful when threshing to limit the amount of mechanical action on the seed to minimize damage.

Fourwing saltbush seed requires about 10 month's after-ripening following harvest before accurate percent germination can be determined. Seeds per pound will vary by accession or ecotype, but averages 38,000 seeds per pound winged and 78,000 seeds per pound dewinged.

Cultivars, Improved and Selected Materials (and area of origin)
Foundation and registered seed is available through the appropriate state Crop Improvement Association or commercial sources to grow certified seed.

'Marana' fourwing saltbush was released in 1979 by the NRCS Plant Materials Center in Lockford, California. It originated from plants near El Cajon, California and was selected for ease of establishment and drought resistance. It is best adapted to areas in the southwest including southern New Mexico, southern Arizona and southern to central California.

'Rincon' fourwing saltbush was selected by the Forest Service, Shrub Science Laboratory in Provo, Utah and cooperatively released with the NRCS Plant Materials Center, Meeker, Colorado in 1983. The original seed was collected at Rincon Blanco near Canjilon, Rio Arriba County, New Mexico at 7,800 feet elevation. Rincon is an erect, leafy form with early season green-up. It is best adapted to the southwest areas of central Utah, central Nevada, western Colorado, to central New Mexico and central Arizona.

'Santa Rita' fourwing saltbush was cooperatively released by the NRCS Plant Materials Center, Tucson, Arizona, ARS, and University of Arizona in 1987. It is best adapted to areas in the southwest including southern New Mexico, southern Arizona and southern to central California.

Snake River Plains Germplasm fourwing saltbush was selected by the NRCS Plant Materials Center, Aberdeen, Idaho and cooperatively released by the Aberdeen PMC, Pullman, Washington PMC and University of Idaho in 2001. Snake River Plains Germplasm is a composite of 4 accessions of fourwing saltbush collected from the Snake River Plains of southern Idaho. It was selected for superior establishment and cold hardiness. It is better adapted to the northern range of fourwing saltbush including southern Idaho, eastern Oregon, western Wyoming, northern Utah and northern Nevada than other fourwing saltbush releases.

'Wytana' fourwing saltbush was released by the NRCS Plant Materials Center, Bridger, Montana in 1976. Wytana is a natural cross between fourwing saltbush and Gardner or Nuttall saltbush. It is a short, herbaceous type that is best adapted to the Great Plains and mountain foothills of Idaho, Montana and Wyoming.

Prepared By
Daniel G. Ogle, Plant Materials Specialist, USDA, NRCS, Boise, Idaho

Loren St. John, Team Leader, USDA, NRCS, Plant Materials Center, Aberdeen, Idaho

Species Coordinator
Daniel G. Ogle, Plant Materials Specialist, USDA, NRCS, Boise, Idaho

Edited 05dec00 jsp; 23sept02 lsj; 20sept02 dgo

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

United States Department of Agriculture
NRCS Natural Resources Conservation Service
Plant Guide
Plant Materials Program

SNOW BUCKWHEAT

Eriogonum niveum Dougl. ex Benth.

plant symbol = ERNI2

Contributed By: USDA, NRCS, Pullman Plant Materials Center, Pullman, Washington

USDA NRCS Pullman PMC

Alternate Names
canyon heather

Uses
Erosion control/reclamation/landscape: Snow buckwheat is a very successful pioneer species (Tiedemann, et al 1997). It tolerates extremely droughty soils and is a common occupant of dry, rocky southern exposures. It is an excellent candidate for stabilizing skeletal soils exposed in road cuts, and mine spoils that lack soil development.

Snow buckwheat grows to 0.5 m (20 in.) in height in most areas but may be as much as 1m tall and 1m wide on better sites. The canopy, while quite short, can effectively protect the soil from erosive winds.

Snow buckwheat is a very useful xeriscaping plant, because it requires very little moisture and does not become weedy. It can be shaped by careful pruning to produce a more formal looking round-full plant. The bloom period is very long and the white flowers take on a pink blush in late fall.

Grazing/rangeland/wildlife: Snow buckwheat has limited domestic livestock grazing value. Sheep will utilize the tips of the flower heads and ignore the rest of the plant. (USDA Forest Service Range Plant Handbook).

Mule deer in north-central Washington are reported to make heavy use of snow buckwheat in the winter and early spring months (Burrell 1982). Bighorn sheep also make heavy use of snow buckwheat, and it decreases in response to bighorn sheep grazing (Wikeem and Pitt 1991). Small birds and mammals use the canopy for cover.

Several species of bees and butterfies utilize snow buckwheat as a foodstuff, including the endangered Mormon Metalmark butterfly (*Apodemia mormo*) (Royal British Columbia Museum 1995).

Ethnobotany: A tea brewed from the roots of snow buckwheat and a related species, Indian tobacco (*E. heracleoides*) were used by Native Americans as a diarrhea remedy. Boiled roots and stems were used to treat a variety of ailments including cuts, colds, and blood poisoning (Parish et al. 1996). It has been suggested that the Columbia Basin buckwheats were also used to develop dyes by the Native Americans (Sackschewsky and Downs 2001).

Status
This is a native species. Consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status, such as state noxious status and wetland indicator values.

Description
General: Buckwheat Family (Polygonaceae). Snow buckwheat is a deciduous, low growing, evergreen halfshrub.

The crown gives rise to numerous short-woody stems. Leaves attached to the main stems are short and generally oblong. The bottoms of the leaves are gray and very tomentose while the tops are only slightly hairy. The flowering stems are tomentose and as much as 200mm in length. Leaves on the flowering stems are short and narrow. The flower heads may be as long as 200mm and generally ascending. The flowers are white or light pink and turn brown at seed maturity in the fall. The seeds are small and shaped like urns. There are approximately 943,000 seeds/kg (427,000 seeds/pound).

Distribution
Hitchcock et al. (1964) described the distribution of snow buckwheat as the east slope of the Cascade Mountains from British Columbia, south to central

Oregon, east to west-central Idaho. For current distribution of this species and its relatives, consult the Plant Profile page for this species on the PLANTS Web site.

Adaptation
Cold Hardiness Zone: 5a-7a.
Mean Annual Precipitation: 150-460mm (6-18 in.)
Elevation: 150-1500m (500-4900 ft.)
MLRA: 6, 8, 9, 10, 11, 23, 24, and 25
Soil: Well-drained sands to clays

Snow buckwheat is common in big sage (*Artemisia tridentata*), antelope bitterbrush (*Purshia tridentata*), and open Ponderosa pine (*Pinus ponderosa*) areas. It also occurs in the canyon grasslands of the Snake and Columbia River systems.

It is primarily found in full sun but will grow in partial shade such as open Ponderosa pine hillsides.

Snow buckwheat is common on steep slopes and rocky scabland soils that support little competing vegetation. Its taproot enables it to acquire moisture percolating through the rock cracks. It occurs much less frequently on deep, moist soils.

Species often associated with snow buckwheat include the following: big sagebrush (*Artemisia tridentata* - probably *wyomingensis, vaseyana,* and *tridentata* subspecies), antelope bitterbrush (*Purshia tridentata*), Ponderosa pine (*Pinus ponderosa*), western juniper (*Juniperus occidentalis*), bluebunch wheatgrass (*Pseudoroegneria spicata*), sand dropseed (*Sporobolus airoides*), Snake River wheatgrass (*Elymus wawawaiensis*), Sandberg bluegrass (*Poa secunda*), Indian ricegrass (*Achnatherum hymenoides*), and needle-and-thread (*Nassella comata*).

Establishment
Seeding: Snow buckwheat should be seeded in late fall (Tiedemann and Driver 1983). Standard reclamation drills and broadcast seeders are capable of handling snow buckwheat seed, however, ensure the seed is kept shallow (max. 6mm deep). Germination in the wild occurs during cool-wet conditions thus allowing the seedlings to develop while moisture is readily available and evaporative rates are low.

Transplanting: Rooted transplants are easily outplanted. The soil should be at least 75% of field capacity when planted. Once fully established, snow buckwheat is long-lived and very persistent.

Management
Snow buckwheat is a low maintenance plant once established. Cheatgrass and other winter annuals should be controlled the first year to allow good establishment. Observations have shown that snow buckwheat withstands severe defoliation if the woody stems and crowns are not damaged.

Digging up plants is not advised because it is difficult to extract a large enough portion of the root to support the plant. Also, removing plants in the wild severely disturbs the site and leaves it especially prone to weed invasion.

Its tolerance to fire is unknown, however, most *Eriogonum* species which remain green year round are severely damaged by fire.

Environmental Concerns
Snow buckwheat is long-lived, spreading via seed in the wild. It is not considered to be a "weedy" or invasive species, but can spread into adjoining vegetative communities under ideal climatic and environmental conditions.

Propagation
Snow buckwheat seed should be grown in areas where it is native or areas that have long growing seasons. Weeds can be controlled by between-row cultivation. No herbicides are labeled for snow buckwheat seed fields.

Seed is fully ripe when the flowers turn brown. Shattering can be severe at full maturity. Mechanical harvest is possible providing that the cutting bar is set high enough to not damage the crown. Observations have indicated that cutting back the woody stems reduces plant life and reduces seed production the following year.

Seed shelf life can be as short at 12 months if not properly stored. Seed is best stored in cool-dry conditions.

Plants are easy to produce for out-planting. Seed should be planted in mid-winter and allow for at least 10 weeks growth before hardening. Avoid potting media that does not drain well, and do not over-water.

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

'**Umatilla**' Snow buckwheat was selected by the Pullman Plant Materials Center and released in 1991. It was developed from a native collection made in

Umatilla County, Oregon. It is primarily recommended for use in rangeland restoration plantings, upland wildlife habitat improvement plantings in semi-arid environments, and soil stabilization plantings on sites that will not support dense populations of conventional conservation species. It has performed very well on mine spoils in central Washington (Zamora and Leier 1993). It is also well suited for xeriscape plantings, particularly where a native halfshrub is desired.

Limited quantities of Foundation seed are available to growers from the Pullman Plant Materials Center.

References

Burrell, G.C. 1982. Winter diets of mule deer in relation to bitterbrush abundance. J. Range Manage. 36:508-510.

Hitchcock, C.L., A. Cronquist, M. Ownbey, and J.W. Thompson 1964. Vascular plants of the Pacific Northwest. University of Washington Press, Seattle, Washington.

Parish, R., Coupe, R. and D. Lloyd 1996. Plants of southern interior British Columbia. Lone Pine Press, Vancouver, B.C., Canada.

Royal British Columbia Museum 1995. >http://rbcm1.rbcm.gov.bc.ca/end_species/species/mmetalm.html<

Sackschewsky, M.R. and J.L. Downs 2001. Vascular plants of the Handford site. U.S. Dept. of Energy, Pacific Northwest National Laboratory Rep. 13688. Richland, Washington.

Tiedemann, A.R. and C.H. Driver. 1983. Snow eriogonum; a native halfshrub to revegetate winter game ranges. Reclam and Reveg Res. 2:31-39.

Tiedemann, A.R., S.M. Lambert, J.R. Carlson, C.J. Perry, N.L. Shaw, B.L. Welch, and C.H. Driver 1997. 'Umatilla' snow buckwheat for rangeland restoration in the interior Pacific Northwest. Rangelands. 19:22-25.

Wikeem, B.M. and M.D. Pitt 1991. Grazing effects and range trend assessment on California bighorn sheep range. J. Range Manage. 44:466-470.

USDA, Forest Service 1937. Range Plant Handbook.

USDA NRCS 2003. *The PLANTS database*. Version: 030106. <http://plants.usda.gov>. National Plant Data Center, Baton Rouge, Louisiana.

Zamora, B.A. and J.W. Leier 1993. The potential of snowy buckwheat (*Eriogonum niveum*) for revegetation of xeric mine spoil sites in the Pacific Northwest. *IN*: Abstracts 8th Wildland Shrub Symp. Arid Land Restoration, Las Vegas, Nevada.

Prepared By

Mark Stannard
USDA, NRCS, Plant Materials Center, Pullman, Washington

Wayne Crowder
USDA, NRCS, Plant Materials Center, Pullman, Washington

Species Coordinator

Mark Stannard
USDA, NRCS, Plant Materials Center, Pullman, Washington

Drafted 06jan03 mes; Edited 06jan03 dgo; 07jan03 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>.

United States Department of Agriculture
NRCS Natural Resources Conservation Service
Plant Guide
Plant Materials Program

WESTERN CLEMATIS

Clematis ligusticifolia Nutt.

plant symbol = CLLI2

Contributed By: USDA, NRCS, Pullman Plant Materials Center, Pullman, Washington

USDA NRCS Pullman PMC

Alternate Names
white clematis, virgin's-bower, traveler's joy, leatherflower

Uses
Erosion control/reclamation/landscape: Western clematis has great potential to improve roadsides and other dryland critical areas even though it typically occurs in riparian and run-on areas. It is very drought tolerant and transplants have performed very well in trials conducted on sites that receive as little as 7 inches of annual precipitation (Pullman PMC 1993). Placing plants along the top of a cut will allow the canopy to drape over the bare soil and effectively protect the soil. If allowed to climb fences, it will slow soil and catch tumbleweeds.

Western clematis can provide excellent stabilization of intermittent streambanks because it does not require as much moisture as many other riparian plants. The stems develop a thick mat that effectively protect streambank soils and may deter livestock movement.

The landscape value of western clematis is apparent in xeriscaping projects. It remains green late throughout the growing season and the leaves drop in late-fall. The dense leaf canopy can effectively shield background objects that the landscaper wishes to remain unseen. The flowers are smaller then hybrid floral varieties but the plumed seedheads are very attractive.

Grazing/rangeland/wildlife: Western clematis has limited grazing value. Sheep will utilize the young tender leaves. Western clematis is occasionally grazed by cattle and rarely by horses (USDA Forest Service Range Plant Handbook). Use by large game is probably limited. Small birds and rodents use the canopy for cover.

Ethnobotany: The root of western clematis was used as a horse stimulant by Native Americans. The root was scraped and placed in the nostrils of fallen, exhausted horses. The fallen horse would jump to its feet and then be led to water. Native Americans also chewed the plant to remedy colds and sore throats. Just touching the scraped root to the tongue causes a burning sensation that lasts for ½ day (Geyer 1846).

Status
This is a native species. Consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status, such as state noxious status and wetland indicator values.

Description
General: Buttercup Family (Ranuculaceae). Western clematis is a deciduous, perennial vine.

Stems grow from the crown and are numerous in hospitable environments. They generally die back each winter, but the first 1-5 m generally persist for several years. Stems may be as long as 20 m in length (Hitchcock et al 1964). The leaves are pinnately compound and are dropped in late fall. It is dioecious and the flowers are white. Flowers first appear in late June and continue through August. Seedheads are very showy and resemble tufts of goose down. A taproot effectively anchors Western clematis to the soil.

Distribution
Hitchcock et al. (1964) described the distribution of western clematis as southern British Columbia, south to California, east to the Dakotas and west to both sides of the Oregon Cascades. For current distribution of this species and its relatives, consult the Plant Profile page for this species on the PLANTS Web site.

Adaptation
Cold Hardiness Zone: 5a-7a.
Mean Annual Precipitation: 230-530mm (9-21 in.)

Elevation: 150-1375m (500-4500 ft.)
MLRA: 6, 8, 9, 10, 11, 12, 23, 24, 25, 43, and 44
Soil: Silt loams and other medium-textured soils

Western clematis is common in open Ponderosa pine (*Pinus ponderosa*) and big sage (*Artemisia tridentata*) riparian areas. It is also common in run-on areas such as railroad fills that impound water for a few weeks during the spring.

It is partially shade tolerant and can be found in stands of alder. Full shade that occurs under stands of tall evergreen trees is less hospitable. It grows well in full sun.

Soils must be relatively deep with good water holding capacity. Shallow soils or deep soils that cannot supply/retain water during the summer months do not support western clematis.

Species often associated with western clematis include the following: the big sagebrush (*Artemisia tridentata*) complex, Ponderosa pine (*Pinus ponderosa*), alder (*Alnus rhombifolia*), juniper (*Juniperus* spp.), Woods rose (*Rosa* woodsii.), Douglas hawthorn (*Crataegus Douglasii*), chokecherry (*Prunus virginiana*), redosier dogwood (*Cornus stolonifera*), bluebunch wheatgrass (*Pseudoroegneria spicata*), sand dropseed (*Sporobolus airoides*), Snake River wheatgrass (*Elymus wawawaiensis*), Sandberg bluegrass (*Poa secunda*), needle-and-thread (*Nassella comata*), and Idaho fescue (*Festuca idahoensis*).

Establishment
Seeding: Western clematis is generally not seeded. Seeding is impractical because germination is far too slow in the field. A minimum of 12 days of favorable moisture and temperature is required for good levels of germination. Further complicating seeding is the long-fuzzy style, which is very difficult to remove from the seed. Standard reclamation drills and broadcast seeders are not capable of handling clematis seed with the stylus intact.

Transplanting: Rooted plants are easily transplanted. The soil should be at least 75% of field capacity at planting. Mulching or erecting a small shade (flat rock turned on end or similar structure) reduces evaporative loss and improves survival. Weed barrier cloth can be used to reduce competition and improve survival. Once fully established, western clematis is very persistent.

USDA NRCS Pullman PMC

Seedhead of western clematis.

Management
Western clematis is a relatively low maintenance plant once established. Competition should be controlled the first year. Observations have shown that plants withstand severe defoliation and even crown damage. While grazing is not a major concern, trampling can be detrimental so plants should be protected until well established.

Mulching under the plant improves layering. Vines can be cut back each year or allowed to accumulate.

Digging plants is not advised because it is difficult to extract a large enough portion of the root to support the plant. Removing plants in the wild may also severely disturb the site and leave it especially prone to weed invasion.

It is a climbing vine so it should not be planted immediately adjacent to structures where it will be a problem. Unwanted plants can be controlled via mechanical removal and/or application of appropriate herbicides. Allow 2 years for good control because the plant may regrow from the root.

Environmental Concerns
Western clematis is long-lived, spreads primarily via seed in the wild, but also via vegetative means (layering). It is not considered to be a "weedy" or invasive species, but can spread into adjoining vegetative communities under ideal climatic and environmental conditions. Some consider this to be an undesirable trait particularly in riparian zones where it may cover associated shrubby vegetation.

Propagation
Seeding: Most clematis species generally require 60 to 180 days of cold stratification to initiate germination (USDA, 1974). However, western

clematis seeds do not require prolonged stratification, and high levels of germination can be achieved by soaking the seeds for 48-hours in a 0.001M solution of giberellic acid or de-ionized water (Pullman PMC, 1982). Seed should be planted to containers that allow for long, dense roots. Well-rooted plants develop in roughly 10 weeks.

Softwood Propagation: Western clematis is easily propagated via softwood cuttings and is the preferred propagation method. Cuttings require a leaf bud and typically root in 15-20 days. Cuttings are treated with 3000 ppm I.B.A. rooting hormone and placed in a misting chamber with bottom heat. Well-rooted plants develop in roughly 10 weeks.

Hardwood Propagation: Western clematis can be rooted via hardwood cuttings. Obtaining good quality cuttings varies from year to year depending on previous year growing conditions. Treating the cutting with a 3000 ppm I.B.A. rooting hormone and placing the cuttings in a cool-dark environment improves rooting. Rooting success as high as 76% can be obtained. Placing the treated cuttings in a misting chamber with bottom heat is an alternative and rooting is more rapid.

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

'Trailar' Western clematis was selected by the Pullman Plant Materials Center and released in 1992. It was selected from native collections made in Walla Walla and Benton Counties, Washington. It is recommended for use as a soil cover in intermittent dryland stream corridors; for roadside and other erosion prone sites; as ground cover for small mammals and upland birds; and as screening or landscape plant, particularly where a native is desired. Rooted clonal-plants are available to nurseries and researchers in limited quantities from the Pullman Plant Materials Center. Seed is not available.

References

Geyer, C.A. 1846. Notes on the vegetation and general character of the Missouri and Oregon Territories, made during a botanical journey in the state of Missouri, across the South Pass of the Rocky Mountains, to the Pacific, during the years 1843 and 1844. London J. Bot. 5:285-310.

Hitchcock, C.L., A. Cronquist, M. Ownbey, and J.W. Thompson 1964. Vascular plants of the Pacific Northwest. University of Washington Press, Seattle, Washington.

USDA, Forest Service 1937. Range Plant Handbook.

USDA, Forest Service 1974. Seeds of woody plants in the United States. Agr. Handbook #450, Washington, DC.

USDA, NRCS. 1982. Pullman Plant Materials Center Annual Technical Report, Pullman, Washington.

USDA, NRCS. 1993. Pullman Plant Materials Center Annual Technical Report, Pullman, Washington.

USDA, NRCS. 2003. *The PLANTS database*. Version: 030106. <http://plants.usda.gov>. National Plant Data Center, Baton Rouge, Louisiana.

Prepared By
Mark Stannard and Wayne Crowder
USDA, NRCS, Plant Materials Center, Pullman, Washington

Species Coordinator
Mark Stannard
USDA, NRCS, Plant Materials Center, Pullman, Washington

Drafted 06jan03mes; Edited 06jan03 dgo; 07jan03 jsp

United States Department of Agriculture
NRCS Natural Resources Conservation Service
Plant Guide

BLUEBUNCH WHEATGRASS

Pseudoroegneria spicata (Pursh) A. Löve

plant symbol = PSSP6

Contributed By: USDA, NRCS, Idaho State Office

Loren St. John
USDA-NRCS, Aberdeen PMC

Alternate Names

Agropyron spicatum, Elytrigia spicata

Uses

Grazing/rangeland/wildlife: Bluebunch wheatgrass can be used for native hay production and will make nutritious feed, but is better suited to grazing use. Bluebunch wheatgrass is palatable to all classes of livestock and wildlife. It is preferred forage for cattle and horses year-round, but it is considered coarse in summer. It is preferred forage for sheep, elk, deer, and antelope in spring. It is considered desired forage for elk in summer. It is desirable forage for sheep in summer, desirable feed for sheep, elk, deer, and antelope in fall and desirable forage for sheep, elk, and deer in winter. In spring, the protein levels can be as high as 20 percent decreasing to about 4 percent protein as the forage matures and cures. Digestible carbohydrates remain about 45 percent throughout the active growth period.

Erosion control/reclamation: Bluebunch wheatgrass is very drought resistant, persistent and adapted to stabilization of disturbed soils. It is very compatible with slower developing native species, such as thickspike wheatgrass (*Elymus lanceolatus*), western wheatgrass (*Pascopyrum smithii*), and needlegrass species (*Achnatherum* spp., Nassella spp., and Hespero*stipa* spp.). It does not compete well with aggressive introduced grasses. Its drought tolerance, combined with extensive root systems and good seedling vigor, make this species ideal for reclamation in areas receiving 10 to 20 inches annual precipitation. 'Secar' competes well in areas as low as 8 inches annual rainfall. This grass can be used in urban areas where irrigation water is limited and to stabilize ditchbanks, dikes, and roadsides as a component of a mix.

Status

Consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status, such as state noxious status and wetland indicator values.

Description

General: Grass Family (Poaceae). Bluebunch wheatgrass is a perennial native bunchgrass. Bluebunch wheatgrass is highly variable and grows to 1.5 to 4 feet tall with seed spikes 3 to 8 inches long. The auricles are pointed and semi-clasping to nearly lacking. Leaves are lax, cauline, flat to in-rolled, 4-6 mm wide, and green to blue in color. The sheath is generally glabrous. Reproductive stems are erect, slender, and sometimes wiry with a wavy rachis. The lemma awns range from being short to prominent and divergent except on the beardless type where the awn is lacking.

Distribution

Bluebunch wheatgrass is common to the northern Great Plains and the Intermountain regions of the western United States. It is a long-lived cool-season native grass with an extensive root system with strong tillers. Bluebunch wheatgrass spreads by seed; except in high rainfall zones where some short rhizomes may occur. For current distribution, consult the Plant Profile page for this species on the PLANTS Web site.

Adaptation
Bluebunch wheatgrass does best on medium to coarse-textured soils and can be found on heavy to medium to coarse-textured soils over 10 inches deep including fairly sandy sites. It can be seeded on clayey sites. It can be found on thin, rocky sites and on very steep slopes. It will tolerate weakly saline conditions. It does not grow on very acidic sites. It is cold tolerant, moderately shade tolerant, and highly fire tolerant. It is intolerant of high water tables, poor drainage, and periods of extended inundation.

On native sites, bluebunch wheatgrass is most abundant in the 8 to 20 inch annual precipitation zones. Seeded varieties do best with 12 to 20 inches of precipitation (exception 'Secar' 8 to 18 inches and 'Anatone' 10 to 20 inches - estimated) and will tolerate up to 35 inches on very well drained soils with southerly aspects. The elevation range is from 500 to 10,000 feet above sea level. It is a major component of many native plant communities and generally occupies 20 to 60 percent of the overall composition by weight.

Species often associated with bluebunch wheatgrass include the following: the big sagebrush complex, juniper, ponderosa pine, needlegrasses, bluegrass complex, bottlebrush squirreltail, prairie junegrass, thickspike wheatgrass, Idaho fescue, arrowleaf balsamroot, and tapertip hawksbeard.

Establishment
Planting: This species should be seeded with a drill at a depth of 1/2 inch or less on medium-textured soils, 1/4 inch on fine-textured soils and 3/4 inch or less on coarse-textured soils. Single-species seeding rate recommended for this grass is 7 pounds Pure Live Seed (PLS) per acre or 21 PLS per square foot. If used as a component of a mix, adjust to percent of mix desired. For mine lands and other harsh critical areas, the seeding rate should be doubled to 42 PLS seeds per square foot. Seedlings are weaker than most introduced wheatgrasses and a clean, firm, weed-free seedbed is required for establishment (cheatgrass and other annual weed competition can cause stand failure).

The best seeding results are obtained from seeding in very early spring on heavy to medium-textured soils and in late fall on medium to light-textured soils. Late summer (August - mid September) seeding is not recommended unless irrigation is available. Dormant fall seedings will pre-chill seed and reduce seed dormancy.

Bluebunch wheatgrass establishes fairly quickly for a native grass and stands should be given 2-3 years to ensure establishment. It is compatible with other native species and should be used in seeding mixtures. It should not be seeded with strongly competitive introduced species.

Bluebunch wheatgrass makes good spring growth, fair summer growth, and good fall regrowth if moisture is available. Seedling vigor is fair to good, but less than crested wheatgrass.

Stands may require weed control measures during establishment. Application of 2,4-D should not be made until plants have reached the four to six-leaf stage. Mow weeds at or prior to their bloom stage. Grasshoppers and other insects may also damage new stands and pesticides may be needed.

Management
Bluebunch wheatgrass has good palatability to livestock and wildlife. Established stands cannot withstand heavy continuous grazing.

Stands of bluebunch wheatgrass should not be grazed until they have firmly established (usually two growing seasons) and have headed out. Six inches of new growth should be attained in spring before grazing is allowed in established stands. The growing point of bluebunch wheatgrass is fairly high and thus stands can easily be overgrazed. It is recommended that this grass be grazed under a deferred, rotational grazing system to ensure plants remain healthy. Spring grazing should occur no more than one out of three years and no more than 40 percent utilization should occur during rapid growth. Heavy early spring grazing is especially damaging and grazing should be delayed until at least mid-boot stage. No more than 60 percent utilization should occur after seed ripens.

Once established, bluebunch wheatgrass is competitive with weedy species, but it can be crowded out by aggressive introduced species.

Environmental Concerns: Bluebunch wheatgrass is long-lived and spreads primarily via seed distribution, but it can slowly spread vegetatively in precipitation zones above 18 inches annual rainfall. It is not considered a "weedy" or invasive species, but can spread into adjoining vegetative communities under ideal climatic and environmental conditions. Most seedings do not spread from original plantings. It is a cross-pollinating species and is known to cross with other ecotypes of bluebunch wheatgrass, quackgrass, thickspike wheatgrass and bottlebrush

squirreltail. These natural crosses broaden the gene pool, do not generally dominate a site or crowd out the native ecotypes, and in many cases are sterile.

Seed Production
Seed production of bluebunch wheatgrass has been very successful under cultivated conditions. Row spacing of 24 to 36 inches are recommended under irrigation and 36 inches under dryland conditions. Seeding rates of 3 to 4 PLS per acre are recommended. Cultivation will be needed to maintain rows and weed-free conditions.
Seed fields are productive for three to four years. Average production of 75 to 100 pounds per acre can be expected under dryland conditions. Average production of 150 to 250 pounds per acre can be expected under irrigated conditions. Harvesting is best completed by swathing, followed by combining of the cured rows. The seed heads readily shatter and require close scrutiny of maturing stands. If direct combined, harvest at 30 percent moisture and dry seed down to 12 percent moisture (if stored in bins) or 15 percent moisture (if stored in sacks). Debearding may be required during processing. Seed is generally harvested from mid-July to mid- August.

Cultivars, Improved and Selected Materials (and area of origin)
Foundation and registered seed is available through the appropriate state Crop Improvement Association or commercial sources to grow certified seed.

'Anatone' bluebunch wheatgrass (*P. spicata spp. spicata*) was selected from seed originating near Anatone, Washington by the Forest Service Shrub Sciences Laboratory. It was released by the Forest Service Shrub Science Laboratory, BLM, Aberdeen Plant Materials Center, Idaho-Utah AES, ARS and the Utah Division of Wildlife Resources in 2003. Its full range of adaptation is not fully understood at this time, but it is expected to have rapid establishment, high forage production, and the ability to survive and thrive under dry conditions at or above 10 inches rainfall. It is intended for use on valley and foothill rangelands for re-establishment of native plant communities, vegetative firebreaks, and critical area stabilization and reclamation purposes. Certified seed will be available in 2004 and Breeder and Foundation seed is maintained by Aberdeen PMC.

'Goldar' bluebunch wheatgrass (*P. spicata spp. spicata*) was selected from seed collected on Mallery Ridge of the Umatilla National Forest in Asotin County, Washington by the Aberdeen Plant Materials Center. It was released by Idaho-Utah AES, ARS and the PMC in 1989. 'Goldar' is noted for rapid establishment, high forage production, and the ability to survive and thrive under dry conditions at or above 12 inches rainfall. It is intended for use on foothill and mountain rangelands for re-establishment of native plant communities, vegetative firebreaks, and critical area stabilization and reclamation purposes. Certified seed is available and Breeder and Foundation seed is maintained by Aberdeen PMC.

P-7 Selected Germplasm bluebunch wheatgrass (*P. spicata spp. spicata*) was generated by open-pollinating 25 native populations of bluebunch wheatgrass from Idaho, Nevada, Oregon, Utah, Washington and British Columbia resulting in high genetic diversity. ARS and the Utah Agricultural Experiment Station released P-7 in 2001. Its full range of adaptation is not fully understood, but it is expected to survive and thrive under dry conditions at or above 12 inches rainfall and perhaps down to 10 inches rainfall. It is intended for use on valley, foothill and mountain rangelands for re-establishment of native plant communities, vegetative firebreaks, and critical area stabilization and reclamation purposes. Certified seed is available and Breeder seed is maintained by USDA-ARS, Logan, Utah. Certified seed production is allowed through Generation 4.

'Secar' is a cultivar of Snake River wheatgrass (*Elymus wawawaiensis*) originally mistakenly identified as bluebunch wheatgrass prior to the original description of Snake River wheatgrass. The original collection site is along the Snake River Gorge near Lewiston, Idaho. The Idaho-Oregon-Montana-Wyoming AES, Washington Agriculture Research Center, and Pullman Plant Materials Center released 'Secar' in 1980. It is one of the most drought-tolerant native perennial grasses presently available and can survive down to 8 inches rainfall. It is a bunchgrass with fair to good seedling vigor and establishes well under droughty conditions. 'Secar' is intended for use on rangeland for re-establishment of native-plant communities. Certified seed is available and Breeder seed is maintained by Pullman PMC.

'Whitmar' beardless wheatgrass (*P. spicata spp. inermis*) is the awnless form of bluebunch wheatgrass and was selected by Pullman PMC from seed native to the Palouse grasslands near Colton, Washington. Idaho-Oregon-Washington AES and Aberdeen-Corvallis-Pullman PMCs released 'Whitmar' in 1946. It performs best above 12 inches rainfall in high winter-low summer precipitation areas. 'Whitmar' was selected for forage quality, seedling vigor, and good seed production and is intended for use on rangeland for re-establishment of native plant communities and for reclamation. Certified seed is

available and Breeder seed is maintained by Pullman PMC.

Jeanne R. Janish
© The New York Botanical Garden
Cronquist et al. (1977)

References

Alderson, J. & W.C. Sharp 1994. *Grass varieties in the United States*. Agriculture Handbook No. 170. USDA, SCS, Washington, D.C.

Carlson, J.R. & M.E. Barkworth 1997. *Elymus wawawaiensis: a species hitherto confused with Pseudoroegneria spicata (Triticeae, Poaceae).* Phytologia 83:312-330.

Cronquist, A., A.H. Holmgren, N.H. Holmgren, J.L. Reveal, & P. K. Holmgren 1977. *Intermountain flora*. Vol. 6. The New York Botanical Garden. Columbia University Press, New York, New York.

Hitchcock, A. S. 1950. *Manual of the grasses of the United States*. USDA, Washington, DC.

Miller, R.P., J.M. Seufert, and M.R. Haferkamp. 1987. The ecology and management of bluebunch wheatgrass (Agropyron spicatum): A review. Oregon Agric. Exp. Sta. Bull. No. 669.

Powell, A.M. 1994. *Grasses of the Trans-Pecos and adjacent areas*. University of Texas Press, Austin, Texas.

USDA, Forest Service 1996. *Fire effects information system*. Version: 000413. <http://www.fs.fed.us/database/feis/>. Rocky Mountain Research Station, Fire Sciences Laboratory, Missoula, Montana.

USDA, NRCS 2000. *The PLANTS database*. Version: 000413. <http://plants.usda.gov>. National Plant Data Center, Baton Rouge, Louisiana.

Prepared By

Daniel G. Ogle
USDA, NRCS, Idaho State Office, Boise, Idaho

Loren St. John
USDA, NRCS, Plant Materials Center, Aberdeen, Idaho

Dr. Thomas A. Jones
USDA, ARS, Forage and Range Laboratory, Logan, Utah

Species Coordinator

Daniel G. Ogle
USDA, NRCS, Idaho State Office, Boise, Idaho

Edited 05dec00 jsp; 15aug02 lsj; 30spet02 taj; 30sept02 dgo

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

United States Department of Agriculture
NRCS Natural Resources Conservation Service
Plant Guide

CRESTED WHEATGRASS

Agropyron cristatum (L.) Gaertn.

plant symbol = AGCR

and

Agropyron desertorum (Fisch. ex Link) J.A. Schultes

Plant symbol = AGDE2

Contributed By: USDA, NRCS, Idaho State Office

Ephraim crested wheatgrass
Loren St. John
USDA-NRCS, Aberdeen PMC

Alternate Names
Fairway wheatgrass, fairway crested wheatgrass, standard crested wheatgrass, desert wheatgrass

Uses
Grazing/rangeland/hayland: Crested wheatgrass is a perennial, introduced grass 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. 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 decreases to about 4 percent when dormant. Digestible carbohydrates remain high throughout the active growth period. It is commonly utilized for winter forage by cattle and horses, but protein supplements are required to ensure good animal health. It is noted for its ability to withstand very heavy grazing pressure (65-70 percent utilization), once stands are established. Crested wheatgrass produces excellent forage yields in the areas where it is best adapted. Crested wheatgrass is generally not recommended for use in areas with more than 14 inches of annual precipitation because better alternative forage species are available. Crested wheatgrass stands generally produce from 1.5 to 2 times more forage than native grass stands.

Erosion control/reclamation: Crested wheatgrass is well adapted for stabilization of disturbed soils. It competes well with other aggressive introduced plants during the establishment period. Crested wheatgrass is generally not compatible in mixes with native species, because it is very competitive and commonly out-competes slower developing native species. However, when seeded at low rates with native species, outstanding mixed stands including Bluebunch wheatgrass, Snake River wheatgrass, Sandberg bluegrass and big bluegrass have been achieved.

Drought tolerance, fibrous root systems, and excellent seedling vigor makes crested wheatgrass ideal for reclamation in areas receiving 9 inches or more annual precipitation. In areas above 14 inches annual precipitation, ‘Roadcrest’ and ‘Ephraim’ may exhibit their rhizomatous traits and make excellent low maintenance turf when broadcast seeded to establish lawns. 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.

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. Where it is planted as a monoculture, the resulting biodiversity is lower than that found in a diverse seeded or native plant community.

Status
Consult the PLANTS Web site and your State Department of Natural Resources for status, such as state noxious status and wetland indicator values.

Description
General: Grass Family (Poaceae). Crested wheatgrass is a long-lived, cool season, drought tolerant, introduced, and winter hardy grass with an extensive root system. Related species include the following: Fairway crested wheatgrass (*Agropyron cristatum),* Standard crested wheatgrass (*Agropyron desertorum*) and Siberian wheatgrass (*Agropyron fragile*).

Fairway crested wheatgrass spikes are 2 to 7 cm long. The spikelets are more widely spreading with the glumes somewhat contoured, gradually tapering into awns 2 to 5 mm 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 crested wheatgrass has longer spikes than fairway, but vary in spike shape from comb-like to oblong. Both Fairway and standard crested wheatgrass grow from 1 to 3 feet tall with seed spikes 1.5 to 3 inches long. 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 awl shaped and firm, and keeled. Culms are erect. Leaves are flat, smooth below, slightly scabrous (coarse) above and vary in width from 2 to 6 mm.

Siberian wheatgrass 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 is more drought tolerant and retains its greenness and palatability later into the summer than either standard or fairway.

Adaptation
Crested wheatgrass is adapted for non-irrigated seedings where annual precipitation averages 8-14 inches (Fairway should be planted in areas averaging 10 inches or more annual precipitation and Standard in areas receiving 9 inches or more), and where the frost-free period is generally less than 140 days. Standard crested wheatgrass including the hybrid crosses 'Hycrest' and 'CD-II' are superior above 9 inches annual precipitation in spring recovery and grazing readiness. On droughty sites with 8-10 inches annual precipitation, Siberian wheatgrass may be the best choice. It is known to surpass fairway and standard crested wheatgrass in rate of establishment, stand persistence, and total forage yield on the more arid sites. Siberian has been seeded in areas with as little as 5 inches of precipitation with some success.

Crested wheatgrass should generally be seeded below 7,000 feet elevation. Fairway does well up to 9,000 feet elevation. Crested wheatgrass does well on shallow to deep, moderately course to fine textured, moderately well to well drained soils. Under saline conditions, vigor and production are reduced. Fairway is not well adapted to silty soils. Crested wheatgrass is cold tolerant and can withstand moderate periodic flooding, not exceeding 7-10 days in the spring but will not tolerate long periods of inundation, standing water, poorly drained soils, or excessive irrigation. Crested wheatgrass is very tolerant of fire.

Distribution
This species was introduced from Asia and is naturalized from the Pacific coast to New York. For current distribution, consult the Plant Profile page for this species on the PLANTS Web site.

Establishment
Crested wheatgrass should be seeded with a drill at a depth of 1/2 inch or less on medium to fine textured soils and 1 inch or less on coarse textured soils. Single species seeding rates recommended for crested wheatgrass is 5 pounds Pure Live Seed (PLS) per acre or 20 PLS seeds per square foot. If used as a component of a mix, such as with alfalfa (*Medicago* spp.), sainfoin (*Onobrychis viciifolia*), yellow sweetclover (*Melilotus officinalis*), cicer milkvetch (*Astragalus cicer*) or others, adjust to percent of mix desired. For mine lands and other harsh critical areas, the seeding rate should be increased to 10 pounds PLS per acre or 40 PLS seeds per square foot. Mulching and light irrigation on highly disturbed, droughty areas are beneficial for stand establishment.

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 - mid September) seedings are not recommended unless irrigation is available.

Crested wheatgrass establishes quickly, with 'Hycrest' and 'CD-II' noted for their seedling vigor. They should not be seeded with native species, unless crested wheatgrass seeding rates are very low (generally < 2 pounds per acre). They may compliment native stands that are already partially established. Under favorable conditions they provide good competition against weeds.

Stands may require weed control measures during establishment, but application of 2,4-D 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. Grasshoppers and other insects may also damage new stands and use of pesticides may be required.

Management

Crested wheatgrass begins to produce forage in the spring about 10 days after bluegrass species and about two weeks earlier than most native wheatgrasses. They make good spring growth, little summer growth and good fall growth if moisture is available.

Crested wheatgrass is palatable to livestock and some wildlife. Livestock and wildlife will graze crested wheatgrass throughout the spring growing season until it becomes too coarse, and again in fall if re-growth occurs. Established stands can withstand very heavy grazing.

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 - 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 competitive with weedy species, but can be crowded out by some aggressive introduced weedy species and native woody species.

Crested wheatgrass is not recommended for hay production, as it is best suited to grazing use. Light, infrequent applications of nitrogen (25 pounds/acre) and light irrigation will increase total biomass production and lengthen the growing period. Re-growth of crested wheatgrass is generally poor.

Environmental Concerns

Crested wheatgrass is long-lived and spreads primarily via seed. Spread of rhizomatous varieties is very slow in the case of 'Roadcrest' and 'Ephraim'. They are not considered "weedy" or invasive species. Most seedings do not spread beyond original plantings. They will cross with each other, but do not cross with native species.

Crested wheatgrass resists cheatgrass competition better than most native species, because it germinates earlier and grows more rapidly at colder temperatures. This is an important competitive advantage when dealing with winter annual species, such as cheatgrass and medusahead rye.

Properly managed (grazed) stands of crested wheatgrass generally exclude native grasses and forbs. When inter-seeded into native stands, crested wheatgrass commonly co-exists with native grasses, forbs and shrubs. Some native shrubs, such as big sagebrush and rabbitbrush often invade crested wheatgrass stands if native seed sources are nearby.

Crested wheatgrass has commonly been planted in monoculture (single species) stands in the past and because of this; some people feel crested wheatgrass is not appropriate for use. <u>It is important to consider this opinion and to plant multiple species mixes to avoid this perception.</u>

Seed Production

Seed production of crested wheatgrasses has been very successful under cultivated conditions. Row spacing of 24 to 36 inches under irrigation and 36 inches under dryland conditions (14 inches plus annual precipitation) are recommended. 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, fall plantings are not recommended.

Control weeds during stand establishment and for long term management of stand by clipping, hand rouging 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 nitrogen and phosphorus are low, an application of 10-15 pounds per acre nitrogen and 20-30 pounds per acre phosphorus 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. Very early spring application of nitrogen may be beneficial on sandy soils to promote vegetative growth. When irrigated, apply adequate moisture for germination, establishment, and to bring soils to field capacity. Following stand establishment, fertilize and irrigate soon after seed harvest in fall to stimulate seed head primordia development for the subsequent crop. Do not stress plants during re-growth and tillering in the fall, late boot stage, and during pollination. Avoid sprinkler irrigation during flowering.

Seed fields are productive for four to five years. Average production of 150 to 200 pounds per acre can be expected under dryland conditions in 14 inch plus rainfall areas. Average production of 500 to 700 pounds per acre can be expected under irrigated conditions. 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 wind-rowing 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 is available through the appropriate state Crop Improvement Association or commercial sources to grow certified seed.

***Agropyron cristatum* - Fairway Type** is not as drought tolerant as standard crested wheatgrass or Siberian wheatgrasses. They are adapted to the Northwest, Intermountain, and Great Plains regions with at least 10 inches of annual precipitation. They do well on shallow to deep, moderately coarse to fine textured, moderately well to well drained and weakly acidic to moderately alkaline (saline and sodic) soils. Under alkaline conditions, vigor and production are reduced. The Fairway type was first recognized in 1950 as being different than other crested types. Fairway is shorter, denser, finer stemmed, and less productive than standard crested wheatgrass at lower elevations and production may exceed standard crested wheatgrass production at higher elevations. Cultivars include the following:

'Douglas' PVP was selected by 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 wheatgrass cultivars 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 13-14 inches 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 selected by the Forest Service Shrub Science Laboratory in Provo, Utah and Utah Division of Wildlife Resources 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. It is weakly rhizomatous, with rhizomes being expressed at higher precipitation zones above 14 inches. 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. Breeder and Foundation seed is maintained by Aberdeen PMC.

'Parkway' was selected by the Canada Department of Agriculture, Research Station, Saskatoon, Saskatchewan 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' PVP was selected by ARS in Logan, Utah and released in 1998. It is a long-lived perennial, and is significantly more rhizomatous than Ephraim, the only other somewhat rhizomatous crested wheatgrass cultivar. Roadcrest is recommended for use along roadsides or similar low-maintenance turf application areas in 10 inch and

higher rainfall areas. Certified seed is available. ARS in Logan, Utah maintains Breeder seed and Foundation seed is commercially produced.

'Ruff' was selected by 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.

***Agropyron desertorum* - Standard Type** is more drought tolerant than fairway crested wheatgrass. It is not as drought tolerant as Siberian wheatgrass. Standard crested wheatgrass is adapted to the Northwest, Intermountain and Great Plains regions with at least 9 inches of annual precipitation below 6500 feet elevation. It does well on shallow to deep, moderately coarse to fine textured, moderately well to well drained and weakly acidic to moderately alkaline soils. Under saline conditions, vigor and production are reduced. It is considered slightly more saline tolerant and more productive than fairway wheatgrass. The following cultivars are Standard crested wheatgrasses:

'Nordan' was selected by ARS at the Northern Great Plains Research Laboratory, Mandan, North Dakota. ARS and ND Agricultural Experiment Station released Nordan in 1953. It is uniform, erect, with heavy seeds that are awnless. The seed heads are dense and compressed. It 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 Western Siberian Experiment Station, Omsk, former USSR. Canada Department of Agriculture released it in 1953. It is considered very similar to 'Nordan'. Certified seed is available. The Canada Department of Agriculture, Saskatoon, Saskatchewan, maintains Breeder and Foundation seed.

Agropyron cristatum* × *Agropyron desertorum is a hybrid cross, which results in a plant with excellent seedling vigor. The following cultivars are hybrid crosses and considered similar to Standard crested wheatgrass:

'CD-II' PVP was released by 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. ARS in Logan, Utah maintains Breeder seed and Foundation seed is commercially produced.

'Hycrest' was developed by ARS in Logan, Utah by crossing Fairway and Standard crested wheatgrasses. ARS, NRCS, and Utah Agricultural Experiment Station released it 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 it is equal to standard crested wheatgrass. The leaves and stems are coarser and it has more stems than Fairway. Good stands have been established in the 9 inch or greater precipitation zones. It is best adapted to 5,000 to 9,000 feet elevation zones, but good stands are common to elevations as low as 2,500 feet. 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 'CD-II' has replaced Hycrest.

Jeanne M. Janish
Cronquist et al. (1977)

References

Alderson, J. & W.C. Sharp 1994. *Grass varieties in the United States*. Agriculture Handbook No. 170. USDA, SCS, Washington, D.C.

Cronquist, A., A. H. Holmgren, N. H. Holmgren, J. L. Reveal, & P. K. Holmgren 1977. *Intermountain flora*. Vol. 6. The New York Botanical Garden. Columbia University Press, New York, New York.

Harrison, R.D., N.J. Chatterton, R.J. Page, M. Curto, K.H. Asay, K.B. Jensen, & W.H. Horton 1996. *Competition, biodiversity, invasion, and wildlife use of selected introduced grasses in the Columbia and Great Basins*. Utah Agricultural Experiment Station, Research Report 155, Utah State University, Logan, Utah. Version: 000418. <http://agx.usu.edu/agx/ResearchReports/USDAREPORT/toc.html>.

Hitchcock, A. S. 1951. *Manual of the grasses of the United States*. USDA, Washington, DC.

Jensen, K.B., D.A. Johnson, K.A. Asay and K.C. Olson. 2001. *Seasonal-accumulated growth and forage quality of range grasses for fall and winter grazing.* Utah Agricultural Experiment Station, Journal Paper 7297, Utah State University, Logan, Utah. Version: 000418.

Tsvelev, N.N. 1983. *Grasses of the Soviet Union. Part I*. Oxonian Press Pvt. Ltd., New Dehli. *Translation of*: Zlaki SSSR, Fedorov, A.A. (Ed.) 1976. Nauka Publishers, Leningrad Section, Leningrad.

USDA, Forest Service 1996. *Fire effects information system*. Version: 000417. <http://www.fs.fed.us/database/feis/>. Rocky Mountain Research Station, Fire Sciences Laboratory, Missoula, Montana.

USDA, NRCS 2000. *The PLANTS database*. Version: 000417. <http://plants.usda.gov>. National Plant Data Center, Baton Rouge, Louisiana.

Prepared By

Daniel G. Ogle, Plant Materials Specialist
USDA, NRCS, Idaho State Office, Boise, Idaho.

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

Dr. Kevin B. Jensen, USDA-ARS, Forage and Range Research Laboratory, Utah State University, Logan, Utah

Species Coordinator

Daniel G. Ogle, Plant Materials Specialist
USDA, NRCS, Idaho State Office, Boise, Idaho.

Edited 17jan01 jsp; 18set02 lsj; 24jan03 kbj; 03febo3 dgo

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

United States Department of Agriculture
NRCS Natural Resources Conservation Service
Plant Guide

INTERMEDIATE WHEATGRASS

Thinopyrum intermedium (Host) Barkworth & D.R. Dewey

plant symbol = THIN6

Contributed By: USDA, NRCS, Idaho State Office

Hitchcock (1950)

Alternate Names

Intermediate wheatgrass*: Agropyron intermedium, Elytrigia intermedia*

Pubescent wheatgrass: *Agropyron trichophorum, Thinopyrum intermedium* ssp. *barbulatum*

Uses

Grazing/pastureland/hayland: This is an introduced species used for hay and pasture in the northern Great Plains, west to central Washington, and south into Colorado, Kansas, and northern New Mexico and Arizona.

It produces good hay yields, both in monoculture and in mixtures with alfalfa (*Medicago* spp.), where its stiff stems tend to keep alfalfa from lodging.

Intermediate wheatgrass has fairly slow re-growth following clipping and is best adapted to single crop-haying situations (where rainfall patterns or limited irrigation prevents multiple cuttings in a season). Intermediate wheatgrass responds very well to irrigation with initial production nearing the level of orchardgrass (*Dactylis glomerata*) and meadow brome (*Bromus biebersteinii*) and exceeding smooth brome (*Bromus inermis*) under full irrigation. Meadow brome and orchardgrass have much better regrowth characteristics and will normally produce more than intermediate wheatgrass for hay production in multiple cutting situations.

Intermediate wheatgrass responds very well to limited irrigation. It is able to tolerate droughty conditions when irrigation ceases as long as about 12-14 inches or more total annual moisture is provided. It provides excellent spring, early summer, and fall pasture, but must be carefully managed to ensure maintenance of the stand and high production.

Intermediate wheatgrass is palatable to all classes of livestock and wildlife. It is a preferred feed for cattle, sheep, horses, deer, antelope, and elk in spring, early summer and fall. It is considered a desirable feed for cattle, sheep, horses, and elk in summer and winter.

Erosion control/reclamation: Intermediate wheatgrass is well adapted to the stabilization of disturbed soils. This grass can be used in critical and urban areas where irrigation water is limited and to stabilize ditchbanks, dikes, and roadsides. This grass can also be use to build soils because of its heavy root production. Levels as high as 7000 pounds (dry weight) per acre of root production in the upper 8 inches of soil have been measured in five-year-old stands.

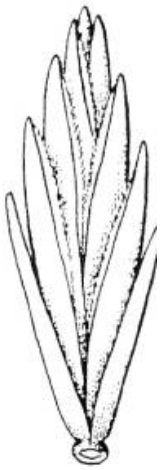
Wildlife: Strips of intermediate wheatgrass left ungrazed provide good nesting cover for game birds and migratory waterfowl.

Status
Consult the PLANTS Web site and your State Department of Natural Resources for status, such as state noxious status and wetland indicator values.

Description
General: Grass Family (Poaceae). As one of the common names implies, the spikes, spikelets, glumes, lemmas, and leaves of what once was considered pubescent wheatgrass are densely covered with hairs, whereas intermediate wheatgrass has vegetative structures which are for the most part smooth, but may have ciliate hairs on the leaf margins. The previously recognized separate species of intermediate and pubescent wheatgrass are now recognized as one species, *Thinopyrum intermedium*.

Intermediate wheatgrass grows to 3 to 4 feet tall. It is a long-lived, cool season grass with short rhizomes and a deep feeding root system. The seed spikes may be up to 4 to 8 inches long. Leaves are 4-8 mm wide and green to blue-green in color and sometimes drooping. The lemmas, paleas, and glumes are smooth to pubescent. The glumes are acute to blunt, generally five nerved, and awnless to awn tipped. There are usually fewer than seven florets. Commercial seed of Intermediate wheatgrass often contains both pubescent and glabrous forms.

Distribution
Intermediate wheatgrass is a perennial grass introduced in 1932 from Europe and Asia. Included in this group is a form that was known as pubescent wheatgrass (*Agropyron trichophorum*), which was introduced in 1934 from Europe and Asia and considered slightly more drought tolerant and winter hardy. For current U.S. distribution, please consult the Plant Profile page for this species on the PLANTS Web site.


Hitchcock (1950)

Adaptation
Intermediate wheatgrass is adapted to areas with 12 to 14 inches of annual rainfall or greater. The pubescent form can tolerate slightly more droughty conditions to 11 or 12 inches of rainfall. It performs best between 3500 and 9000 feet elevation. It can be seeded at lower elevations, but moisture requirements are greater. It is not as drought tolerant as crested wheatgrass (*Agropyron desertorum* and *A. cristatum)*, Siberian wheatgrass (*Agropyron fragile)* or Russian wildrye (*Psathyrostachys juncea*).

The glabrous form of Intermediate wheatgrass prefers well drained loamy to clayey textured soils. It will tolerate slightly acidic to mildly saline conditions, is cold tolerant, can withstand moderate periodic flooding in the spring, and is very tolerant of fire. The pubescent form performs best on loamy to sandy to shallow soils and can tolerate lower fertility, more alkaline soils, higher elevations, and drier conditions than the glabrous form. It performs poorly on wet, poorly drained, and moderately saline to alkaline soils with prolonged inundation.

Establishment
Planting: It should be seeded with a drill at a depth of 1/2 inch or less on medium to fine textured soils and no more than 1 inch deep on coarse textured soils. Recommended seeding rate is 8 pounds Pure Live Seed (PLS) per acre or 15 PLS seeds per square foot.

A firm weed free seedbed enhances stand establishment. It is compatible with other species, particularly alfalfa (*Medicago* spp.). In a mixture with alfalfa, stand longevity and productivity is often enhanced. If used as a component of a mix, adjust seeding rates to percent of mix desired. The best dryland results are obtained from seeding in very early spring on heavy to medium textured soils and in late fall (dormant) on medium to light textured soils. Irrigated lands should be seeded in spring through summer. Late summer (August - mid September) seedings are not recommended unless irrigation is available.

For mine lands, roadsides, and other harsh critical areas, the seeding rate should be increased to 16 pounds PLS per acre or 30 PLS seeds per square foot.

Intermediate wheatgrass establishes fairly quickly. Establishment is quicker than meadow brome or smooth brome varieties. Seedling vigor is good to excellent. Under favorable conditions intermediate wheatgrass provides good weed suppression. It makes good spring growth, fair summer growth, and good fall growth, if moisture is available. Light, frequent irrigation is beneficial for stand establishment.

Protect a new seeding until it is fully established and the plants are able to withstand pulling by grazing animals without being uprooted. It is beneficial to cut at least one hay crop prior to grazing.

Stands may require weed control measures during establishment. Application of 2,4-D should not be made until plants have reached the four to six leaf stage (be sure to read and follow label directions). Mow weeds at or prior to their bloom stage. Grasshoppers and other insects may also damage new stands and pesticides may be needed for control.

Management

Intermediate wheatgrass is highly palatable to livestock and wildlife. Livestock and wildlife will graze it throughout the growing season, but it is most preferred as forage in spring, early summer, and fall. A healthy, productive stand will not withstand heavy continuous grazing. Stands of intermediate wheatgrass are not as susceptible to spring and fall freezing as smooth brome, meadow brome, or orchardgrass.

Rush intermediate wheatgrass
Loren St. John
USDA-NRCS, Aberdeen, Idaho

Ten to twelve inches of new growth should be attained in spring before grazing is allowed on established stands. A six-inch stubble height should be maintained following grazing or mowing and going into winter. In pasture tests, stands consistently out-yield other grass-legume mixtures. For this reason, stocking rates can be set higher than other grasses. Care should be taken to allow proper rest of at least 21 to 28 days between grazing periods under irrigated and high moisture situations.

When planted with a legume, harvest hay at optimum stage for the legume. This will allow the grass to be harvested prior to flowering and result in very high quality hay. Harvest pure stands of intermediate wheatgrass for hay when plants start to flower.

Apply nitrogen as needed to maintain vigorous growth. Irrigated seedings and those in higher rainfall zones (18 inches +) will respond well to annual applications of 40 or more pounds of available nitrogen per acre during the establishment year and 70 to 90 pounds per acre each fall after establishment. A balance of nitrogen and phosphate fertilizer needs to be considered in order to maintain a legume component in a mixture. A soil test is recommended.

Forage production can be restored and stands may benefit from ripping if sodbound conditions occur. Care should be taken to avoid excessive tillage because stands may be damaged.

Environmental Concerns

Intermediate is long-lived (50+ years), spreads slowly vegetatively, and very little via seed distribution. It is not considered a "weedy" or invasive species, but can spread into adjoining vegetative communities under ideal climatic and environmental conditions. Research indicates that most seedings do not spread from original planting sites. It is known to coexist with native plants. On favorable sites where it is best adapted, it can maintain dominance and exist as a monoculture. There is no documentation that it crosses with native species.

Seed Production

Seed production of intermediate wheatgrass is generally not difficult. If fields are maintained in rows and adequate fertility levels are maintained, seed can be produced for 7 to 10 years. Row spacing of 36 inches dryland (areas with a minimum of 14 inches annual precipitation) and 24 to 36 inches irrigated are recommended. Intermediate wheatgrass is rhizomatous and to maintain seed production it should be maintained in row culture. Cultivation is required to maintain rows.

Average production of 250 to 350 pounds per acre can be expected under dryland conditions. Average production of 450 to 550 pounds per acre can be expected under irrigated conditions. Seed yields drop significantly after about four years of production. Harvesting is best completed by swathing, followed by combining of the cured rows. The seed heads will shatter when mature and if direct combining is desired the stand should be harvested when the top of

seed heads just begin to shatter. Harvested seed must be dried to 12 percent moisture before storing in bins and to 15 percent before storing in sacks. Seed is generally harvested in mid to late August.

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

Certified seed of many cultivars in the following discussion are available through the appropriate state Crop Improvement Associations or from commercial sources.

'Amur' intermediate wheatgrass was selected from seed originally obtained from China by the Pullman PMC and transferred to the Los Lunas PMC, New Mexico and released by the PMC, New Mexico AES and University Park in 1952. It was selected for leafiness, vigorous growth, strong seedling vigor, and good seed production. It is a slow sod former. It was originally released for revegetation of disturbed lands and for pasture seedings at higher elevations. Introgression has occurred resulting in a high percentage of pubescent types over the years. Certified seed stock is no longer available. It has been replaced by other varieties, which are more widely adapted and/or better producers. It is not readily utilized in the northern U.S.

'Chief' intermediate wheatgrass was selected from seed originating in Russia by the Agriculture Canada Research Station in Saskatoon, Saskatchewan and was released in 1961. It was selected for high seed yield and forage quality. Its intended uses are as a grass component in grass-alfalfa hay mixtures and for short-term pasture that remains productive for about five years under heavy grazing pressure. Certified seed is available and Agriculture Canada maintains Breeder seed.

'Clarke' intermediate wheatgrass was selected from seed originating in Russia by the Agriculture Canada Research Station and was released in 1980. It was selected for drought tolerance, winter hardiness and high seed yields. It's intended uses are for hay and pasture either dryland or irrigated in the northern Great Plains of Canada and the U.S. Certified seed is available and Agriculture Canada maintains Breeder seed.

'Greenar' intermediate wheatgrass was selected from seed originating in Russia by Pullman PMC and was released by Idaho-Oregon-Washington AES and the PMC as P-2327 in 1945. Aberdeen and Pullman Plant Materials Centers named it in 1956. It was selected for vigor, moderate sod formation, leafy, broad-leafed, late maturing, and high production. Its intended use is for hay and pasture. Certified seed is no longer available.

'Greenleaf' pubescent wheatgrass was selected from seed originating from unknown European or Asian sources. Commercial seed sources in Washington and North Dakota were utilized by the Agriculture Canada Research Station to develop this cultivar and it was released in 1966. It has higher forage yields than 'Topar' and improved seedling vigor over 'Mandan 759'. It was intended for use as a winter hardy plant for pasture and hay production. Stands will not maintain high productivity under continuous heavy grazing. Certified seed is available and Agriculture Canada maintains Breeder seed.

'Luna' pubescent wheatgrass was selected from seed originating in Russia and Turkey by the Los Lunas PMC and was released by the New Mexico AES and PMC in 1963. It was selected for excellent seedling vigor, fast establishment and good forage production. Luna is one of the most broadly adapted pubescent wheatgrasses available and performs well from the central to northern Great Plains to the northern Rockies and Sierra Nevada regions. Certified seed is available and Breeder seed is maintained by the Meeker PMC.

'Manska' pubescent wheatgrass was selected from seed originating in Russia by the Great Plains Research Laboratory. It traces to 11 separate commercial lots of 'Mandan 759' intermediate wheatgrass (no longer available). It was selected for improved vigor, resistance to leaf spot, high forage and seed production, and nutritional quality. High nutritional value is the primary advantage of 'Manska' over other pubescent wheatgrass cultivars. ARS, Bismarck PMC, University of Nebraska and North Dakota AES, released it in 1992. It is intended for use in grass alfalfa hay mixes and for pasture. Certified seed is available and the Great Plains Research Laboratory maintains Breeder seed.

'Oahe' intermediate wheatgrass was selected from seed originating in Russia by South Dakota AES, Brookings, South Dakota and was released in 1961. Named after the Oahe Dam on the Missouri River, it is an abbreviation for the Sioux word meaning "Big House." It was selected for its uniformly bluish-green color, drought tolerance, vigor, rhizomatous traits and high seed yields. Oahe is adapted for hay, pasture and conservation purposes. Certified seed is available and South Dakota State University maintains Breeder seed.

'**Reliant**' intermediate wheatgrass was selected from sources adapted to the Northern Great Plains region. It was developed by the Northern Great Plains Research Laboratory and released by ARS, North Dakota AES and Bismarck PMC in 1991. It was selected for resistance to leaf spot, improved vigor, forage, seed production, forage quality and winter survival. It is of medium height, late maturing and adapted for hay, pasture and conservation purposes. Persistence and sustained productivity under hayland management in mixes with alfalfa are the primary advantages of 'Reliant' over other intermediate wheatgrass cultivars. Certified seed is available and the Great Plains Research Laboratory maintains Breeder seed.

'**Rush**' intermediate wheatgrass was selected from seed originating from sources in Germany. It was selected by the Aberdeen PMC and released by the Idaho AES and Aberdeen PMC in 1994. It was selected for superior seedling emergence and vigor compared to other intermediate wheatgrasses, good spring recovery, good rate of spread by rhizomes, uniform seedheads, wide leaves, high forage production, and high seed production. It has the largest seed of intermediate wheatgrasses, averaging 66,000 seeds per pound. It is adapted for soil erosion control, roadside stabilization, mine spoil stabilization, hayland, and pastureland both dry and irrigated, and forage for livestock and wildlife. It is not adapted to hay mixtures with alfalfa. Certified seed is available and Breeder seed is maintained by Aberdeen PMC.

'**Slate**' intermediate wheatgrass was selected from seed originating from a derivative of 'Amur' and another experimental accession. It was developed by the Nebraska AES and ARS and was released in 1969. It was selected for strong rhizomatous spread, erect form, broad flat leaves, and slate green color. It is adapted for use in the central Great Plains region. Certified seed is available and Breeder seed is maintained by Nebraska AES and ARS.

'**Tegmar**' intermediate wheatgrass was selected from seed originating in Turkey. It was developed by Pullman PMC and was released by Idaho-Washington AES and Aberdeen and Pullman PMCs in 1968. It was selected for long life, late maturing, vigorous seedlings, rapidly developing rhizomes, drought tolerance and dwarf growth form. It is generally about half the height of other intermediate wheatgrasses. Intended for use in erosion control, roadside and ditch stabilization, dam stabilization and grassed waterways. Certified seed is available and Breeder seed is maintained by Aberdeen PMC

References

Alderson, J. & W.C. Sharp 1994. *Grass varieties in the United States*. Agriculture Handbook No. 170. USDA, SCS, Washington, D.C.

Barkworth, M.E. & D.R. Dewey 1985. *Thinopyrum intermedium*. American Journal of Botany 72:772.

Cronquist, A., A.H. Holmgren, N.H. Holmgren, J.L. Reveal, & P.K. Holmgren 1977. *Intermountain flora*. Vol. 6. The New York Botanical Garden. Columbia University Press, New York, New York.

Hitchcock, A.S. 1950. *Manual of the grasses of the United States*. USDA, Washington, DC.

International Plant Names Index 2000. *Thinopyrum intermedium*. <http://www.ipni.org>. Version: 000418. Harvard University, Cambridge, Massachusetts.

Powell, A.M. 1994. *Grasses of the Trans-Pecos and adjacent areas*. University of Texas Press, Austin, Texas.

USDA, Forest Service 1996. *Fire effects information system*. Version: 000418. <http://www.fs.fed.us/database/feis/>. Rocky Mountain Research Station, Fire Sciences Laboratory, Missoula, Montana.

USDA, NRCS 2000. *The PLANTS database*. Version: 000418. <http://plants.usda.gov>. National Plant Data Center, Baton Rouge, Louisiana.

Prepared By

Daniel G. Ogle, Plant Materials Specialist
USDA, NRCS, Idaho State Office, Boise, Idaho

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

Dr. Kevin B. Jensen, USDA-ARS, Forage and Range Research Laboratory, Utah State University, Logan, Utah

Species Coordinator

Daniel G. Ogle
USDA, NRCS, Idaho State Office, Boise, Idaho.

Edited 18sep00 jsp; 18sept02 lsj; 24jan03 kbj; 03feb03 dgo

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>.

United States Department of Agriculture
NRCS Natural Resources Conservation Service
Plant Guide

SIBERIAN WHEATGRASS

Agropyron fragile (Roth) Candargy

plant symbol = AGFR

Contributed By: USDA, NRCS, Idaho State Office

P-27 Siberian Wheatgrass
Loren St John
Aberdeen PMC

Alternate Names

Agropyron sibericum, Agropyron cristatum ssp. fragile, Agropyron fragile ssp. sibericum

Uses

Grazing/rangeland/hayland: Siberian wheatgrass is a perennial, introduced grass commonly seeded in the arid sections of the western United States. Siberian wheatgrass is commonly 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 growing season rainfall. It is considered a desirable feed for deer and antelope in spring and again in fall, if additional growth occurs. 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 decreases to about 4 percent when dormant. Digestible carbohydrates remain high throughout the active growth period. It is commonly utilized for winter forage by cattle and horses, but protein supplements are required to ensure good animal health. It is noted for its ability to withstand very heavy grazing pressure (65-70 percent utilization), once stands are established. Siberian wheatgrass produces good forage yields in the areas where it is best adapted and will generally produce from 1.5 to 2 times more forage than native grasses. Siberian wheatgrass is generally not recommended in areas with more than 14 inches of annual rainfall because better, alternative forage species are available.

Erosion control/reclamation: Siberian wheatgrass is well adapted for the stabilization of disturbed soils. It competes well with other aggressive introduced plants during the establishment period. Siberian wheatgrass is generally not compatible in mixes with native species, because it is very competitive and commonly out-competes slower developing native species. However, when seeded at low rates with native species, outstanding mixed stands including bluebunch wheatgrass, Snake River wheatgrass, Sandberg bluegrass and big bluegrass have been achieved.

Its drought tolerance, fibrous root system, and excellent seedling vigor make Siberian wheatgrass ideal for reclamation in areas receiving 8 inches or more annual precipitation. This grass 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.

Wildlife: Birds and small rodents eat Siberian wheatgrass seeds. Deer, antelope, and elk graze it, especially in spring and fall. Upland and songbirds utilize stands for nesting. Where it is planted as a monoculture, the resulting biodiversity is lower than that found in a diverse seeded or native plant community.

Status
Consult the PLANTS Web site and your State Department of Natural Resources for status, such as state noxious status and wetland indicator values.

Description
General: Grass Family (Poaceae). Siberian wheatgrass is a long-lived, cool season, drought tolerant, introduced, and winter hardy grass with an extensive root system. Related species include the following:) Fairway crested wheatgrass (*Agropyron cristatum),* Standard crested wheatgrass (*Agropyron desertorum*) and crested wheatgrass hybrid (*A. cristatum* x *A. desertorum*).

Siberian wheatgrass 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 and palatability later into the summer than either standard or fairway crested wheatgrass.

Adaptation
Siberian wheatgrass is adapted for non-irrigated seedings where annual precipitation averages 8-14 inches and where the frost-free period is generally less than 140 days.

On droughty sites with 8 to 10 inches annual precipitation, Siberian wheatgrass is an excellent choice. It is known to surpass fairway and standard crested wheatgrass in rate of establishment, stand persistence, and total forage yield on more arid sites (8 to 10 inches annual precipitation).

Siberian wheatgrass is well adapted to light-sandy, droughty soils. Siberian has been seeded in areas with as little as 5 inches of annual precipitation with some success. Siberian wheatgrass is cold tolerant and can withstand moderate periodic flooding, not exceeding 7-10 days in the spring. It is very tolerant of fire. It will not tolerate long periods of inundation-standing water, poorly drained soils, or excessive irrigation.

Distribution
This species was introduced from Asia and is naturalized from the Pacific coast to New York. For current distribution, consult the Plant Profile page for this species on the PLANTS Web site.

Establishment
Siberian wheatgrass should be seeded with a drill at a depth of 1/2 inch or less on medium to fine textured soils and 1 inch or less on coarse textured soils. The seeding rate recommended for Siberian wheatgrass is 6 pounds Pure Live Seed (PLS) per acre or 24 PLS seeds per square foot.
If used as a component of a mix, with alfalfa (*Medicago* spp.), sainfoin (*Onobrychis viciifolia*), yellow sweetclover (*Melilotus officinalis*), cicer milkvetch (*Astragalus cicer*) or others, adjust to percent of mix desired. For mine lands and other harsh critical areas, the seeding rate for Siberian wheatgrass should be increased to 12 pounds PLS per acre or 50 PLS seeds per square foot. Mulching and light irrigation on highly disturbed, droughty areas are beneficial for stand establishment.

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 - mid September) seedings are not recommended unless irrigation is available.

Siberian wheatgrass establishes quickly, with 'Vavilov' Siberian wheatgrass noted for seedling vigor. It should not be seeded with native species unless seeding rates are very low (generally < 2 pounds per acre) for Siberian wheatgrass. It may compliment native stands that are already partially established. Under favorable conditions it provides good weed competition.

Stands may require weed control measures during establishment, but application of 2,4-D should not be made until plants have reached the four to six leaf stage. Mow when weeds are beginning to bloom to reduce weed seed development. Grasshoppers and other insects may also damage new stands and use of pesticides may be required. Be sure to read and follow pesticide labels.

Management
Siberian wheatgrass produces new growth 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.

Siberian wheatgrass has good palatability for livestock and wildlife. Livestock and wildlife will graze Siberian wheatgrass throughout the spring growing season until it becomes too coarse, and again

in fall if re-growth occurs. Established stands can withstand very heavy grazing.

New stands of Siberian wheatgrass should not be grazed until they are firmly established and have started to produce seed heads. Six inches of new

P-27 Siberian wheatgrass
Loren St John
Aberdeen PMC

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 will result in a 10 to 14 day earlier growth period or "green-up" the following spring.

Siberian 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.

Siberian wheatgrass is competitive with weedy species, but can be crowded out by some aggressive introduced weedy species and native woody species.

Siberian wheatgrass is not recommended for hay production, but is more suited to dryland pasture use. Light infrequent applications of nitrogen (25 pounds/acre) and light irrigation will increase total biomass production and lengthen the growing period. Re-growth following grazing is generally poor.

Environmental Concerns
Siberian wheatgrass is long-lived and spreads primarily via seed. It is not considered "weedy" or an invasive species. Most seedings do not spread beyond original plantings. It does not cross with native species.

Siberian wheatgrass resists cheatgrass competition better than most native species, because it germinates earlier and grows more rapidly at colder temperatures than many other perennial grasses. This is an important competitive advantage when dealing with winter annual species such as cheatgrass.
Properly managed (grazed) stands of Siberian wheatgrass generally exclude native grasses and forbs. When inter-seeded into native stands, Siberian wheatgrass commonly co-exists with native grasses, forbs and shrubs. Some native shrubs, such as big sagebrush and rabbitbrush, often invade Siberian wheatgrass stands if native seed sources are nearby.

Due to commonly being planted in monoculture (single species) stands in the past, some feel Siberian wheatgrass is not ecologically appropriate. It is important to consider this opinion and to plant multiple species mixes to avoid this perception.

Seed Production
Seed production of Siberian wheatgrasses has been very successful under cultivated conditions. Row spacing of 24 to 36 inches when irrigated and 36 inches under dryland conditions (14 to 16 + inches annual precipitation) are recommended. Early spring or late fall seedings are recommended 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, fall plantings are not recommended in irrigated regions.

Control weeds during stand establishment and long term management of stand by clipping, hand rouging 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 nitrogen and phosphorus are

low, an application of 10-15 pounds per acre nitrogen and 20-30 pounds per acre phosphorus 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. Very early spring application of nitrogen may be beneficial on sandy soils to promote vegetative growth. When irrigated, apply adequate moisture for germination, establishment, and to bring soils to field capacity. Following stand establishment, fertilize and irrigate soon after seed harvest in fall to stimulate seed head primordia development for the subsequent harvest the following year. Do not stress plants during re-growth and tillering in the fall, late boot stage, and during pollination. Avoid sprinkler irrigation during flowering.

Seed fields are productive for four to five years. Average production of 150 to 200 pounds per acre can be expected under dryland conditions in 14 inch plus rainfall areas. Average production of 400 to 500 pounds per acre can be expected under irrigated conditions. 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 windrowing at hard dough stage and combining with pickup attachment about 5 to 7 days following windrowing operation. Seed is generally harvested in mid July to mid August.

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

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

Agropyron fragile **- Siberian wheatgrass** is similar to crested wheatgrass, but is considered more drought tolerant than fairway and standard crested wheatgrass. 'P27' and 'Vavilov' are Siberian wheatgrass varieties.

'P27' was selected by the Aberdeen and Pullman Plant Materials Centers from collections originating from Kazakhstan and was released in 1953 by NRCS, Aberdeen and Pullman PMCs, and Idaho Agricultural Experiment Station. The seed is awnless, has finer leaves, and retains greenness and palatability later into the summer than crested wheatgrass. It yields less and has poorer seedling vigor in higher rainfall areas than crested wheatgrass. It will yield more than crested wheatgrass varieties in low rainfall areas. It is best adapted to 8 inches and above annual precipitation and is noted for tolerating longer drought periods better than all other wheatgrasses once established. It is well adapted to light-sandy, droughty soils. Certified seed is available. Breeder and Foundation seed is maintained by Aberdeen PMC.

'Vavilov' was developed from collections originating from the former USSR, Turkey, and P-27 by ARS in Logan, Utah. ARS and the Utah Agricultural Experiment Station released it in 1994. Seedling vigor is similar to 'Hycrest' and 'CD-II' crested wheatgrass and it is consistently better than 'P-27'. It is more drought tolerant and better adapted to sandy soils than other crested wheatgrasses. It is best adapted to 8 inches and above annual precipitation and elevations below 7,000 feet. It is noted for tolerating longer drought periods once established than crested wheatgrass. It is expected that 'Vavilov' will eventually replace 'P-27' on the commercial seed market. Certified seed is available. ARS Logan, Utah maintains Breeder and Foundation seed.

References

Alderson, J. & W.C. Sharp 1994. *Grass varieties in the United States*. Agriculture Handbook No. 170. USDA, SCS, Washington, D.C.

Cronquist, A., A. H. Holmgren, N. H. Holmgren, J. L. Reveal, & P. K. Holmgren 1977. *Intermountain flora*. Vol. 6. The New York Botanical Garden. Columbia University Press, New York, New York.

Harrison, R.D., N.J. Chatterton, R.J. Page, M. Curto, K.H. Asay, K.B. Jensen, & W.H. Horton 1996. *Competition, biodiversity, invasion, and wildlife use of selected introduced grasses in the Columbia and Great Basins.* Utah Agricultural Experiment Station, Research Report 155, Utah State University, Logan, Utah. Version: 000418. <http://agx.usu.edu/agx/ResearchReports/USDAREPORT/toc.html>.

Hitchcock, A. S. 1951. *Manual of the grasses of the United States*. USDA, Washington, DC.

Jensen, K.B., D.A. Johnson, K.A. Asay and K.C. Olson. 2001. *Seasonal-accumulated growth and forage quality of range grasses for fall and winter grazing.* Utah Agricultural Experiment Station, Journal Paper 7297, Utah State University, Logan, Utah. Version: 000418.

Tsvelev, N.N. 1983. *Grasses of the Soviet Union. Part I*. Oxonian Press Pvt. Ltd., New Dehli. *Translation of*: Zlaki SSSR, Fedorov, A.A. (Ed.)

1976. Nauka Publishers, Leningrad Section, Leningrad.

USDA, Forest Service 1996. *Fire effects information system*. Version: 000417. <http://www.fs.fed.us/database/feis/>. Rocky Mountain Research Station, Fire Sciences Laboratory, Missoula, Montana.

USDA, NRCS 2000. *The PLANTS database*. Version: 000417. <http://plants.usda.gov>. National Plant Data Center, Baton Rouge, Louisiana.

Prepared By

Daniel G. Ogle, Plant Materials Specialist
USDA, NRCS, Idaho State Office, Boise, Idaho.

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

Dr. Kevin B. Jensen, USDA-ARS, Forage and Range Research Laboratory, Utah State University, Logan, Utah

Species Coordinator

Daniel G. Ogle, Plant Materials Specialist
USDA, NRCS, Idaho State Office, Boise, Idaho.

Edited 17jan01 jsp; 23septo2 lsj; 24jan03 kbj; 03feb03 dgo

United States Department of Agriculture
NRCS Natural Resources Conservation Service
Plant Guide

THICKSPIKE WHEATGRASS

Elymus lanceolatus spp. *lanceolatus* (Scribn. & J.G. Sm.) Gould

plant symbol = ELLAL

STREAMBANK WHEATGRASS

Elymus lanceolatus ssp. lanceolatus (Scribn. & J.G. Sm.) Gould

plant symbol = ELLAL

Loren St. John
NRCS, Idaho

Contributed By: USDA, NRCS, Idaho State Office

Alternate Names
Thickspike wheatgrass: *Elytrigia dasystachya*, *Agropyron dasystachyum*, Northern wheatgrass.

Streambank wheatgrass: *Agropyron riparium.*

Uses
Grazing/rangeland/hayland: Thickspike and streambank wheatgrasses are palatable to all classes of livestock and wildlife. They are a preferred feed for cattle, sheep, horses, and elk in spring and are considered a desirable feed for deer and antelope in spring. They are considered a desirable feed for cattle, sheep, horses, and elk in summer, fall, and winter. In the spring, the protein levels can be as high as 20 percent, decreasing to about 4 percent as the plant matures. Digestible carbohydrates remain about 45 percent throughout the active growth period. These species are generally relatively low forage producers, but can be utilized as native hay when planted in association with other species. They have been noted as one of the highest yielding forage producers in the Red Desert and Big Horn Basin of Wyoming.

They are best utilized as a component of a species mix for native pasture and rangeland.

Erosion control/reclamation: Both are well adapted to the stabilization of disturbed soils. They should not be planted with introduced grasses. They are very compatible with slower developing natives, such as Snake River wheatgrass (*Elymus wawawaiensis*), bluebunch wheatgrass (*Pseudoroegneria spicata*), and needlegrass *(Nassella and Hesperostipa* spp.). Their drought tolerance combined with rhizomes, fibrous root systems, and good seedling vigor make these species ideal for reclamation in areas receiving 8 to 20 inches annual precipitation. They are commonly used for reclamation in the Red Desert of Wyoming, where annual rainfall is 5 to 9 inches (50 - 70 percent growing season precipitation). Their low growth form, weak sod form, and low maintenance requirements make them ideal for stabilization and ground cover. These grasses can be used in urban xeriscape areas where irrigation water is limited. They provide ground cover for low maintenance lawns and stabilize ditchbanks, dikes, and roadsides.

Status
This is a native species. Consult the PLANTS Web site and your State Department of Natural Resources

for this plant's current status, such as state noxious status and wetland indicator values.

Description
General: Grass Family (Poaceae). These are perennial, weakly rhizomatous grasses. They are long-lived, cool season natives with an extensive rhizomatous root system combined with a few deep roots.

Thickspike wheatgrass grows from 1 to 3 feet tall and under ideal conditions seed spikes may be 10 inches long. The auricles are pointed and semi-clasping. Leaves are 4-8 mm wide and green to blue-green in color. The lemmas, paleas, and glumes are generally pubescent.

Streambank wheatgrass has moderately short stems and seedheads and has no pubescence in the inflorescence.

Distribution
They are common to the northern Great Plains and Intermountain regions of the western United States. For current distribution of this species and its relatives, consult the Plant Profile page for this species on the PLANTS Web site.

Adaptation
Thickspike and streambank wheatgrass are similar to western wheatgrass in appearance, except they are not as coarse, their rhizomes are not as aggressive, and thickspike is somewhat greener in color. They are also more drought tolerant than western wheatgrass. In comparison to western wheatgrass, they "green up" and "head out" earlier and total biomass production is generally lower. Thickspike wheatgrass does better on medium to coarse-textured soils. Streambank wheatgrass is found on heavy to medium-textured soils. Western wheatgrass may be a better choice on heavy-textured soils if rainfall is high enough (> 14 inches annual precipitation). Thickspike and streambank wheatgrasses will tolerate slightly acidic and moderately saline conditions. They are cold tolerant, can withstand moderate periodic flooding in the spring, are moderately shade tolerant, and are very tolerant of fire. They will not tolerate long periods of inundation, poorly drained soils, or excessive irrigation.

On native sites, thickspike and streambank wheatgrasses are most abundant in the 8 to 20 inch annual precipitation zones. Seeded varieties do best with 8 to 20 inches of precipitation and have been successfully established in areas with as little as 5 inches of annual precipitation.

The natural geographic range of thickspike and streambank wheatgrass is from near sea level in the Great Plains region to 10,000 feet in the Rocky Mountains. Thickspike and streambank wheatgrass are very polymorphic and are commonly a component of the vegetation on such diverse sites as stabilized sand dunes in eastern Washington, glacial outwash fans in Montana, and loess (wind-blown silt loam) soils in southern Idaho. They are a component of many native-plant communities and generally occupy less than 10 percent of the overall composition by weight. An exception to this may be in Southern Idaho, and the Red Desert and Bighorn Basin of Wyoming, where for short periods following fire, particularly in juniper stands they may nearly dominate the site.

Species often associated with thickspike and streambank wheatgrass include the following: the big sagebrush (*Artemisia tridentata*) complex, juniper (*Juniperus* spp.), needlegrass, sand dropseed (*Sporobolus airoides*), prairie sandreed (*Calamovilfa longifolia*), bluebunch wheatgrass, Snake River wheatgrass, Sandberg bluegrass (*Poa secunda*), prairie junegrass (*Koeleria cristata*), Needle-and - Thread (*Nassella comata*), and Idaho fescue (*Festuca idahoensis*).

Establishment
Planting: This species should be seeded with a drill at a depth of 1/2 inch or less on medium to fine-textured soils and 1 inch or less on coarse-textured soils. Recommended single species seeding rate is 6 pounds Pure Live Seed (PLS) or 19 PLS seed per square foot. If used as a component of a mix, adjust to percent of mix desired. For mine lands and other harsh critical areas, the seeding rate should be increased to 38 PLS per square foot. Mulching and light irrigation are beneficial for stand establishment.

The best seeding results are obtained from seeding in very early spring on heavy to medium-textured soils and in late fall on medium to light-textured soils. Late summer (August - mid September) seedings are not recommended unless irrigation is available. Pre-chilling seed aids germination. Seedling vigor is good to excellent, exceeding that of western wheatgrass, but less than of crested wheatgrass (*Agropyron cristatum* and *Agropyron desertorum*).

Thickspike establishes more quickly than streambank and both establish more quickly than western wheatgrass. They are the most rapidly establishing native species except for slender wheatgrass (*Elymus trachycaulus*) and mountain brome (*Bromus marginatus*). They are compatible with other species

and can be used in seeding mixtures. They should not be seeded with strongly competitive introduced species. Under favorable conditions, they can provide good weed competition.

Stands may require weed control measures during establishment, but application of 2,4-D should not be made until plants have reached the four to six-leaf stage. Mow when weeds are beginning to bloom to reduce seed development. Grasshoppers and other insects may also damage new stands and the use of pesticides may be required. Be sure to read and follow pesticide labels.

Management

These grasses begin growth in the spring about 2 weeks after native bluegrass (*Poa* spp.) and about 3 weeks earlier than western wheatgrass. They make good spring growth, fair summer growth, and good fall growth if moisture is available.

Thickspike and streambank wheatgrass have good palatability for livestock and wildlife. Livestock and wildlife will graze thickspike and streambank wheatgrass throughout the growing season, until the plants become too coarse in late summer. Established stands can withstand fairly heavy grazing.

Stands should not be grazed until they are firmly established and have headed out. Six inches of new growth should be attained in spring before grazing is allowed in established stands.

These grasses are low-maintenance plants, requiring little additional treatment or care. However, on better sites stands may become sodbound and may need attention in the form of fertilization and moderate spring/fall deferment to renew productivity and vigor. Stands may also benefit from ripping if sod-bound conditions occur to increase forage production. Care should be taken to avoid excessive tillage because stands may be damaged. Both wheatgrasses are competitive with weedy species, but can be crowded out by aggressive introduced species.

Environmental Concerns

Thickspike and streambank wheatgrasses are long-lived, spreading primarily via vegetative means (rhizomes), but also via seed. They are not considered to be "weedy" or invasive species, but can spread into adjoining vegetative communities under ideal climatic and environmental conditions. Most seedings do not spread from original plantings, or if they do spread, the rate of spread is slow.

Seed Production

Seed production of thickspike and streambank wheatgrass has been very successful under cultivated conditions. Row spacing of 28 to 36 inches are recommended (although rhizomatous, they should be maintained in rows). Cultivation will be needed to maintain rows and extend the life of the seed production field.

Seed fields are productive for two to four years. Average production of 100 to 250 pounds per acre can be expected under dryland conditions in 14-inch plus rainfall areas. Average production of 200 to 400 pounds per acre can be expected under irrigated conditions. Harvesting is best completed by swathing, followed by combining of the cured windrows. The seed heads readily shatter and require close scrutiny of maturing stands. Seed is generally harvested in mid-July to mid-August.

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

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

'Bannock' thickspike wheatgrass was selected by the Aberdeen Plant Materials Center and released in 1995. It is a composite of collections from The Dalles, Oregon; Pocatello, Idaho; and Quincy, Washington. It is adapted to the Northwest and Intermountain regions where precipitation averages 8 inches or above. It prefers moderately deep loamy soils, but does grow in sandy to clayey soils. It is noted for rapid establishment, moderate sod formation, high forage production, and ability to survive and thrive under dry conditions. Certified seed is available and Breeder and Foundation seed is maintained by Aberdeen PMC.

'Critana' thickspike wheatgrass was selected by the Bridger Plant Materials Center and released in 1971. The original collection site was in north central Montana near Havre. It is drought tolerant, has good seedling vigor, and readily establishes on critically disturbed sites. It is especially good as a sand dune stabilization species. ‘Critana' is noted for its variable genetic expression. Certified seed is available and Bridger PMC maintains Breeder and Foundation seed.

'Schwendimar' thickspike wheatgrass was selected by the Pullman Plant Materials Center and released in 1994. It was collected on wind blown sands along the Columbia River near The Dalles, Oregon. It is

adapted to northwest sites with 8 inches or greater precipitation and is recommended primarily for quick stabilization of coarse-textured soils. Certified seed is limited and Breeder seed is maintained by Pullman PMC.

'Sodar' streambank wheatgrass was selected and released by the Aberdeen Plant Materials Center in 1954. The original collection was made in Grant County, Oregon. It features drought tolerance, excellent seedling vigor, vigorous rhizomes once established, and competitive ability against weeds. It is most commonly used for stabilization of critical sites. Certified seed is available and Breeder and Foundation seed is maintained by Aberdeen PMC.

References

Alderson, J. & W.C. Sharp 1994. *Grass varieties in the United States*. Agriculture Handbook No. 170. USDA, SCS, Washington, D.C.

Carlson, J.R. & M.E. Barkworth 1997. *Elymus wawawaiensis: a species hitherto confused with Pseudoroegneria spicata (Triticeae, Poaceae).* Phytologia 83:312-330.

Cronquist, A., A. H. Holmgren, N. H. Holmgren, J. L. Reveal, & P. K. Holmgren 1977. *Intermountain flora*. Vol. 6. The New York Botanical Garden. Columbia University Press, New York, New York.

Hitchcock, A. S. 1950. *Manual of the grasses of the United States*. USDA, Washington, DC.

Powell, A.M. 1994. *Grasses of the Trans-Pecos and adjacent areas*. University of Texas Press, Austin, Texas.

USDA, Forest Service 1996. *Fire effects information system*. Version: 000413. <http://www.fs.fed.us/database/feis/>. Rocky Mountain Research Station, Fire Sciences Laboratory, Missoula, Montana.

USDA, NRCS 2000. *The PLANTS database*. Version: 000413. <http://plants.usda.gov>. National Plant Data Center, Baton Rouge, Louisiana.

Prepared By

Daniel G. Ogle
USDA, NRCS, Idaho State Office
Boise, Idaho

Loren St. John
USDA, NRCS, Plant Materials Center, Aberdeen, Idaho

Larry K. Holzworth
USDA, NRCS, Montana State Office
Bozeman, Montana

Susan R. Winslow
USDA, NRCS, Plant Materials Center, Bridger, Montana

Dr. Thomas A. Jones
USDA, ARS, Forage and Range Laboratory, Logan, Utah

Species Coordinator

Daniel G. Ogle
USDA, NRCS, Idaho State Office
Boise, Idaho

Edited 19sep00 jsp; 16aug02 lkh; 16aug02 srw; 23sept02 lsj; 30sept02taj; 30oct02 dgo

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

United States Department of Agriculture
NRCS Natural Resources Conservation Service
Plant Guide

WESTERN WHEATGRASS

Pascopyrum smithii (Rydb.) A. Love

plant symbol = PASM

Contributed By: USDA, NRCS, Idaho State Office & the National Plant Data Center

Robert Mohlenbrock
USDA, NRCS, Wetland Science Institute
@ PLANTS

Alternate Names
Agropyron smithii, *Elytrigia smithii*, bluestem wheatgrass, bluejoint wheatgrass.

Uses
Grazing/rangeland/hayland: Western wheatgrass is palatable to all classes of livestock and wildlife. It is a preferred feed for cattle, horses, deer, and elk in spring and is considered a desirable feed for sheep and antelope in spring. It is considered a desirable feed for cattle, horses, and elk in summer, fall and winter. In spring, the protein levels can be fairly high and decreases as it matures and cures out. This species is generally a relatively low yielding forage producer, but can be utilized as native hay, especially when harvested in overflow or run in sites that collect additional moisture.

Erosion control/reclamation: Western wheatgrass is well adapted to stabilization of disturbed soils because of its strong spreading rhizomes. It should not be planted with aggressive introduced grasses, but is very compatible with slower developing natives such as bluebunch wheatgrass (*Pseudoroegneria spicata*), thickspike wheatgrass (*Elymus lanceolatus* ssp. *lanceolatus*), streambank wheatgrass (*Elymus lanceolatus* ssp. *psammophilus*), and needlegrass species (*Nassella* spp., *Stipa* spp., and *Ptilagrostis* spp.).

Its relatively good drought tolerance combined with strong rhizomatous root systems and adaptation to a variety of soils make this species ideal for reclamation in areas receiving 12 to 20 inches annual precipitation. Its low growth form, vigorous sod, and low maintenance requirements make it ideal for ground cover purposes. This grass can be used in urban areas where irrigation water is limited to provide ground cover and to stabilize ditchbanks, dikes, and roadsides.

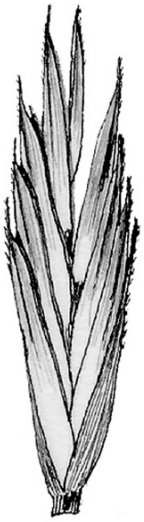
Status
This is a native species. Consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status such as state noxious status and wetland indicator values.

Description
General: Grass Family (Poaceae). Western wheatgrass *Pascopyrum smithii* (Rydb.) A. Love is perhaps one of the best known and most common of our native grasses. It is long-lived with an extensive, very strong, rhizomatous root system combined with a few deep roots.

Stems arise singly or in small clusters and grow from 1 to 3 feet tall. The sheaths are hairy and the purplish auricles are clawlike and clasp the stem. The seed spike is stiff, erect and about 2 to 6 inches long. The awn-tipped (to 5mm) lemmas, paleas and glumes are generally glabrous or short-hairy. The ligule is inconspicuous and leaves are flat, very rough on the upper surface and margins, blue-green in color, with very prominent veins. Because of this bluish color, western wheatgrass is sometimes called bluestem or bluejoint wheatgrass.

Distribution
It is a cool season perennial grass common to intermittent moist, sometimes saline to saline-sodic, medium to fine textured soils in the Great Plains, Southwest, and Intermountain regions of the western United States. For current distribution, consult the Plant Profile page for this species on the PLANTS Web site.

Adaptation
Western wheatgrass is similar to thickspike and streambank wheatgrasses in appearance. However, it is coarser textured, its rhizomatous trait is more aggressive, and its leaves are very rough on the upper surface and margins and coloration is blue-green rather than green. It is not as drought tolerant as thickspike or streambank wheatgrass. In comparison to thickspike and streambank wheatgrasses, it greens up and heads out later and total biomass production is generally greater. Thickspike and streambank wheatgrasses do better on medium to coarse textured soils. Streambank wheatgrass can be found on slightly heavy to medium textured soils. Western wheatgrass may be a better choice on heavy textured soils if rainfall is high enough. Western wheatgrass tolerates saline and saline-sodic soil conditions, poor drainage, and moderately severe drought. It will tolerate spring flooding, high watertables, and considerable silt deposition. It is very cold tolerant, moderately shade tolerant, and tolerant of fire if in the dormant stage. Recovery from fire however, is slow. It will not tolerate long periods of inundation.



B&W
Texas A&M Univ. (1997)

On native sites western wheatgrass is most abundant in the 10 to 20 inch annual precipitation zones. Seeded varieties do best with 12 to 20 inches of annual precipitation. The natural geographic range of western wheatgrass is from southern Ontario and northern Minnesota, west to British Columbia, and south to west central California and western Texas from 1000 to 9000 feet elevation. Western wheatgrass is a component of many native plant communities and grows in association with blue grama (*Bouteloua gracilis*), buffalograss (*Buchloe dactyloides*), needlegrasses (*Stipa* spp.), bluebunch wheatgrass (*Pseudoroegneria spicata*), rough fescue (*Festuca scabra*), Idaho fescue (*Festuca idahoensis*), prairie junegrass (*Koeleria cristata*), and basin wildrye (*Elymus cinereus*).

Establishment
Planting: Seed of western wheatgrass should be seeded with a drill at a depth of 3/4 to1/2 inch or less on medium to fine textured soils. Plant at 1/4 to 1/2-inch depth on heavy textured soils. Single species seeding rates recommended for western wheatgrass is 6 pounds Pure Live Seed (PLS) or 15 PLS per square foot. If used as a component of a mix, adjust to percent of mix desired. For mine lands and other harsh critical areas, the seeding rate should be increased to 12 pounds PLS or 30 PLS per square foot. Mulching and light irrigation is beneficial for stand establishment.

The best seeding results are obtained from seeding in very early spring on heavy to medium textured soils or in late fall on medium to light textured soils. Late summer (August - mid September) seedings are not recommended unless irrigation is available. It can also be established by transplanting sod. Seedling vigor is poor to fair; stands are generally slow to develop and may be non-existent the establishment year. However, good stands are typically achieved by the end of the fourth or fifth growing season. Poor germination accounts for the poor initial establishment and strong rhizome spread accounts for stand development in later years.

It is compatible with other adapted native species and can be used in seeding mixtures. It should not be seeded with strongly competitive introduced species. Under favorable conditions it can provide good weed control.

Stands may require weed control measures during establishment, but application of 2,4-D should not be made until plants have reached the four to six leaf stage. Mow above seedlings when weeds are beginning to bloom to reduce seed development. Grasshoppers and other insects may also damage new stands and use of pesticides may be required. Be sure to read and follow label directions.

Irrigation, weed control and fertilization will improve western wheatgrass stands and aid in establishment and overall production.

Management
Western wheatgrass "greens up" in March to early April and matures in mid-July to August. It makes good spring growth, fair summer growth and good fall growth if moisture is available.

Established stands can withstand heavy grazing. Rotational grazing systems on western wheatgrass are recommended and 40 to 50 percent of the annual growth (3 to 4 inch stubble) should remain following grazing. Stands of western wheatgrass should not be grazed until they have firmly established. Six inches of new growth should be attained in spring before grazing is allowed in established stands.

Western wheatgrass is a low maintenance plant requiring little additional treatment or care. However, on better sites, stands can become sodbound and may need fertilization and moderate spring/fall deferment. Sodbound stands may benefit from ripping which can increase forage production. Care should be taken to avoid excessive tillage, because stands may be damaged.

Once established, western wheatgrass is very competitive with weedy species. Its primary pests include grasshoppers, ergot, and stem and leaf rusts.

Environmental Concerns
Western wheatgrass is long-lived, spreads primarily via vegetative means (rhizomes) but may also spread via seed distribution. It is not considered "weedy", but can spread into adjoining vegetative communities under ideal climatic and environmental conditions.

Seed Production
Seed production of western wheatgrass has been very successful under cultivated conditions. Row spacing of 24 to 36 inches are recommended and although rhizomatous, it should be maintained in rows. Cultivation will be needed to maintain rows. In Montana, Rosana western wheatgrass is commonly grown in solid stands or narrower row spacing without inter-row cultivation, but seed yields and stand longevity can be reduced.

Seed fields are productive for three to five years. Average production of 75 to 150 pounds per acre can be expected under dryland conditions in 14 inch plus rainfall areas. Average production of 150 to 300 pounds per acre can be expected under irrigated conditions. Harvesting is best completed by direct combining or swathing in the hard dough stage, followed by combining of the cured windrows. Stands are prone to lodging and careful application of fertilizer and irrigation is recommended. Seed is generally harvested in late July to mid August.

Cultivars, Improved and Selected Materials (and area of origin)
Foundation and Registered seed is available through the appropriate state Crop Improvement Association or commercial sources to grow certified seed.

'Arriba' western wheatgrass was released for dryland hay production, grazing, and conservation seedings in the western part of the Central Great Plains and Southwestern United States. It was collected from native plants growing near Flagler, Colorado. Seed is commercially available and the USDA, NRCS Plant Materials Center, Meeker, Colorado maintain Breeder and Foundation seed.

'Flintlock' western wheatgrass is a broadbased cultivar derived from seed collections made in Kansas and Nebraska. It is recommended for conservation seeding, dryland hay production, and grazing in the Central Great Plains. Seed is commercially available.

'Barton' western wheatgrass was a native collection from clay bottomlands in central Kansas. It is a strongly rhizomatous, leafy accession with intermediate growth between the northern and southern types. Barton is high in forage and seed production. Commercial seed is available. Breeder and Foundation seed is maintained at the USDA, NRCS Plant Materials Center, Manhattan, Kansas.

'Rosana' western wheatgrass is a northern type collected in east central Montana near Forsyth. It was selected for seedling vigor and ease of establishment. Rosana is recommended for reseeding depleted rangelands and the reclamation of disturbed land in the Northern Great Plains and Intermountain regions. Rhizomes produce a tight sod. Seed is commercially available. Breeder and Foundation seed is maintained at the USDA, NRCS Plant Materials Center, Bridger, Montana.

'Rodan' western wheatgrass is a northern type originating from seed collected on the Missouri River bottom in central North Dakota. It was selected for drought-tolerance, leafiness, and forage vigor. It is moderately rhizomatous and forms dense swards. Leaves are thinner and less heavily veined than other released cultivars. It was developed by USDA, ARS, Northern Great Plains Research Center, Mandan, North Dakota, in cooperation with USDA, NRCS Plant Materials Center, Bismarck, North Dakota, and the North Dakota Agricultural Experiment Station.

Seed is commercially available. Breeder and Foundation seed is maintained at USDA, NRCS Plant Materials Center, Bismarck, North Dakota.

'Walsh' western wheatgrass was released by Agriculture Canada, Lethbridge, Alberta. It was selected for rhizome development, freedom from disease, and improved forage and seed yields. It is a northern type originating from seed collected in the Northern Great Plains of southern Alberta and Saskatchewan, Canada. Seed is commercially available.

References

Alderson, J. & W.C. Sharp 1994. *Grass varieties in the United States*. Agriculture Handbook No. 170. USDA, SCS, Washington, D.C.

Carlson, J.R. & M.E. Barkworth 1997. *Elymus wawawaiensis: a species hitherto confused with Pseudoroegneria spicata (Triticeae, Poaceae).* Phytologia 83:312-330.

Cronquist, A., A. H. Holmgren, N. H. Holmgren, J. L. Reveal, & P. K. Holmgren 1977. *Intermountain flora*. Vol. 6. The New York Botanical Garden. Columbia University Press, New York, New York.

Hitchcock, A. S. 1950. *Manual of the grasses of the United States*. USDA, Washington, DC.

Powell, A.M. 1994. *Grasses of the Trans-Pecos and adjacent areas*. University of Texas Press, Austin, Texas.

USDA, Forest Service 1996. *Fire effects information system*. Version: 000413. <http://www.fs.fed.us/database/feis/>. Rocky Mountain Research Station, Fire Sciences Laboratory, Missoula, Montana.

USDA, NRCS 2000. *The PLANTS database*. Version: 000413. <http://plants.usda.gov>. National Plant Data Center, Baton Rouge, Louisiana.

Prepared By

Daniel G. Ogle
USDA, NRCS, Idaho State Office, Boise, Idaho

John Scheetz
USDA, NRCS, National Plant Materials Program, Located at Bridger, Montana

Larry Holzworth
USDA, NRCS, Montana State Office, Bozeman, Montana

Loren St. John
USDA, NRCS, Plant Materials Center, Aberdeen, Idaho

Susan R. Winslow
USDA, NRCS, Plant Materials Center, Bridger, Montana

Species Coordinator

Larry Holzworth
USDA, NRCS, Montana State Office, Bozeman, Montana

Edited 05dec00 jsp; 16aug02 srw; 16aug02 lkh; 30sept02 js; 30sept02 dgo

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

United States Department of Agriculture
NRCS Natural Resources Conservation Service
Plant Guide

BASIN WILDRYE

Leymus cinereus (Scribn. & Merr.) A. Love

plant symbol = LECI4

Contributed By: USDA, NRCS, Idaho State Office & the National Plant Data Center

Hitchcock (1950)

Alternate Names
Giant wildrye, great basin wildrye, *Elymus cinereus*

Uses
Grazing/rangeland/hayland: Basin wildrye is generally not recommended for spring or summer utilization, because it has an elevated growing point and is easily damaged by overgrazing.

Basin wildrye is palatable to all classes of livestock and wildlife. It is a preferred feed for horses in spring and is considered a desirable feed for cattle, sheep, elk, deer, and antelope in the spring. It is considered a desirable feed for cattle and horses in early summer, late fall, and winter. It reaches its peak production in protein per acre from mid-June through August. Protein levels can be as high as 20 percent and decrease to about 7 to 8 percent protein as it matures and cures.

This species produces large amounts of forage and can be used as standing winter forage. Leaving 10 to 12 inches of stubble height will help reduce grazing damage. It is generally not recommended for haying, because it is difficult to harvest above its natural growing point. Once harvested by grazing or cutting, it produces little regrowth.

Basin wildrye is ideal for providing wind protection in winter calving pastures. It holds its nutrient value well at maturity (7-8% protein) and can withstand heavy grazing and trampling in its dormant state. Its tall stature and stiff stems make this forage accessible in areas of deep snow.

Erosion control/reclamation: Basin wildrye is well adapted to stabilizing disturbed soils. It should not be planted with aggressive introduced grasses. It is very compatible with slower developing natives such as Snake River wheatgrass (*Elymus wawawaiensis*), bluebunch wheatgrass (*Pseudoroegneria spicata*), thickspike wheatgrass (*Elymus lanceolatus* ssp. *lanceolatus*), streambank wheatgrass (*Elymus lanceolatus* ssp. *psammophilus*), western wheatgrass (*Pascopyrum smithii*), and needlegrass species (*Hesperostipa* spp. and *Nasella* spp.). Basin wildrye's drought tolerance, combined with its fibrous root system and fair seedling vigor, make it desirable for reclamation in areas receiving 8 to 20 inches annual precipitation. It is commonly used as a grass barrier to control wind erosion or blowing snow. It has also been planted on hilly cropland as a vegetative terrace for water erosion control.

Wildlife: Because basin wildrye is a tall upright bunchgrass, it is considered excellent cover habitat for small animals and birds, excellent nesting cover for upland birds, and excellent standing winter feed and cover for big game animals.

Status
Consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status, such as state noxious status and wetland indicator values.

Description
General: Grass Family (Poaceae). Basin wildrye is a large, coarse, robust, perennial bunchgrass, sometimes with short rhizomes. It is a long-lived cool-season native with an extensive, deep, coarse, fibrous root system.

Basin wildrye has long leaf blades (15 to 25 inches) and flat wide (up to 3/4 inch) leaves with long pointed auricles. The reproductive stems are dense, stout, and strongly erect. Seed heads are 6 to 10 inches long. Basin wildrye clumps may reach 3 feet in diameter and stand 3 to 6 feet tall (10 feet under excellent soil and climate conditions). Growing points are 10 to 12 inches above the crown.

Basin wildrye has fair seedling vigor. It is one of the first grasses to initiate spring growth and it produces an abundance of basal leaf growth until the development of seed heads in mid-June to mid-July. Following the development of seed heads, basin wildrye produces very little additional basal leaf growth and rapidly becomes coarse and stemmy. Regrowth does not occur following seed production.

Distribution
It is native to the western Great Plains and Intermountain regions of the western United States. For current distribution, please consult the Plant Profile page for this species on the PLANTS Web site.

Adaptation
Basin wildrye is very winter hardy and has a rather broad range of climatic adaptation. It can be found at elevations from 2000 up to 9000 feet. It grows best in areas with average annual precipitation of 8 inches to above 20 inches. 'Trailhead' seeded in areas with as low as 5 inches of rainfall has reproduced to populate areas around the original plots. In lower rainfall areas, basin wildrye grows in run-in areas, along gullies or watercourses, or near sites with high seasonal water tables. It does not tolerate areas with extended periods of inundation. It will tolerate short-term winter flooding. It is susceptible to leaf and stem rust in wetter climatic areas.

Basin wildrye has a broad soil texture adaptation, but it is not adapted to shallow soils. It is most common on deep soils with high water holding capacities.

It is tolerant of low to moderate levels (< 10 mmhos/cm3) of saline and (SAR < 15) sodic soil conditions and slightly acidic soils. Established stands of basin wildrye can tolerate long periods of drought, and it prefers cycles of wet winters and dry summers. It tolerates partial shading and wildfire if soil moisture is not too dry.

It does well as a pioneer plant and establishes seedlings in disturbed areas, such as recent road fills and areas disturbed by wildlife (ex. rodent diggings).

Species often associated with basin wildrye include the big sagebrush complex (*Artemisia tridentata*), juniper species (*Juniper* spp.), needlegrass species (*Hesperostipa and Nassella* spp.), bluebunch wheatgrass, Snake River wheatgrass, thickspike wheatgrass, streambank wheatgrass, Indian ricegrass (*Achnatherum hymenoides*), western wheatgrass (*Pascopyrum smithii*) and Idaho fescue (*Festuca idahoensis*).

Establishment
Planting: This species should be seeded with a disc or deep furrow drill at a depth of 1/4 to 3/4 inch on medium to fine-textured soils and 1 inch or less on coarse-textured soils. Single species seeding rate recommended for basin wildrye is 7 pounds Pure Live Seed (PLS) per acre or 21 PLS per square foot. If used as a component of a mix, adjust to percent of mix desired. For rangeland mixtures, basin wildrye should comprise approximately 10 to 20 percent of the seed mix or 1 to 2 pounds PLS.

For seeding mine lands and other harsh critical areas, the seeding rate should be doubled. When seeding is for a vegetative windbreak, vegetative terrace, or wildlife cover, it is recommended that 3.0 to 3.5 pounds PLS be seeded in 36 to 48-inch rows.

The best seeding results are obtained from seeding in very early spring on heavy to medium-textured soils and in late fall on medium to light-textured soils. Summer and late summer (July to mid September) seedings are not recommended. Seedling vigor is fair, and stands may take 2 to 5 years to fully establish.

Seed production stands may require weed control measures during establishment. Bromoxynil may be applied at the 3-4-leaf stage of grass for early suppression of young broadleaf weeds. Application of 2,4-D should not be made until plants have reached the 4-6-leaf stage. Mow above establishing seedlings when weeds are beginning to bloom will help to reduce weed seed development.

Grasshoppers and other insects may also damage new stands. Use of pesticides may be required. All herbicides and pesticides should be applied according to the label.

Management
Basin wildrye establishes slowly and new seedings should not be grazed until at least late summer or fall of the second growing season. Basin wildrye makes its initial growth in early spring and matures seed by late summer. It reproduces primarily by seed and tillers.

Basin wildrye is palatable to all classes of livestock and wildlife. New stands should not be grazed until plants are at least 10 inches tall. Overgrazing, especially in spring, severely damages basin wildrye, and stubble of at least 10 inches should remain following grazing.

Established stands can be grazed in late spring or fall (leave about 10 inches of stubble to protect plant health). Following grazing, little re-growth can be expected, even when the stand is irrigated. Basin wildrye is a low-maintenance plant requiring little additional treatment or care.

Environmental Concerns: Basin wildrye is long-lived and spreads primarily via seed distribution. It is not considered "weedy" or an invasive species, but can spread into adjoining vegetative communities under ideal climatic and environmental conditions. Most seedings do not spread from original plantings. If they do spread, the rate is slow. Basin wildrye accessions with the same chromosome number (28 or 56) will cross with each other but are not noted for crossing with other native species or basin wildrye genotypes of a different chromosome number.

Seed Production
Seed production of basin wildrye has been very successful under cultivated conditions. Row spacing of 36 inches (seeding rate 3.5 pounds PLS per acre) to 48 inches (seeding rate 3.0 pounds PLS per acre) are recommended. Cultivation will be needed for weed control and to maintain row culture.

For seed production, basin wildrye benefits from low levels of fertilization based on soil tests. Apply approximately 30 pounds actual N per acre on dryland plantings and 60 to 80 pounds actual N per acre on irrigated plantings for optimum production. Seed fields are productive for at least five to seven years. Average production of 150 to 200 pounds per acre can be expected under dryland conditions in 14-inch plus rainfall areas. Average production of 300 to 400 pounds per acre can be expected under irrigated conditions. Direct combining, leaving 24 to 30 inches stubble (to reduce handling of leaves and stems), is the preferred method to harvest basin wildrye. The seed heads have moderate rates of shatter and require close scrutiny of maturing stands to determine optimum harvest date. Seed is generally harvested from mid-August to September. Seed must be dried immediately after combining (12 percent bins / 15 percent sacks moisture content).

Cultivars, Improved and Selected Materials (and area of origin)
Foundation and registered seed is available through the appropriate state Crop Improvement Association or commercial sources to grow certified seed.

'Magnar' (*Leymus cinereus*) was originally collected by the Pullman, Washington, Plant Materials Center (PMC). It was selected by the Aberdeen, Idaho, PMC and released in 1979. It is a selection of vigorous plant types over several generations. It is adapted to the Northwest and Intermountain Regions of the Western United States where precipitation averages 8 inches or above. It has survived in plantings with 7 inches annual rainfall. It prefers deep clayey to loamy to sandy soils and can be found in weakly saline conditions. It is noted for blue foliage, fair seedling vigor and establishment, high forage production, good winter cover, fair winter forage, and ability to survive and thrive under very dry conditions. 'Magnar' is a 56-chromosome cultivar. Certified seed is available, and Breeder and Foundation seed is maintained by the Aberdeen PMC.

'Trailhead' (*Leymus cinereus*) was selected by the Bridger, Montana, PMC and released in 1991. The original collection site was near Roundup, Montana, in a sub-irrigated rangeland community. It is adapted to the Northern Great Plains and Intermountain Regions of the Western United States where precipitation averages 8 inches or above. It has survived in plantings with 5 inches annual rainfall. It was selected for its stand longevity and drought tolerance as compared to other basin wildrye accessions. It prefers deep clayey to loamy to sandy soils and tolerates weakly saline conditions. It is noted for green foliage, fair seedling vigor and establishment, high forage production, good winter cover, fair winter forage, and ability to survive and thrive under very dry conditions. 'Trailhead' is a 28-chromosome cultivar. Certified seed is available, and the Bridger PMC maintains Breeder and Foundation seed.

Washoe Germplasm basin wildrye (*Leymus cinereus*) is a Selected Class germplasm that was released in 2002. It was originally collected in Deer Lodge County, Montana near the old Washoe smelter stack south of Anaconda, Montana. Heavy metal and

sulfide fallout from historic copper smelting emissions has elevated heavy metal levels and decreased soil pH in the area. At the collection site arsenic, cadmium, copper, lead, and zinc levels range from moderate to high phytotoxic. Soil pH ranges from 4.6 to 5.6. Washoe Germplasm had better overall height, vigor, and survival compared to 'Magnar' and 'Trailhead' when tested in low pH and heavy metal contaminated soil. Bridger PMC maintains Generation (G) 0 and G1 seed.

References

Alderson, J. & W.C. Sharp 1994. *Grass varieties in the United States*. Agriculture Handbook No. 170. USDA, SCS, Washington, D.C.

Carlson, J.R. & M.E. Barkworth 1997. *Elymus wawawaiensis: a species hitherto confused with Pseudoroegneria spicata (Triticeae, Poaceae).* Phytologia 83:312-330.

Cronquist, A., A. H. Holmgren, N. H. Holmgren, J. L. Reveal, & P. K. Holmgren 1977. *Intermountain flora*. Vol. 6. The New York Botanical Garden. Columbia University Press, New York, New York.
Hitchcock, A. S. 1950. *Manual of the grasses of the United States*. USDA, Washington, DC.

Powell, A.M. 1994. *Grasses of the Trans-Pecos and adjacent areas.* University of Texas Press, Austin, Texas.

USDA, Forest Service 1996. *Fire effects information system*. Version: 000417. <http://www.fs.fed.us/database/feis/>. Rocky Mountain Research Station, Fire Sciences Laboratory, Missoula, Montana.

USDA, NRCS 2000. *The PLANTS database*. Version: 000417. <http://plants.usda.gov>. National Plant Data Center, Baton Rouge, Louisiana.

Prepared By

Daniel G. Ogle
USDA, NRCS, Idaho State Office, Boise, Idaho

Loren St. John
USDA, NRCS, Plant Materials Center, Aberdeen, Idaho

Larry K. Holzworth
USDA, NRCS, Montana State Office, Bozeman, Montana

Susan R. Winslow
USDA, NRCS, Plant Materials Center, Bridger, Montana

Dr. Thomas A. Jones
USDA, ARS, Forage and Range Laboratory, Logan, Utah

Species Coordinator

Daniel G. Ogle
USDA, NRCS, Idaho State Office, Boise, Idaho

Edited 19sep00 jsp; 31july02 lsj; 15aug02 lkh; 15aug02 srw; 30sept02 taj; 30sept02 dgo

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

United States Department of Agriculture
NRCS Natural Resources Conservation Service
Plant Guide

WINTERFAT

Krascheninnikovia lanata (Pursh) A.D.J. Meeuse and Smit

plant symbol = KRLA2

Northern Cold Desert Germplasm
Loren St. John, Aberdeen PMC

Contributed By: USDA, NRCS, Idaho State Office

Alternate Names
White sage, winter-sage, feather-sage, sweet sage, lambstail, *Eurotia lanata, and Ceratoides lanata*

Uses
Rangeland/Grazing – Winterfat is superior winter browse for livestock and wildlife. It is rated as excellent to good browse for cattle, sheep, and goats and fair browse for horses. It is one of the most valuable rangeland browse plants for maintaining the weight of adult animals on winter grazing ranges because of the high (>10 percent) crude protein content in winter.

Wildlife – Winterfat is considered very good browse for wildlife and is extensively utilized by rodents, rabbits, antelope, deer, elk, and bighorn sheep.

Erosion Control – Winterfat is a good erosion control plant when planted in a mixture to provide greater plant density. It has a deep taproot and an extensive fibrous root system near the soil surface, which helps stabilize soils. It germinates readily and provides fairly rapid growth under favorable growing conditions.

Reclamation – Winterfat is an important pioneer species and establishes fairly easily on drastically disturbed sites or poorly developed soils such as those commonly found on mine lands.

Status
Consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status such as, state noxious status and wetland indicator values.

Description
Winterfat (*Krascheninnikovia lanata* (Pursh) A.D.J. Meeuse and Smit is an erect to spreading, low-growing, long-lived half-shrub native to the western United States. It is a cool season plant, typically with a central woody stem arising from a woody crown. Annual secondary stems, 8 inches to 4 feet and sometimes taller, are herbaceous on dwarf forms and herbaceous to woody throughout on taller forms, wooly and branched. Winterfat has an extensive fibrous root system and a deep penetrating taproot.

Leaves are simple, alternate, mostly linear, and revolutely margined (rolled back from the margin). The inflorescence is a spike. Plants are monoecious with staminate flowers above the pistillate ones or occasionally they are dioecious. Pollination usually occurs between plants, but self-pollination may occur on monecious plants. Wind is the principal mode of pollination. The seed is a utricle and the seed coat is thin and covered with fine white, silky pilose hairs to ½ inch long.

Active growth begins in early to mid spring, flowering occurs from mid spring to early summer, and seed maturity is reached by mid to late fall. Winterfat has many common names including white sage, winter-sage, feather-sage, sweet sage, and lambstail.

Distribution
This plant is widely distributed from Saskatchewan and Manitoba, Canada to western Nebraska, Colorado, west Texas, California and Washington.

Adaptation
Winterfat is most common in the 7 to 16 inch annual precipitation zones, but has been found in areas with less than 6 inches of annual precipitation and in areas with greater than 20 inches annual precipitation. Winterfat is found from near sea level to 10,000 feet elevation. It occurs in salt desert shrub, pinyon juniper, sagebrush grass and near the edges of some forested plant communities.

Winterfat grows well on a wide range of soil textures, although it prefers more basic or limy soils. It tolerates moderate to highly saline conditions, but is not tolerant of acidic soils. It does not tolerate flooding or extended wet conditions. Refer to soil surveys and ecological site descriptions for additional guidance. It generally has good cold tolerance with some accessions (see Northern Cold Desert Germplasm and Open Range Germplasm) being more tolerant.

Establishment
Planting: Winterfat seed does not remain viable for extended periods and use of seed no older than two years is recommended. Winterfat seed may lose as much as 50 percent or more viability during the first year of storage. It is very important to have current germination test results for seed that is to be planted.

Dormant fall - winter or very early spring plantings result in the best stands. Studies indicate that winterfat seedlings can survive freezing temperatures and do well at cool temperatures, but growth is very slow during hot summer periods.

Winterfat utricles are covered with fine silky hairs that will not flow through a drill. . Debearded seed flows readily through a drill, but this seed (with hairs removed) may be viable for a shorter period of time than non-debearded seed.

Winterfat should be seeded on the soil surface to no deeper than ¼ inch. Broadcasting seed on snow or broadcasting on a moist firm soil surface followed by a packing operation results in the best stands. Drilling seed from 1/16 to ¼ inch deep using a drill with good depth control and packer wheels into firm soil also results in satisfactory stands.

When drill seeded alone to reclaim winterfat monoculture plant communities, 15 Pure Live seeds (PLS) per square foot (5.0 pounds PLS per acre) is recommended. If broadcast seeded, the seeding rate should be increased to 21 PLS seeds per square foot or 7.0 pounds PLS per acre.

When seeded as a component of a mix, 0.025 to 0.5 pound PLS per acre drilled or 0.05 to 1.0 pound PLS per acre broadcast is recommended. Seeding in alternate or cross rows promotes optimum establishment of winterfat. A seeding rate of 1/40 (0.025) pound PLS per acre will result in approximately 400 plants per acre under favorable establishment and growing conditions.

If winterfat is seeded in areas where annual weeds such as cheatgrass, medusahead rye, and/or tumble mustard are prevalent, it should be seeded in a mixture of adapted, vigorous native grasses following control practices such as tillage or herbicide treatment for the annual weeds.

Management
Winterfat has excellent tolerance to browsing during the winter. However, over-browsing has greatly reduced or eliminated it in some areas. No more than 25 percent of the annual season growth should be removed during the active growing period (less during active spring growth period) and no more than 50 percent of the annual season growth should be removed during dormant periods.

New plantings should be excluded from browsing by livestock and wildlife until plants are well established and producing seed.

Environmental Concerns
Winterfat is native, long-lived, and spreads by seed distribution. It is not considered "weedy", but could slowly spread into adjoining vegetative communities under ideal climatic and environmental conditions.

This species is well documented as having beneficial qualities and no negative impacts on wild or domestic animals.

Seed Production

Seed production fields can be established from transplants or by direct seeding. Establishing plants in a greenhouse and transplanting to the field will result in the most satisfactory stands for seed production. Plant spacing under transplant conditions should be 4 - 5 feet within row and a minimum of 5 feet between rows. Transplanting into weed barrier fabric can also improve plant establishment and seed production, weed control, and moisture conservation. Transplanting is recommended in the spring prior to hot summer temperatures. . Full seed production is usually reached the second to third year following transplanting.

Plantings can also be established by direct seeding. A minimum of 15 to 20 PLS seeds per linear foot of drill row should be planted. Hand seeding in late fall or very early spring may also be an option. Plant 5 to 10 seeds in a close group at desired spacing and thin to 1 or 2 plants after emergence. Full seed production may be reached the third to fourth year following direct seeding.

Winterfat requires an equivalent of 10 to 12 inches annual precipitation for seed production. Irrigation may only be needed for establishment. Expected seed yields may range from 200 to 400 pounds per acre. Fertilization is not generally recommended unless soil tests indicate severe nutrient deficiencies. Rabbits and rodents can damage stands and may destroy seedlings. Insects such as grasshoppers and Mormon crickets infrequently damage stands beyond recovery.

Harvesting seed is best accomplished by hand stripping. Mechanized harvesting has been used, but seed requires additional conditioning to properly dry and clean excessive trash (leaves, stems, other inert matter). Harvested seed is usually threshed by debearding or run through a hammermill to remove the fine silky hairs that cover the seed followed by screening. This process greatly enhances the ability of the seed to flow through planting equipment. Removing the white hairs that surround the seed can injure the seed resulting in reduced viability, seedling vigor, and stand establishment. One must be extremely careful when threshing seed to limit the amount of mechanical action on the seed to minimize seed damage. Unthreshed seed is recommended for best stand establishment if hand seeding directly or for transplants.

Viability of winterfat seed rapidly decreases after storage for 1 to 2 years even under the best storage conditions. Germination of fresh seed can be as high as 85 to 95 percent. Germination of seed 3 years or older is commonly below 25 percent. It is extremely important to have a current germination test for seed that will be planted. Seeds per pound will vary by accession, but averages 125,000 with bracts intact. Seed conditioned with a hammer-mill to remove bracts averages 200,000 seeds per pound.

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

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

'Hatch' winterfat was released in 1985 by the USDA-NRCS Los Lunas Plant Materials Center in cooperation with New Mexico, Colorado, Utah, and Idaho Agricultural Experiment Stations, USDA-Forest Service, and Utah Division of Wildlife Resources. Hatch was selected for improved seed production, germination, seedling vigor, and big game wildlife preference.

Hatch originated from the Hatch, Utah area at a site with 11 to 12 inches annual precipitation, 7300 feet elevation, and a mixed pinyon-juniper to mountain big sagebrush plant community. It performs well in New Mexico, Arizona, western Colorado, southern Utah, and southern Nevada. It is best adapted to upland sites and less adapted to arid desert shrub sites. Field plantings in the northern regions of the Great Basin and Intermountain West generally fail due to poor cold tolerance.

Northern Cold Desert Germplasm Selected Class winterfat was released in 2001 by the USDA-NRCS Aberdeen Plant Materials Center and Idaho Agricultural Experiment Station. Northern Cold Desert Germplasm winterfat was selected for improved cold hardiness and is better adapted to the northern regions of the natural range of winterfat.

Northern Cold Desert Germplasm winterfat is a composite of five accessions of winterfat. These accessions were selected from a collection of 45 accessions evaluated and found to be significantly more cold tolerant than others in the study. Source locations include a site southeast of Price, Utah; a site near Castledale, Utah; a site six miles east of Kanab, Utah; a site along Northfork Road in Washington County, Utah; and a site in Rio Blanco County, Colorado.

The Northern Cold Desert Germplasm winterfat is an erect shrub that can grow to 3 feet tall with a 2 feet diameter canopy cover. It is better adapted to the colder, northern portions of the Great Basin and Intermountain West than Hatch. It tolerates very dry conditions in the 7 – 14 inch annual precipitation zone. It is highly tolerant of alkaline/saline soils and soils derived from limestone parent materials. Uses include rangeland restoration, erosion control, and browse for livestock and wildlife.

Open Range Germplasm winterfat is a Tested Class germplasm released in 2002 by Bridger, Montana Plant Materials Center. It is a composite of three superior accessions from near Terry in Prairie County, Montana; near Bridger in Carbon County, Montana; and near Rawlins in Carbon County, Wyoming. Open Range Germplasm is adapted for use throughout the Northern Great Plains region including north-central U.S. and south-central Canada.

References

Stevens, R., Giunta, B., Jorgensen, K., Plummer, A. 1977. Winterfat (Ceratoides lanata) Publication No. 77-2 Utah Division of Wildlife Resources. Federal Project W-82-R 1977. 41pp.

Stevens, R., Jorgensen, K., Young, S., Monsen, S. 1996. Forb and Shrub Seed Production Guide for Utah. Utah State University Extension AG 501. 51pp.

Wasser, C. 1982. Ecology and Culture of Selected Species useful in Revegetating Disturbed Lands in the West. U.S. Dept. Int., fish Wildl. Serv. FWS/OBS-82/56. 347 pp.

Prepared By

Daniel G. Ogle, Plant Materials Specialist, USDA, NRCS, Boise, Idaho

Loren St. John, Team Leader, USDA, NRCS, Plant Materials Center, Aberdeen, Idaho

Larry Holzworth, Plant Materials Specialist, USDA, NRCS, Bozeman, Montana

Susan R. Winslow, Agronomist, USDA, NRCS, Bridger, Montana

Species Coordinator

Daniel G. Ogle, Plant Materials Specialist, USDA, NRCS, Boise, Idaho

Edited 05dec00 jsp; 16aug02 srw; 16aug02 lkh; 24sept02 lsj; 24sept02 dgo

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

Streambank Soil Bioengineering Field Guide for Low Precipitation Areas

Prepared by

Chris Hoag, Wetland Plant Ecologist, USDA-NRCS, Plant Materials Center, P.O. Box 296, Aberdeen ID 83210

And

Jon Fripp, Stream Mechanics Civil Engineer, USDA-NRCS, National Design, Construction, and Soil Mechanics Center, P.O. Box 6567, Fort Worth TX, 76115

December 2002

Plant Materials Center

NRCS

National Design, Construction, and Soil Mechanics Center

Streambank Soil Bioengineering Field Guide for Low Precipitation Areas

Prepared by

Chris Hoag, Wetland Plant Ecologist, USDA-NRCS, Plant Materials Center, P.O. Box 296, Aberdeen ID 83210

And

Jon Fripp, Stream Mechanics Civil Engineer, USDA-NRCS, National Design, Construction, and Soil Mechanics Center, P.O. Box 6567, Fort Worth TX, 76115

December 2002

Streambank Soil Bioengineering Field Guide for Low Precipitation Areas

This Streambank Soil Bioengineering Field Guide is intended as a pocket field guide for many of the soil bioengineering treatments that are used to reduce streambank erosion. It has been prepared for use in the *Riparian Ecology and Restoration Workshop* which focuses on many of the popular streambank soil bioengineering treatments which are used in drier areas of the American West. This field guide incorporates a general discussion on riparian zones, plant materials selection criteria, and streambank soil bioengineering treatments including installation guidelines and materials requirements. This field guide also includes an appendix that provides some useful information on a variety of useful tools such as soil mechanics considerations, stream classification, rock sizing, limiting velocity and shear criterion, as well as planting tools. Datasheets describing woody plant species that are applicable to soil bioengineering treatments in the arid and semiarid Great Basin and the Intermountain West of the United States are provided. However, this field guide is neither inclusive nor exhaustive. Many publications are available which provide more detail on these as well as other treatments. The practitioner is encouraged to review these publications as well as available local knowledge of the area. Successful application of these treatments is dependent upon many site specific conditions such as stream velocity, soil conditions, soil nutrients, salinity, ice and debris load, flooding, drought, plant availability, and climate, to name a few.

This Streambank Soil Bioengineering Field Guide is small enough to fit in a field pack. It is printed on water resistant paper so it can be used in most any weather. The user is encouraged to take notes on the pages. The information in the field book is meant to provide a quick reference while in the field working on a project. This guide is not intended to be an exhaustive design tool. While the appendix contains overview information, this field guide is not intended for the final design of rock structures such as deflectors, weirs, or riprap revetments nor is it intended to provide sufficient information for a geotechnical slope stability analysis. Rather this field guide should be viewed as a general field reference and review document.

Table of Contents

Introduction

Streambank Soil Bioengineering is also referred to as soil bioengineering, ecoengineering, biotechnical soil stabilization, and water bioengineering. There are distinctions made between these different names and these distinctions may not be consistent. However, they all basically refer to the use of live and dead herbaceous and woody plant materials in combination with natural and synthetic support materials for slope stabilization, erosion reduction, and vegetative establishment. In simple terms, streambank soil bioengineering uses plants and sometimes inert material to increase the strength and structure of the soil.

Streambank soil bioengineering is dependent upon the establishment of plant species at the boundaries of a river or stream. Therefore, it is critical that practitioners understand the function and importance of this area.

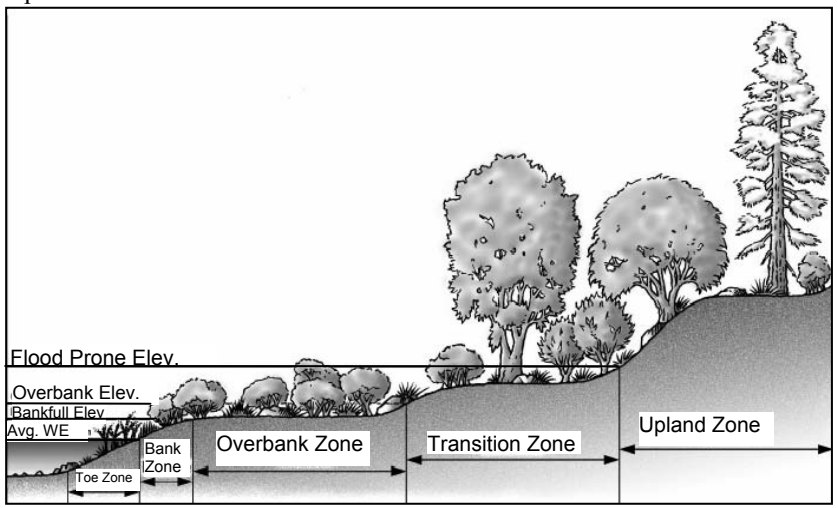
Riparian Planting Zones

A riparian zone is often described as the area between land and water. In the West, they are long linear areas along rivers and streams that are occasionally flooded by those bodies of water. They can be identified by having: 1) vegetation that requires free and unbound water or conditions moister than normal and 2) saturated soil conditions. Simply stated, riparian areas are where water saturates the soil more than adjacent areas and where water-loving vegetation is concentrated. Riparian zones are very important because they provide erosion control by regulating sediment transport and distribution, enhance water quality, produce organic matter for aquatic habitats, and provide fish and wildlife habitat.

Riparian vegetation is one of the main components of streambank soil bioengineering. Understanding riparian vegetation concepts is extremely important. The vegetation is adaptive and can withstand high flows if it is established in the correct planting zone. When establishing vegetation, success is dependent on many site specific conditions such as soil compaction, soil type, nutrients, salinity, ice load, debris load, sediment load, flooding, inundation time, water availability, drought, hydrology, plant availability and climate, to name a few.

The success of streambank soil bioengineering treatments is dependent upon the establishment of riparian plant species. The success of the plants is, in turn, dependent upon the species used, their procurement, planting and handling techniques, and their location relative to the stream. Therefore, it is important to observe the location and types of existing vegetation in and adjacent to the project area. Proposed streambank soil bioengineering should also be assessed and designed in terms of the relative location of the plants to the stream and water table. The elevation and lateral relationships can be visualized and described in terms of Riparian Planting Zones. A figure illustrating an idealized

depiction of these zones, as well as a brief description of each, is provided below. Not all streams will exhibit all of these zones.



Riparian Planting Zones (Riparian/Wetland Project Information Series No. 16)

Toe Zone: This zone is located below the average water elevation or baseflow. The cross-sectional area at this discharge often defines the limiting biologic condition for aquatic organisms. Typically this is the zone of highest stress. It is vitally important to the success of any stabilization project that the toe is stabilized. Due to the long inundation, this zone will rarely have any woody vegetation in it. Often stone or some inert protection is required for this zone.

Bank Zone: The bank zone is located between the average water elevation and the bankfull discharge elevation. While it is generally in a less erosive environment than the toe zone, it is potentially exposed to wind generated waves, wet and dry cycles, ice scour, debris deposition, as well as freezing and thawing cycles. The bank zone is generally vegetated with early colonizing herbaceous species, flexible stemmed willows, and low shrubs. Sediment transport typically becomes an issue for flows in this zone, especially for alluvial channels.

Bankfull Channel Elevation: Bankfull stage is typically defined at a point where the width to depth ratio is at a minimum. Many practitioners also use other consistent morphological indices to aid in its identification. In many situations, the flow at the bankfull stage has a recurrence interval of 1.5-years. Due to the high velocities and frequent inundation, many practitioners use rock or other hard structures in conjunction with streambank soil bioengineering treatments below this elevation.

A bankfull flow is often considered to be synonymous with channel-forming discharge in stable channels and is used in channel classification as well as for an initial determination of main channel dimensions, plan and profile. In many situations, the channel velocity begins to approach a maximum at bankfull stage. In some cases, on wide, flat floodplains, it

has been observed that the channel velocity can drop as the stream overtops its bank and the flow spills onto the floodplain. In a situation such as this, it may be appropriate to use the bankfull hydraulic conditions to assess stability and to select and design streambank protection. However, when the floodplain is narrower or obstructed, channel velocities may continue to increase with rising stage. As a result, it may be appropriate to also use a discharge greater than bankfull discharge to select and design streambank protection treatments.

Overbank Zone: This zone is located between the bankfull discharge elevation and the overbank elevation. This typically flat zone may be formed from sediment deposition with layered soils. It is sporadically flooded, usually about every 2 to 5 years. Vegetation found in this zone is generally flood tolerant and may have a high percentage of hydrophytic plants. Shrubby willow with flexible stems, dogwoods, alder, birch and others may be found in this zone. Larger willows, cottonwoods and other trees may be found in the upper end of this zone.

Transitional Zone: The transitional zone is located between the overbank elevation and the flood prone elevation. This zone may be inundated every 50 years. It is not exposed to high velocities except during high water events. Hydrophytic species generally transcend to larger upland species in this zone. As a result, this is the first zone (from the channel invert) where tree species should be considered. The plants in this zone need not be especially flood tolerant.

Flood Prone Elevation: Many practitioners estimate the flood prone elevation at twice the maximum depth of the bankfull elevation. A calculation of an entrenchment ratio, which is defined as the ratio of the width of the channel at the floodprone elevation to the width of the bankfull channel, is used in channel classification. The area below this elevation may include the active floodplain and the low terrace.

Upland Zone: This zone is found above the flood prone elevation. Erosion in this zone is typically due to overland water flow, wind erosion, improper farming practices, logging, development, and overgrazing. The upland zone is typically vegetated with upland species. Drought tolerance may be one of the most important factors in species selection.

Choice of Plant Material

Most streambank soil bioengineering treatments involve material that is collected from adventitiously rootable stock (plants that will easily root from a hardwood cutting). When possible, it is best to procure plants from areas that are similar in their location relative to the stream. Planting will be most successful where the soil, site, and species match a nearby stable site. If possible, harvest two or more species from different locations.

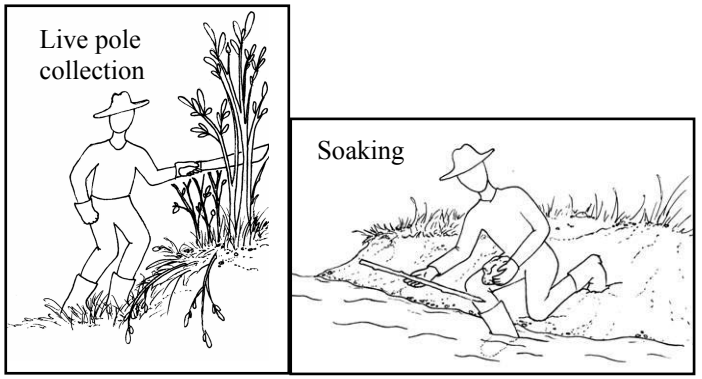
Most species should be harvested when the plants are dormant. This is typically in the late fall to early spring, after leaf fall and before the buds swell. Choose and harvest healthy material that is free of splits, rot,

disease, and insect infestation. While it is often appropriate to include material that ranges in age up to 4 years, material should be harvested from plants that are at least 2 years old. In drier areas, one year old stock should not be used. This younger material is often too small and does not have enough stored energy for good root establishment. Harvesting of live material should leave at least one third of the parent plant intact. The equipment should be sharp enough to make clean cuts.

Soak material before planting for a minimum of 24 hours in cool, aerated water. Optimum time for soaking is 5 to 7 days but they can also be planted the same day as harvested if they are watered. If it is necessary to harvest material significantly before installation, the cuttings should be stored dry at approximately 33 to 40 degrees F. Live hardwood cuttings can last up to four months if refrigerated. Stored material should be soaked before planting. If the harvested material is stored under wet conditions for longer than 10 days, the root process may start. These initial roots are typically very tender making it difficult to use the material in many of the treatments without damaging them.

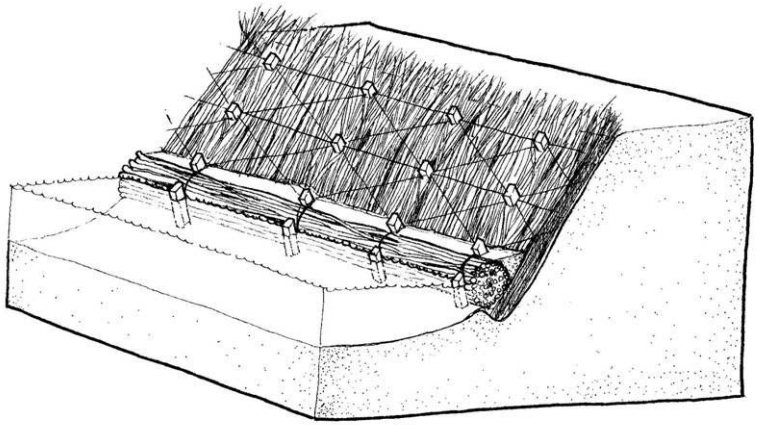
Hardwood cuttings can be divided into four general categories: whips, poles (sometimes referred to as stakes), posts, and bundles. Whips are typically one year old material. Because of their small size, they should not be used in drier areas or areas without consistent water. Pole cuttings can made be from shrub and tree species and usually ranges in diameter from ¾ to 3 inches. Post plantings are from tree species and range in diameter from 3 to 6 inches. Bundles are packages of smaller diameter cuttings from various species with the branches left intact.

Local expertise and guidelines should be consulted when selecting the appropriate plant material. A partial list of some woody species available in the arid and semiarid Great Basin and the Intermountain West of the United States is provided in Appendix of Useful Information.



STREAMBANK SOIL BIOENGINEERING TREATMENTS

There are many types of streambank soil bioengineering treatments that have been used throughout the country. The following is a collection of technique sheets on some streambank soil bioengineering treatments that are applicable to low precipitation areas. It is important to note that it may be appropriate to modify these treatments to account for site specific conditions and material availability. Also, as shown in the figure below, streambank soil bioengineering treatments are often used in conjunction with one another.



Brush mattress with a fascine toe

Pole Plantings

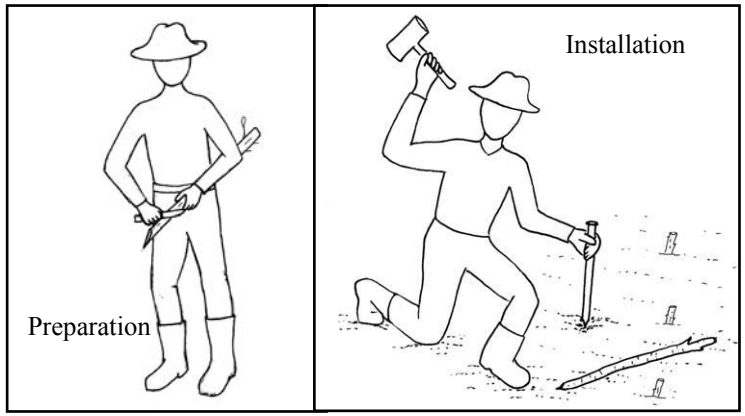
Description: Poles are cuttings of live woody plant material inserted into the ground. The poles provide some limited immediate reinforcement of soil layers if they extend beyond a failure plane. The live cuttings are intended to root and provide reinforcing and subsurface protection, as well as providing roughness to the stream bank and some control of internal seepage. The live cuttings are frequently used in conjunction with a rock toe along streams and with coir erosion fabric. This treatment is sometimes referred to as live stakes.

Materials:

- Live cuttings/stakes - adventitiously rootable, 3/4 to 3-inch diameter, 2 to 5 feet long. May use up to 10 feet long with use of augers.
- Tools: Machete, clippers, hammer, punch bar, saw. May also include chainsaw, loppers, power auger, hand auger, waterjet.

Installation:

- Cleanly remove all side branches and the top foot. Sharpen the basal (bottom) end. At least 2 buds or bud scars should be present above the ground.
- Collect and soak cuttings.
- Use a punch bar or auger to create a pilot hole that is perpendicular to the slope. The hole should be $^{2}/_{3}$ to ¾ the length of the stake. Make the hole diameter as close to the cutting diameter size as possible. Hole should be deep enough to intercept the lowest water table of the year or a minimum of 2 feet.
- Push or lightly tap the stake into the ground such that the sharpened basal end is inserted first.
- To achieve good soil to stem contact, fill the hole around the pole with a mixture of water and soil slurry. Tamp the ground around the stake and water the hole.
- Place stakes on 1 to 3 foot spacing in a random pattern for most shrub species. Spacing is species dependent.



Note: Posts (3 to 6-inch diameter) are prepared and installed very similar to poles. However, power augers are used more often to create the holes.

Brush or Tree Revetment

Description: Brush and tree revetments are non-sprouting shrubs or trees installed along the toe of the streambank. This treatment is sometimes referred to as Christmas Tree Revetments or Juniper Revetments. The purpose of a revetment is to slow stream velocity adjacent to an eroding bank and to promote sediment deposition at the toe of the bank. The revetment material does not need to sprout (most species used will not). It is generally recommended that live willows or other quickly sprouting species be planted behind the revetment to provide permanent cover.

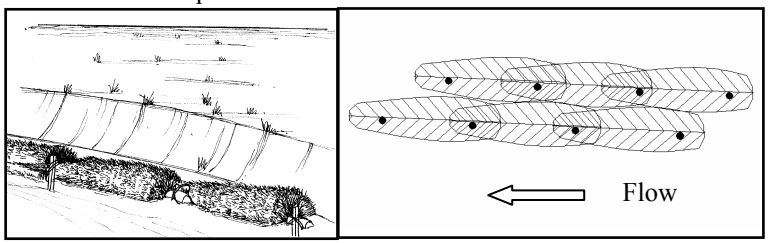
Materials:

- Dead/live brush or trees such as junipers, spruce, fir, or hawthorn. Pine trees do not typically have dense and durable enough needles and branches to provide ideal shielding.
- Ties: 10-12 gauge non-galvanized wire, 1/8 to 1/4 inch cable, clamps
- Anchors: 5' metal t-posts or 2-inch oak posts (for larger revetments, larger posts are recommended). Soil anchors may also be used.
- Tools: wire cutters, hammer, post pounder, chainsaw (for cutting brush)

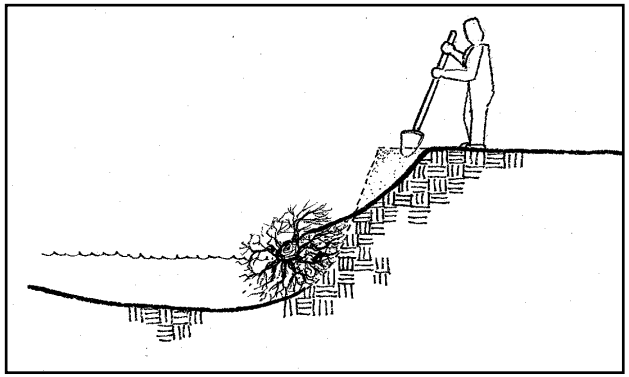
Installation:

- Installation of brush or tree revetment can usually be accomplished throughout the year. For safety reasons, avoid high water periods.
- Harvest the trees for the revetment and stage near site. Use trees with dense branching such as junipers, because they will collect more sediment. Collect trees or brush and stage at treatment area.
- Place the first tree one tree length below the downstream end of the treatment area. The stump of the tree should point upstream. Push firmly into the channel bank.
- Install an anchor post on the streamside of the tree adjacent to the trunk at the stump end. Secure the tree to the post with three wraps of cable or wire and clamp. Note: In some situations, it may be easier to install the anchor posts before placing the trees.
- Overlap the next downstream tree trunk into the main branches of the first one by 1/3rd of the length of the tree. The stump end of the second tree should be between the top end of first tree and the bank. The result is a shingle-like arrangement.
- Wire the two trunks together, leaving the branches loose. Use a minimum of three wraps of cable or wire and clamp.
- Install a second anchor post in the middle of the overlap portion of the two trees. Secure the two trees to the post with a minimum of three wraps of cable or wire and clamp.
- Continue this process until a continuous row of brush protects the length of the treatment area.
- The trunks of the revetment should be placed between the annual low and high water levels. In areas of fluctuating water levels, it may be necessary to place a second row of revetment at the high water line, in order to prevent scouring behind the revetment during flood events.

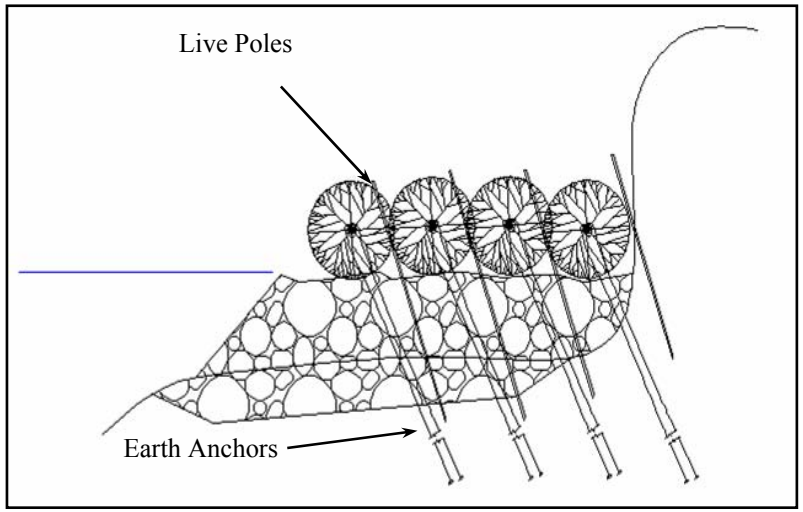
- Fill in the space between the bank and the revetment with branches or fascines to create a dense matrix.
- It is critical that the revetment extends upstream and downstream for a minimum of one tree length past the eroded area being treated to prevent flows from getting behind the revetment. It is advisable to key the upstream and downstream ends of the revetment into the bank and reinforce the key with additional brush or rock. These endpoints are the areas that are most likely to fail and require substantial protection.



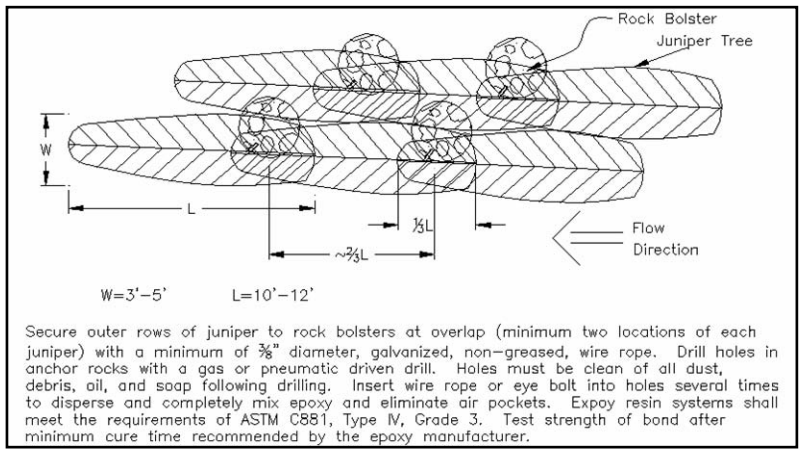
Option 1: To enhance recovery of treated area, knock down the sloughing streambank on the revetment to create a gentler streambank slope as shown below. Make sure the revetment has enough brush material to catch the soil. If not, add additional brush before shaping the bank. Willow cuttings or other quickly sprouting species should then be planted on the new slope using treatments such as willow wattles, brush mattress, vertical bundles, or willow pole plantings. Note that this option will damage any existing vegetation on the bank and may result in some instability of the upper bank.



Option 2: In areas of higher stress, as can be found along the outer bank of a turn, anchor the revetment over a stone toe with soil anchors. In the detail shown below, live poles are also specified.



Option 3: In areas where it is difficult to install anchor posts, the trees can be secured to large rock as shown in the detail below. The determination of the size of the rock must take into account not only the affects of the flow on the rock but also the additional stresses of the flows on the attached revetment.



Brush Mattress

Description: A brush mattress is a layer of live branches placed on a slope. Wood stakes and wire (or string) is used to anchor the material. The branches provide immediate protection against surface erosion. The live cuttings eventually root and provide permanent reinforcement.

Materials:

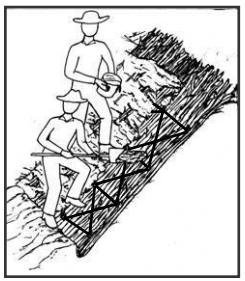
- Live Branches – adventitiously rootable, ½ to 1 inch diameter. The stems or branches should be at least 2 feet longer than the length of the slope so that the basal ends can be placed in the water and the growing ends overlap the top of the slope.
- Dead Stakes – wedge shaped, 1.5 to 4 feet long, depending on soil.
- String or non-galvanized wire.
- Tools: Machete, shovels, clippers, hammer, sledge hammer punch bar, saw.

Installation:

- Diagonally cut a 2x4 board to create a wedge shaped dead stake.
- Collect and soak cuttings. Leave side branches intact.
- Excavate the bank to a slope of 1V: 2H or flatter. Maximum slope length is typically 10 feet. Excavate a 1 to 2 foot wide and 8 to 12 inches deep trench along the toe.
- Lay the cuttings perpendicular with their basal (bottom) end in the trench and bud end upslope. The cuttings should overlap in a slight criss-cross pattern. The layer should be 6 to 12 inches thick. Approximately 12 to 24 branches should be used per foot of bank.
- Drive stakes 1 to 3 foot into the ground. Use longer stakes in less cohesive soil. The tops of the stakes should extend above the top of the brush mattress. Space stakes on approximately a 3-foot by 3-foot grid (or square). Live stakes may be mixed with the dead stout stakes or driven in alone. They offer the advantage of growing and becoming part of the vegetative cover with time but they can generally not be driven in as securely.
- Stand on the cuttings and secure them by tying the wire in a diamond pattern between the stakes. Short lengths are preferable.
- Hammer the stakes to firmly secure the brush to the bank.
- Wash loose soil into the branch layer with water. Approximately ½ of the depth of the mattress should be covered with soil.
- Backfill the trench with stone or suitable toe protection.
- Trim the terminal bud at the top of bank so that stem energy will be routed to the lateral buds for more rapid root and stem sprouting.


Install stakes perpendicular to mat.


Cut 2x4 to create wedge stake



Fascines

Description: A fascine is a long bundle of live branch cuttings bound together into rope or sausage-like bundles. The structure provides immediate protection against surface erosion. The structures can change overland flow by breaking up long slopes. The live cuttings eventually root and provide permanent reinforcement.

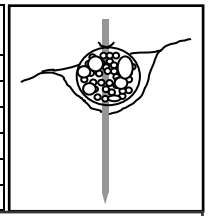
Materials:

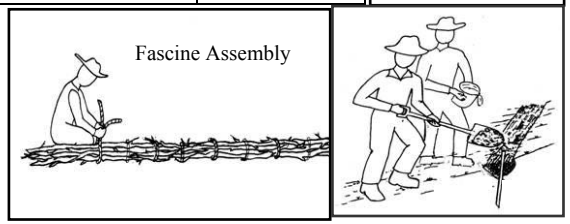
- Live Branches – adventitiously rootable, ¾ to 2 inch, 5 to 8 feet long
- Cord or non-galvanized wire
- Dead stakes - - wedge shaped, 2 to 3 feet long depending on soil
- Tools: Machete, shovels, clippers, hammer, sledge hammer, saw

Installation:

- Collect and soak cuttings.
- Stagger cuttings in a uniform line 5 to 20 feet long depending on site conditions and handling capabilities. Vary the orientation of the cuttings.
- Tie bundles with string or wire at approximate 1.5 to 2 foot increments. The bundle should be 6 to 12 inch in diameter.
- Start installation from the toe of the slope.
- Remove loose, failed or failing soil from face of the slope.
- Align the fascine along the contour for dry slopes. Place at a slight angle along wet slopes to facilitate drainage. On upper banks adjacent to a stream, it may also be advisable to align the fascines at a slight angle to reduce the likelihood of rilling during high flows.
- Excavate a trench approximately 2/3rds the diameter of the bundle.
- Place bundle in trench and stake (use wedge shaped dead stakes) through the bundle at approximately 2 to 4 foot centers. Allow stake to protrude 3 inches above top of bundle.
- Cover the brush with soil, then wash in to assure good soil to stem contact. Some of the stems should remain exposed to sunlight to promote sprouting. Use material from next, upslope trench. It may be desirable to use erosion control fabric to hold the adjacent soil.
- Since this is a surface treatment, it is important to avoid sites that will be too wet or too dry.

Slope H:V	Slope distance between trenches (ft)	Maximum slope length (ft)
1:1 to 1.5:1	3-4	15
1.5:1 to 2:1	4-5	20
2:1 to 2.5:1	5-6	30
2.5:1 to 3:1	6-8	40
3:1 to 4:1	8-9	50
4:1 to 5:1	9-10	60





Vertical Bundles

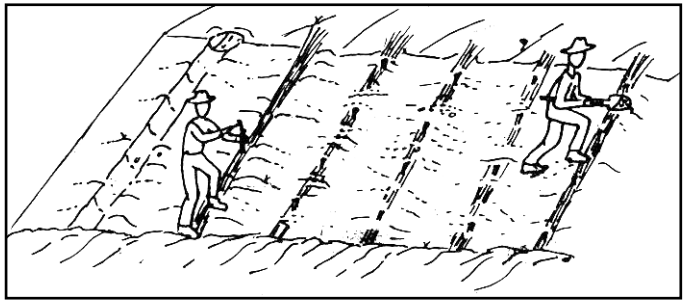
Description: Vertical bundles are long bundles of live branch cuttings bound together into rope or sausage-like bundles. The bundles are placed and staked along a stream bank in trenches that are perpendicular to the water surface. The structure provides immediate protection through increased roughness. The live cuttings eventually root and provide permanent reinforcement.

Materials:

- Live Branches – adventitiously rootable, 2 to 18 inch diameter, 5 to 15 feet long
- Cord or non-galvanized wire
- Dead stakes - wedge shaped, 2 to 3 feet long depending on soil
- Tools: Machete, shovels, clippers, hammer, saw

Installation:

- Remove loose, failed or failing soil from face of the slope.
- Excavate a vertical trench into a slope that is 2H: 1V or flatter. Assure that the bottom of the trench will be under water during low flows. The trenches should be on 3 to 5 foot centers and 2/3 rds the diameter of the bundle.
- Determine the required length of the bundle. Measure the length of the trench and add 6 to 12 inches so that the growing end of the bundle will extend above the crest of the slope.
- Collect and soak cuttings.
- Place cuttings in a uniform bundle of the required length. The growing or top end should be oriented in one direction. The cut or bottom end should be approximately even.
- Tie bundles with string or wire at approximate 2 to 3 foot increments. The bundle should be 4 to 18 inches in diameter.
- Place bundle in trench and stake (use wedge shaped dead stakes) through the bundle at approximately 2 to 4 foot centers. Allow stake to protrude approximately 3 inches above top of bundle.
- Trim the terminal bud so that stem energy will be routed to the lateral buds for more rapid root and stem sprouting.
- Cover the brush with soil then wash in to assure good soil to stem contact. Some of the stems should remain exposed to sunlight to promote sprouting. It may be desirable to use erosion control fabric to hold the adjacent soil in place. A modification of this treatment is to use stone over the bundles.



Brush Layering

Description: Brush layering is alternating layers of live branches and earth. The branches protrude beyond the face of the slope. The brush stems provide frictional resistance to shallow slides similar to conventional geotextile reinforcement. The protruding stems serve to break long slopes into shorter slopes and retard runoff erosion. The live cuttings eventually root and provide a permanent reinforcement.

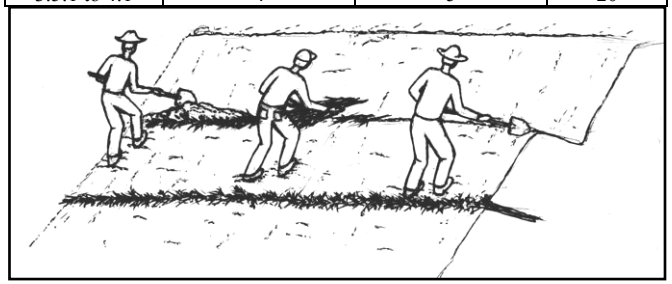
Materials:

- Live Branches – adventitiously rootable, ½ to 3 inch, length so that the cut end of the branches can touch the undisturbed soil at the back of the void and the growing end can protrude 6 to 24 inches from the face of the slope
- Tools: Machete, shovels, clippers, saw, hammer

Installation:

- Collect and soak cuttings. Leave side branches intact.
- Remove loose, failed or failing soil from face of the slope.
- Start installation from the toe of the slope.
- For cut slopes: Excavate benches on contour, 2 to 5 feet wide.
- For fill slopes: Construct benches on contour, 5 to 20 feet wide.
- Benches should be sloped at about 10 degrees (6H: 1V) so that they tilt back and into the slope.
- Place branches in over-lapping and criss-cross configuration. Typically 12 to 24 stems per foot of bench (measured on the contour) depending upon the size of material.
- Orient the stems such that the basal ends touch the back of the undisturbed slope. Approximately ¼ of the branch stem should extend beyond the completed slope.
- Place 3 to 6-inches of soil on the layer of cuttings and tamp to remove air pockets. Place additional soil in 6 to 8-inch lifts and compact. Repeat until desired thickness is reached. Use material from next, upslope terrace if working on a cut slope.
- Trim the terminal bud so that stem energy will be routed to the lateral buds for more rapid root and stem sprouting.
- Construct at spacing shown in the table below.

Slope H:V	Slope distance (ft) between benches for wet slopes	Slope distance (ft) between benches for dry slopes	Maximum slope length (ft)
2:1 to 2.5:1	3	3	15
2.5:1 to 3.5:1	3	4	15
3.5:1 to 4:1	4	5	20



Brush Packing

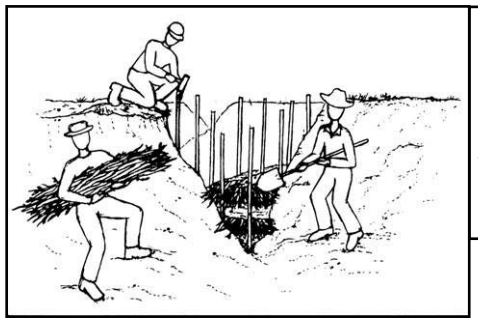
Description: Brush Packing is alternating layers of live branches and earth used to fill localized slumps. The branches protrude beyond the face of the slope. The brush stems reinforce the earth similar to conventional geotextile reinforcement. The stems provide frictional resistance to shallow slides. Wood stakes are used to anchor the material. The live cuttings eventually root and provide a permanent reinforcement.

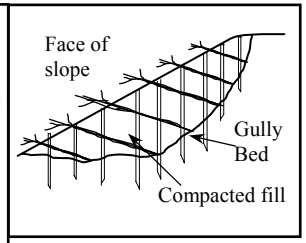
Materials:

- Live Branches – ½ to 3-inch diameter, length such that the cut end of the branches can touch the undisturbed soil at the back of the void and the growing end can protrude 6 to 18 inches from the face of the slope.
- Stakes –2 to 3 inch diameter, 5 to 8 feet long
- Tools: Machete, shovels, clippers, saw, hammer

Installation:

- Collect and soak cuttings. Leave side branches intact.
- Remove loose, failed or failing soil from the face of the slope.
- Start installation from the toe of the slope.
- Construct a bench on contour, 4 to 6 feet deep into the slope.
- Benches should be sloped at about 10 degrees (6H: 1V) so that it slopes down and into the slope.
- Drive stakes 3 to 5 feet into the ground. The tops of the stakes should extend to the projected surface of the completed slope. Space stakes 1 to 2 feet apart.
- Place a 3 to 6 inch layer of branches between the stakes in over lapping configuration. Typically 20 to 25 stems per yard of bench.
- Orient the stems such that the basal end touches the back of the undisturbed slope. Approximately ¼ of the branch stem should extend beyond the completed slope.
- Backfill 3 inches of soil on the layer and tamp to remove air pockets.
- Place additional soil in 6 to 8 inch lifts. Repeat until desired thickness is reached. Once the soil layer is 6 to 12 inches deep, place another layer of branches over the terrace and repeat until the slump is filled.
- Trim the terminal bud so that stem energy will be routed to the lateral buds for more rapid root and stem sprouting.





Brush Packing in gully: Cross Section

Log Cribwalls

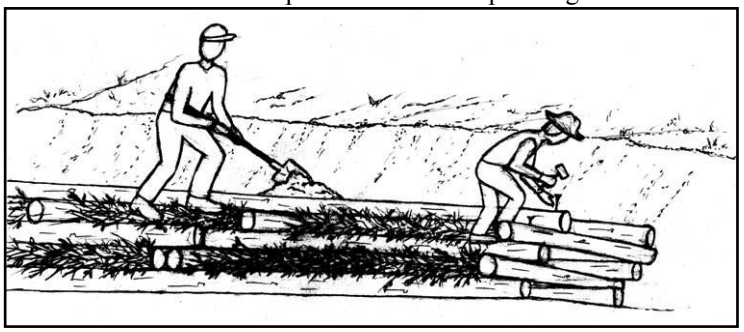
Description: A log cribwall is a hollow box-like structure of interlocking logs or timbers. The structure is filled with rock, soil and cuttings. The live cuttings eventually grow and take over some of the structural functions of the logs. The maximum height is typically less than 6 feet for untreated timber. Treated timber can be used to construct larger structures. It is important to note that the structure may not be able to resist large lateral earth pressures and it may provide a false sense of security. If used adjacent to a stream, the impact of the structure being washed downstream must be considered should it fail. It is critical that the toe be set securely below the estimated maximum scour and is secure.

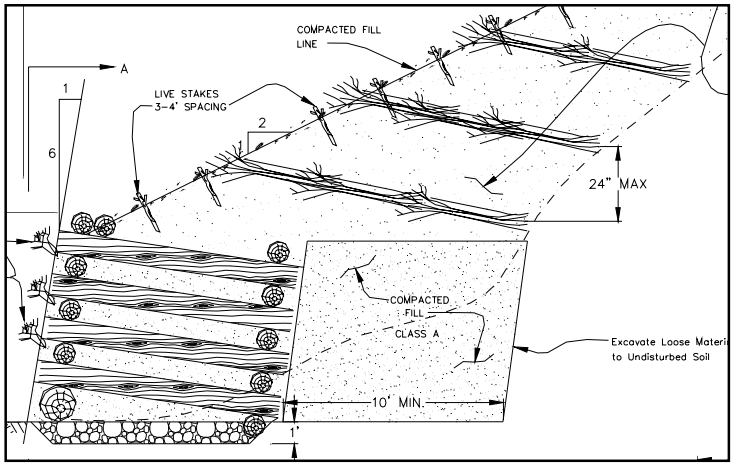
Materials:

- Front and rear beams - 4 to 12-inch diameter logs, approximately 20 feet long. Peeled logs are typically more resistant to rot than logs with bark.
- Cross Beams – 4 to 12 inch diameter logs, length equal to anticipated height of the structure.
- Live Branches – ½ to 3-inch diameter, 5 to 7 feet long.
- Rebar or spikes - ½ inch diameter to secure logs.
- Stone or rock for the toe as required
- Fill material. The permeability of soil in cribbing must be less than that of the undisturbed back slope to prevent backpressure. Heights of over 5 feet may require an engineered fill.
- Tools: Machete, shovels, clippers, ax, hammer, sledge hammer, saw.

Installation:

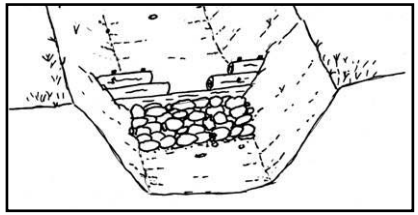
- Collect and soak cuttings. Leave side branches intact.
- Remove loose, failed or failing soil from the face of the slope.
- Excavate loose material to reach a stable foundation. Tilt the excavated toe so that the structure slopes into the embankment by approximately 6 inches to 1 foot. If the structure is to be used adjacent to a stream, it is recommended that a stone toe set below the anticipated scour be placed in front and under the structure.
- Place front and rear beams approximately 4 to 5 feet apart and parallel to slope. Rear beam should be approximately 6 inches to 1 foot below front beam.
- Place cross beams perpendicular to front and rear beams at approximately 5 to 6 foot centers.
- Allow crossbeams to overlap front and rear beams by 6 inches to 1 foot. Secure with spikes or rebar.
- Fill inside of structure with soil. If the structure is to be used adjacent to a stream, stone should be used along the face of the cribwall to a height of 1 to 2 foot above baseflow.
- Incline succeeding layers so that the cribwall is inclined approximately 10 to 20 degrees from vertical (1H:6V to 1H:3V).
- Once logs are above the existing ground line, place live branches with basal end towards slope and the growing tips towards the outside. Allow bud ends to extend beyond front and rear cross beams by approximately 1 foot.
- Align live branches so that they extend on top of the front cross beam and below the rear cross beam for a given course.
- Trim the terminal bud so that stem energy will be routed to the lateral buds for more rapid root and stem sprouting.





Cross Section of a vegetated crib wall. Note that in this case, brush layering and live staking treatments are specified above the structure.

Logs have also been used for habitat enhancement and as erosion stops in dry channels and ditches. Note in the figure below that the logs should be keyed into the bank and that the structure does not fill the channel. Also note that an energy dissipation apron is typically keyed into the bed below the structure. The minimum length of this apron is typically 2 times the height of the structure



Crimping and Seeding

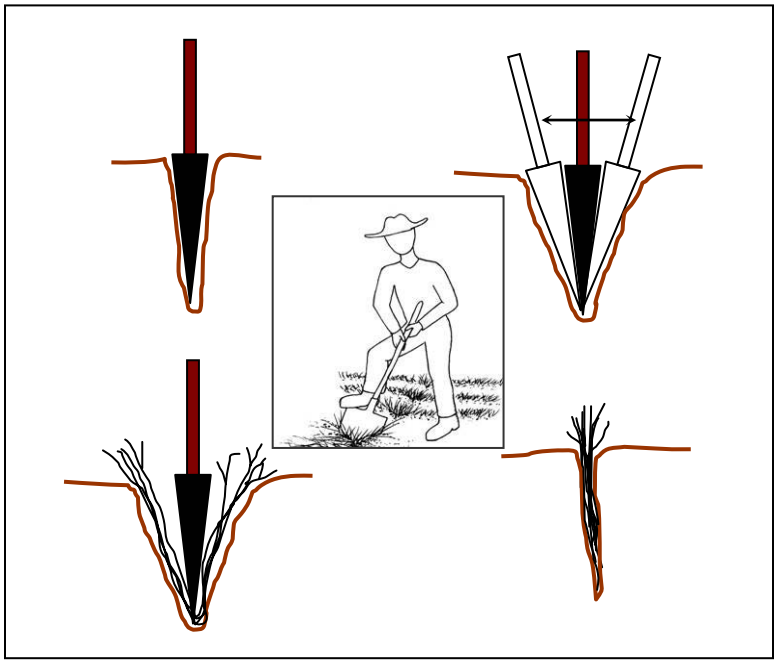
Description: Crimping is a surface roughening treatment that secures straw to the surface. It is a temporary surface treatment that protects and promotes the establishment of permanent grasses and vegetation. This can be accomplished with heavy equipment or by hand. This page describes a hand treatment.

Materials:

- Straw – avoid moldy or compacted straw.
- Seeds or live plants.
- Tools: shovels

Installation:

- Determine approximate contour lines for installation along the slope. The contour lines should be separated by approximately 2 to 3 feet.
- Push the shovel into the ground along the contour lines to a depth of approximately 8 inches. Move the shovel back and forth to leave a 'V' shaped indentation.
- Distribute straw along the tops of the holes.
- Push the straw into the hole using the shovel. Approximately 1 to 3 inches of straw should protrude above the ground surface.
- Tamp the ground with a foot to close the hole around the straw.
- Seed the area and water.
- Place additional straw between the contours. A typical depth of placed straw is 2 to 4 inches.



Wattle Siltation Fence

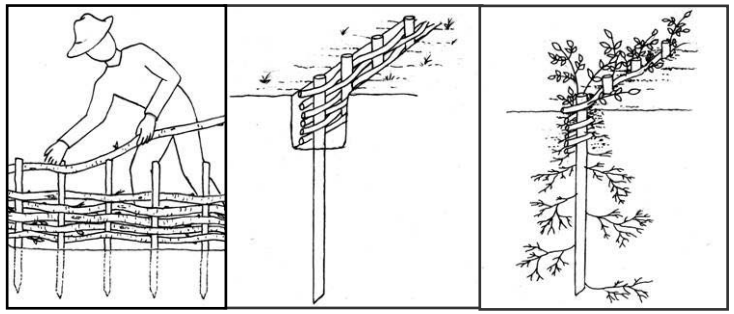
Description: Siltation treatments are generally intended to promote sediment deposition and protect the bed from erosion. They are typically used in multiple rows along flood plains and areas adjacent to banks. Wattle fences are rows of live stakes or poles about which live brush is woven in a basket like fashion. The live cuttings eventually root and provide a permanent structure.

Materials:

- Stakes – 2 to 4 inches in diameter, 3 to 4 feet long.
- Wattling – ½ to 1 inch diameter, 4 to 10 feet long.
- Tools: Machete, shovels, hammer, punch bar, clippers, saw

Installation:

- Collect and soak stakes. Collect and soak wattling. Leave side branches intact. It is important to utilize low growing species that remain supple.
- Excavate a trench that is approximately 1 to 2 foot deep. If the treatment is to be located along a channel, it should be oriented at an approximate 20 to 30-degree angle against the direction of the flow and keyed into the bank.
- Trenches should be approximately 10 to 50 feet apart, depending on the erodibility of the soil and the gradient of the channel.
- Use a punch bar or stake to create a pilot hole at the base of the trench. The pilot hole should have a minimum depth of 1 foot below the invert of the trench.
- Tap the stake into the ground such that the sharpened basal end is inserted first. Approximately 2 inches of the stake should remain above the top of the trench.
- Fill the hole with a water and soil slurry. Tamp the ground around the stake.
- Insert additional stakes along a line at approximately 1 to 2 foot intervals depending upon the flexibility of the branches.
- Weave flexible plant material in an alternating fashion. Press down each strand after being woven
- Backfill the trench and tamp the soil. After installation, the area should be watered.



Wattle Siltation Fence as an Erosion Stop

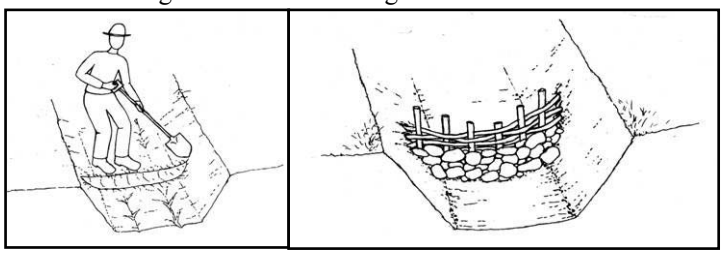
Description: A Wattle Siltation fence can function as erosion stops in ditches or small dry channel beds to resist the formation of rills and gullies. Wattle fences are rows of live stakes or poles about which live brush is woven in a basket like fashion. The live cuttings eventually root and provide a permanent structure. During planning and selection of wattling material, consideration should be given to the potential of excessive growth clogging the channel. This treatment is not typically suitable for areas with high velocities, prolonged inundation or headcuts.

Materials:

- Stakes – 2 to 4 inches in diameter, 2 to 3 feet long.
- Wattling – ½ to 1 inch diameter, 4 to 10 feet long.
- Tools: Machete, shovels, hammer, punch bar, clippers, saw

Installation:

- Collect and soak stakes. Collect and soak wattling. Leave side branches intact. It is important to utilize low growing species that remain supple.
- Excavate a trench across the dry channel or ditch that is approximately 6 inches to 1 foot deep.
- The trench should extend into the sides of the channel or ditch.
- Use a punch bar or stake to create a pilot hole at the base of the trench. The pilot hole should have a minimum depth of 1 foot below the invert of the trench.
- Tap the stake into the ground such that the sharpened basal end is inserted first. Approximately 2/3 to 3/4 of the stake should be below the top of the trench. In addition, the top of the stakes should not be higher than 1/3rd of the channel depth.
- Fill the hole with a water and soil slurry. Tamp the ground around the stake.
- Insert additional stakes along a line at approximately 1 to 2 foot intervals depending upon the flexibility of the branches.
- Weave flexible plant material in an alternating fashion. Press down each strand after being woven
- The center portion of the wattle should be lower than the sides to reduce the likelihood of bank erosion. The sides of the wattling should extend into the sides of the ditch or channel.
- Backfill the trench and tamp the soil. After installation, the area should be watered.
- Key stones into the bed of the channel below the wattle structure for a minimum length of 2 times the height of the structure.



Stone Sill with Live Joint Plantings

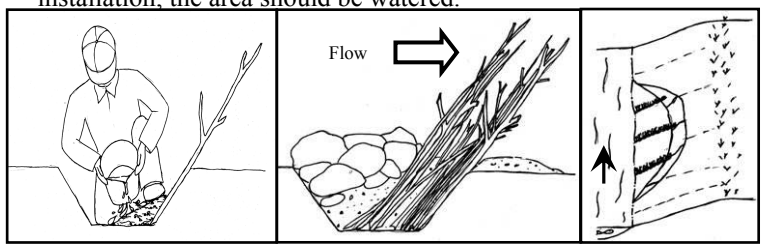
Description: Stone sills with live joint plantings are rows of live material inserted into a trench in the ground and covered with stone. Stone is used to anchor the plant material and the live material promotes siltation. They are sometimes referred to as brush traverses. This is considered a siltation treatment, which is intended to promote sediment deposition and to protect the bank from erosion. This treatment requires a moderate to high sediment load of fine material and is not suitable for area with high velocities or prolonged inundation. Siltation treatments can also function as erosion stops in dry channels to resist the formation of rills and gullies or in bends to resist meander cutoffs.

Materials:

- Live brush - 1/4 to 2-inch diameter, 3 to 6 feet long.
- Appropriately sized quarry or crushed stone (see Appendix).
- Tools: Machete, clippers, shovel, saw, hammer.

Installation:

- Collect and soak live brush. Leave side branches intact. It is important to utilize low growing species that remain supple.
- Excavate a trench that is approximately 1.5 to 3 feet deep depending upon the size of stone required. If the trench is located along a channel, it should be oriented about 20 to 30-degree angle against the direction of the flow and should be keyed into the bank.
- Trenches should be approximately 10 to 50 feet apart, depending on the erodibility of the soil and the gradient of the channel.
- Pack the branches tightly with the basal end down, forming an intertwined mat on the downstream side of the trench. Approximately 8 to 15 cuttings per foot of trench should be used. Avoid gaps in the vegetation as accelerated flow though the gap may result in downstream erosion. The ends of the branch should protrude from the top of the trench by 0.5 to 3 feet.
- Cover the brush with soil then wash in to assure good soil to stem contact.
- Cover the trench with appropriately sized stones.
- If this treatment is to be used across a dry channel, the center portion should be lower than the sides to reduce the likelihood of bank erosion. In addition, consideration should be given to the potential of excessive growth clogging the channel.
- The structure should be keyed securely into the bank.
- Trim the terminal or bud end to promote root growth. After installation, the area should be watered.



Live Brush Sills

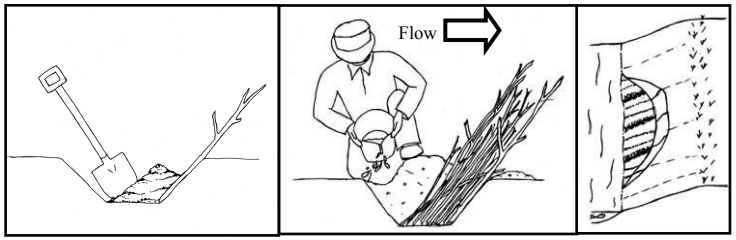
Description: Live brush sills are rows of live material inserted into a trench in the ground. The live cuttings eventually root and provide a permanent structure. Live brush sills are often used to supplement other siltation treatments to assist with final silting up of scoured areas. Since this is a siltation treatment that intended to promote sediment deposition, it requires a moderate to high sediment load of fine material. Live brush sills are generally not suitable for areas with high velocities or prolonged inundation. Live brush sills can also function as erosion stops in dry channel beds to resist the formation of rills and gullies or in bends to resist meander cutoffs. They can also be placed adjacent to the toe of slopes parallel to the stream.

Materials:

- Live brush - 1/4 to 2-inch diameter, 2.5 to 3 feet long.
- Tools: Machete, clippers, shovel, saw, hammer.

Installation:

- Collect and soak live brush. Leave side branches intact. It is important to utilize low growing species that remain supple.
- Excavate a trench that is approximately 1 to 2 foot deep. If the trench is located along a channel, it should be oriented at about a 20 to 30-degree angle against the direction of the flow. The trench should also be keyed into the bank.
- Trenches should be approximately 3 to 15 feet apart, depending on the erodibility of the soil, gradient of the channel, and nature of the siltation treatment it is being used to supplement.
- Pack the branches tightly with the basal end down, forming an intertwined mat on the downstream side of the trench. Approximately 8 to 15 cuttings per foot of trench should be used. Avoid gaps in the vegetation as accelerated flow though the gap may result in downstream erosion. The ends of the branches should protrude from the top of the trench by 4 to 18 inches.
- Cover the brush with soil, then wash in to assure good soil to stem contact. All gaps between plant material should be filled with soil.
- Stone may be added to provide additional strength and protection.
- The structure should be keyed securely into the bank.
- Consider seeding between the traverses.
- Trim the terminal end or bud to promote root growth. After installation, the area should be watered.



Brush Trench

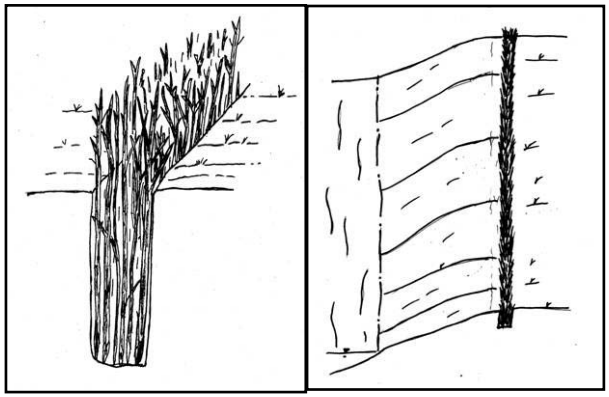
Description: A brush trench is a row of live brush cuttings that is inserted into a trench along the top of an eroding stream bank, parallel to the stream. The cuttings form a fence that filters runoff and reduces the likelihood of rilling in the bank surface. The live cuttings eventually root and provide a permanent structure. Brush trenches are often used to supplement other bank protection bioengineering treatments.

Materials:

- Live brush - 1/2 to 1-inch diameter, 2.5 to 3 feet long.
- Tools: Machete, clippers, shovel, saw, hammer.

Installation:

- Collect and soak live brush. Leave side branches intact. It is important to utilize low growing species that remain supple.
- Install appropriate bank and toe protection prior to construction of the brush trench.
- If a moderate amount of runoff is currently flowing over the bank, consideration should be given to using a low berm at the top of the bank and directing the flow to a stable outfall.
- Excavate a narrow 10 to 12 inch wide trench that is approximately 1 to 2 feet deep. The trench should be far enough from the top of the bank that it does not weaken the bank. A typical minimum distance from the top of the stream bank is 1 foot.
- Pack the branches tightly with the basal end down, forming an intertwined mat. Make sure the cut ends reach the bottom of the trench. Approximately 8 to 15 cuttings per foot of trench should be used. The tops of the branches should protrude from the top of the trench above the height of competing vegetation.
- Avoid gaps in the vegetation.
- Cover the brush with soil, then wash in to assure good soil to stem contact. All gaps between plant material within the trench should be filled with soil.
- Trim the terminal end or bud to promote root growth. After installation, the area should be watered.



Brush Spurs

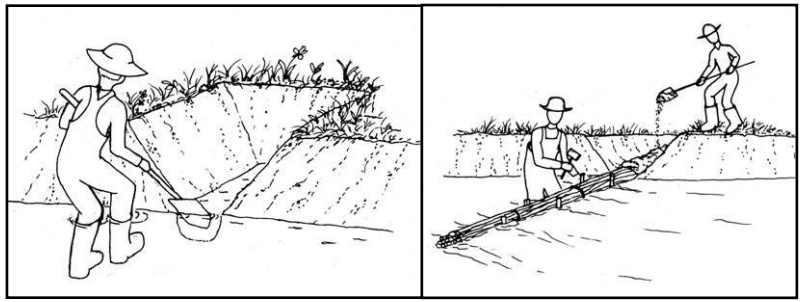
Description: A brush spur is a long, box like structure of brush that extends from the bank into the stream. The primary purpose of brush spurs is to promote sediment deposition along the toe of the bank, which aids in rebuilding and strengthening an eroding bank. Other benefits of the structures include deflection of flows from the bank and habitat enhancement. Brush spurs are relatively low structures and are completely overtopped during channel forming flow events. They typically project into the channel a distance less than 1/5th of the channel width. Brush spurs are sometimes referred to as brush box spurs or deflectors. This treatment requires a moderate to high sediment load of fine material and is not suitable for area with high velocities, prolonged inundation, or high debris load.

Materials:

- Live brush - 1/4 to 2-inch diameter, 20 feet long.
- Ties: 10-12 gauge non-galvanized wire, 1/8 to 1/4 inch cable, clamps
- Anchor Posts: 6 to 12 feet long, 6-inch oak posts. Use longer posts in areas of higher stream velocity and looser bed material.
- Tools: wire cutters, shovel, hammer, post pounder, chainsaw

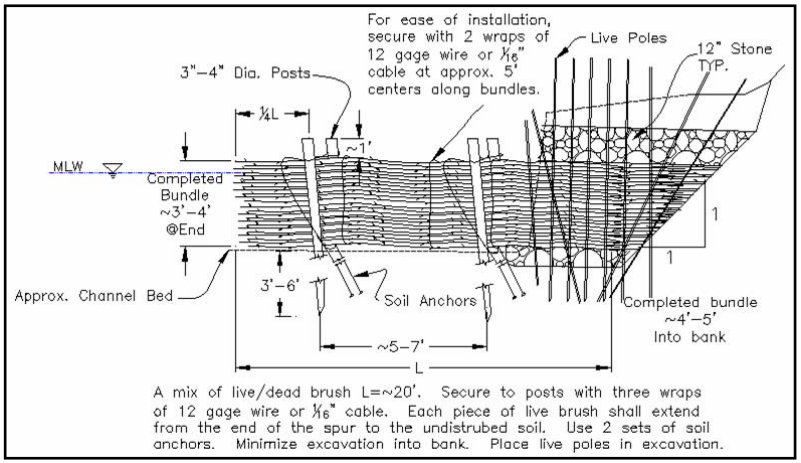
Installation:

- Collect and soak live brush. Leave side branches intact.
- Determine alignment and spacing of brush spurs. Spurs are typically installed at an angle of 30 to 45 degrees facing upstream and act together as a system.
- The top of the spurs should be between the annual low and high water levels and sloping down towards the stream. The root end should not extend above the top of the bank.
- Excavate a 2 to 4 feet wide key or root trench 1/5 the spur length into the bank at the root of each spur. The bottom of the trench should be below the bottom of the channel at the toe of the bank.
- Install a minimum of two pairs of anchor posts at 1/3 and 2/3 along the length of the spur. The minimum interval between the posts should be 7 feet. The posts should be spaced apart at the expected width of the spur (2 to 4 feet). The final set of anchor posts should be 3 to 5 feet from the end or nose of the spur. The top of the anchor posts should extend above the top of the planned spur by 6 to 12 inches.
- Pack live material tightly into the gap between the anchor posts. The butt or basal end of the brush should be in the key trench and touching the undisturbed soil.
- Secure the brush between the posts with a minimum of two wraps of wire or cable.
- Install live poles around the outside edge of the key trench.
- Cover the brush in the key trench with soil then wash in to assure good soil to stem contact.
- Once deposition is established, it may be advisable to install live poles or one of the various siltation treatments between the spurs.

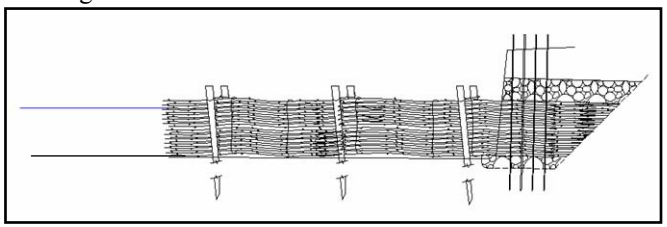


Option 1: In high stress areas, stone can be used to reinforce the key of the spur. The installation procedure is the same as described above with the exception of the following:

- Excavate a wider trench where the invert of the key trench is 1 to 2 feet below the toe of the bank.
- Fill the invert of the trench to elevation of the toe of the bank with appropriately sized stone material.
- Install the brush spur as described but fill around the key trench with additional stone.



Option 2: In areas where a longer spur is needed, overlap a mixture of live and dead material by a minimum of ½ the length of the brush. Secure the material together with 2 wraps of wire or cable at approximate 5 feet centers along the bundle.



Stone in Bioengineering

Description: Stone used as riprap can be a component of many streambank soil bioengineering projects. It is often used where long term durablity is needed, velocities are high, inundation long, and where there is a significant threat to life and property. The sizing of stone for riprap should be approached with caution as it can be expensive and can give a false sence of security if not applied appropriately*. Techniques for stone sizing are provided in the Appendix. Additional issues that must be addressed include, but are not limited to, some of the points below:

Filter Layer: Where stone is placed against a bank that is made up of fine grained or loose alluvium, a filter layer is often used. This layer prevents the smaller grained particles from being lost through the interstices of the riprap layer while allowing seepage from the banks to pass. The filter layer typically consists of an 8-inch thick layer of sand, gravel or quarry spalls. The gradation is based in part of the gradation of the riprap layer and the bank material. Banks with very small grained silts or clays may require a geotextile as a filter; however, some bioengineering techniques such as vertical bundles do not function well under geotextiles.

Bank Slope: Many of the available stone sizing techniques take into effect the bank slope. In addition, a geotechnical embankment analysis may place a limit on the bank slope. In general, the slope of a stone revetment usually does not exceed 1.5H: 1V. However, it should be noted that gentler slopes increase the opportunity for establishment of vegetation.

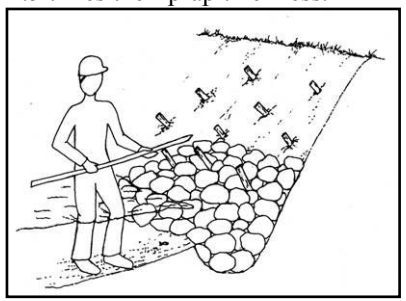
Height: In general, a stone revetment typically does not exceed the channel forming flow event level when it is incorporated in a bioengineering project. However, there are certainly exceptions where it is advisable to extend the riprap to the top of the bank.

Thickness: The thickness of a stone revetment is taken into consideration by the technique used to determine the stone size. A typical minimum thickness is the greater of the D100 and 1.5 the D50. The ability to use vegetative methods within a rip rap revetment is diminished by additional riprap depth. While posts have been installed in revetments up to 4 feet thick, joint planting within a thickness larger than 24 inches may be a problem.

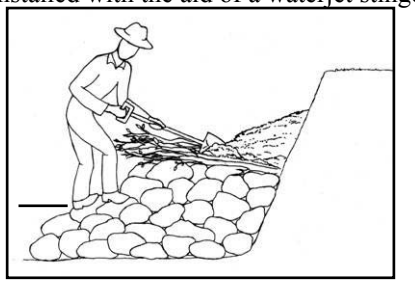
Length: The revetment should cover the eroding area. In general, a stone revetment should begin and end at stable areas. Where this is not possible, it is generally recommended that a stone revetment be extended for a minimum distance of one channel width upstream and 1.5 channel widths downstream.

Tiebacks: Tiebacks are used to reduce the likelihood of high flows concentrating behind a low stone revetment. They are used on both the upstream and downstream ends of a stone revetment. On long stone revetments, tiebacks are often used at intervals of 15 times the depth of flow at the toe. A typical rule of thumb for a key in distance into the bank is the bank height plus the anticipated scour depth.

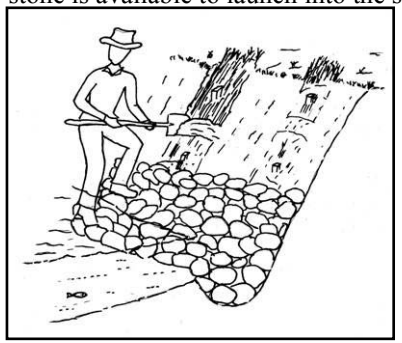
Scour: Toe scour is probably the most frequent cause of failure in stone revetments. Two common methods for providing toe protection are extending the stone to the maximum expected scour depth or placing sufficient launchable stone along the toe of the revetment to fill any expected scour. A typical rule of thumb for a minimum key in depth is 1.5 times the riprap thickness.



The above figure shows a stone toe and live poles. The stone is keyed into the bed below an anticipated scour depth. Live poles can be installed with the aid of a waterjet stinger.



The above figure shows a brush layer being installed over a stone toe. Since the stone is not keyed into the bed, additional stone is placed in the toe. As the bed is scoured adjacent to the bank protection, this additional stone is available to launch into the scour hole.

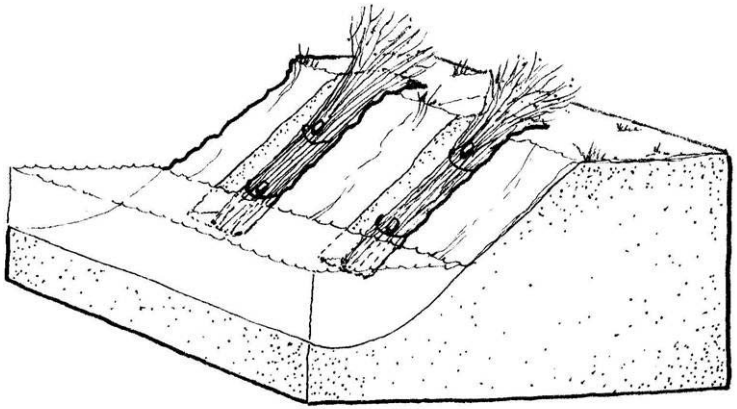


The above figure shows a verticle bundle being installed under a stone toe. The bundles are placed in trenches which are then filled with soil. This minimizes potential damage to the live material during stone placement as well as maximizes soil to stem contact.

* More information on issues related to the design of riprap revetments can be found in NRCS National Engineering Handbook and USACE EM 1110-2-1601

Appendix of Useful Information

This appendix contains a collection of guides, charts, plant descriptions and discussions that may be useful references during fieldwork. The practioner is encouraged to review the complete references for each of the entries to assess the relevance to site specific conditions.



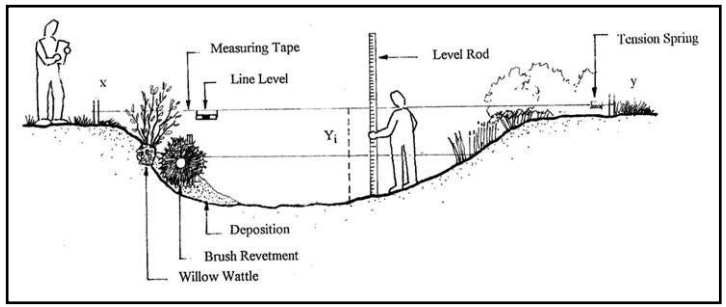
Vertical bundles

Pre Field Work
(Preliminary Inventory)

The following is a description of information that might be collected before going to the field to work on riparian areas. This information will help you understand the catchment and stream before you go to the field. Not all items will be used in every investigation and not all items will be collected at the same level of detail.

- Geology
- Climate - Water and Climate Center
  http://www.wcc.nrcs.usda.gov/water/w_clim.html
- Maps
  - Topo Maps
  - USGS quad sheets http://mcmcweb.er.usgs.gov/topomaps/
  - State Division of Lands
  - State Lands Map
- Aerial Photos
- Soils - USDA Soil Survey
- Land Use – current and historical
- Ownership
- Gage data http://waterdata.usgs.gov/nwis
- Watershed development patterns and history
- Prior Investigations
  FEMA floodplain maps and studies
  Federal PFC
  BURP
  USFS Watershed Analysis
  Water Resources Investigation
  Large Private Land Owners (timber, power, agricultural)
  Fish and Game fish surveys,
- Key Reach Identification, project and reference reach

Look at some of the data, and estimate which data types contain the most relevant information for your effort. Try and combine some of the data for clarity (e.g. dry cropland on steep slopes, streams on north slopes, streams near mass wasting areas).



Measuring a stream cross section

Stream Assessment Procedure

1. Prior to conducting fieldwork, it may be advisable to conduct a team meeting and discuss the following:
   - Develop goals, objectives of assessment
   - Identify and discuss inventory procedures (SVAP, PFC, etc)
   - Discuss reaches, how they were identified and delineated.
   - Discuss constraints that may impact the type of project that can be implemented (both physical and ecological)
   - Discuss dominant processes in watershed
   - Identify and discuss recent extreme events (flood, drought, fire, etc) and their effects on the project site
   - Mix disciplines on teams
   - Discuss the plan of movement and logistics
   - Discuss safety requirements and issues (moose, buffalo, cliffs, snakes, etc)
   - Identify relevant field equipment (clothes, water, lunch, sun block, bug juice, graduated wading staff, clip board, tape (25 to 100 foot), waders, camera, chalk board or white board for photo caption, binoculars, radios, GPS, digital range finder, hand level, plant keys, field packet, topo of area, site diagram, inventory worksheets, stream bug id sheets)
2. Once on the site the team should assess the site as a group.
   - Discuss the dominant processes acting on the site (both physical and ecological)
   - Discuss what might have occurred to result in the current condition of the site
   - Discuss how the site might respond to future conditions (flood, fire, development, etc)
   - Discuss what conditions may limit change in the site
   - Measure the entire channel depth and width for the various points identified in the riparian zones.
   - Estimate the side slopes of the channel.
   - Measure entire stream cross section including some of the overbank
   - Measure the bed gradient
   - Assess and quantify the bed and bank material
   - Assess the condition and type of riparian vegetation
   - Discuss possible treatment alternatives
   - Assess the impact of the "do nothing" alternative
   - Discuss the access to the site, construction and staging areas
   - Take photographs at the start of reach, at each active erosion site, and at end of reach looking upstream
3. At the end of the day, the entire team should meet.
   - Discuss problems
   - Discuss possible treatment solutions
   - Discuss possible impacts of solutions (physical and ecological)

Limiting Velocity and Shear Criterion

The affects of the water current on the stability of any streambank protection treatment should be considered. This evaluation should include the full range of flow conditions that can be expected during the design life of the project. Two approaches that are commonly used to express the tolerances are allowable velocity and allowable shear stress.

Flow in a natural channel is governed in part by boundary roughness, gradient, channel shape, obstructions and downstream water level. If the project represents a sizable investment, it may be appropriate to use a computer model such as HEC-RAS to assess the hydraulic conditions. However, if a normal depth approximation is applicable, velocity can be estimated with Manning's equation as provided below. It is important to note that this estimate will be an average channel velocity. Velocity along the outer bank curves may be considerably larger.

$$V = \frac{1.49}{n} S_f^{1/2} R^{2/3}$$

where

V = velocity(fps)

n = Manning's n

A = area

S_f = friction slope, often approximated with bed slope

R = Hydraulic radius (cross section area /wetted parameter)

Manning's n values for small, natural streams (top width <30m)				
Lowland Streams		Minimum	Normal	Maximum
(a)	Clean, straight, no deep pools	0.025	0.030	0.033
(b)	Same as (a), but more stones and weeds	0.030	0.035	0.040
(c)	Clean, winding, some pools and shoals	0.033	0.040	0.045
(d)	Same as (c), but some weeds and stones	0.035	0.045	0.050
(e)	Same as (c), at lower stages, with less effective and sections	0.040	0.048	0.055
(f)	Same as (d) but more stones	0.045	0.050	0.060
(g)	Sluggish reaches, weedy, deep pools	0.050	0.070	0.080
(h)	Very weedy reaches, deep pools and floodways with heavy stand of timber and brush	0.075	0.100	0.150
Mountain streams (no vegetation in channel, banks steep, trees and brush submerged at high stages				
(a)	Streambed consists of gravel, cobbles and few boulders	0.030	0.040	0.050
(b)	Bed is cobbles with large boulders	0.040	0.050	0.070
(Chow, 1959)				

The average shear stress exerted on a channel boundary can be estimated with the equation provided below, assuming the flow is steady, uniform, and two-dimensional.

$$\tau_0 = \gamma R S_f$$

where

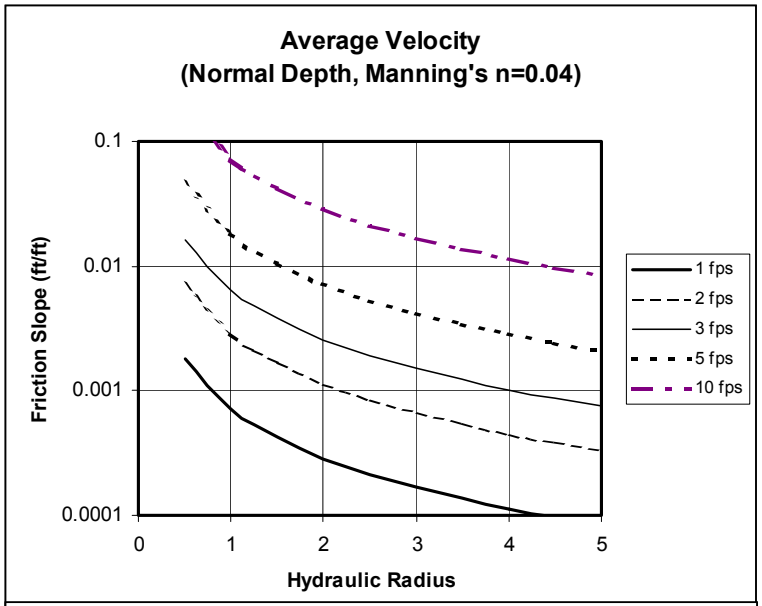
τ_0 = average boundary shear (lb/ft^2)

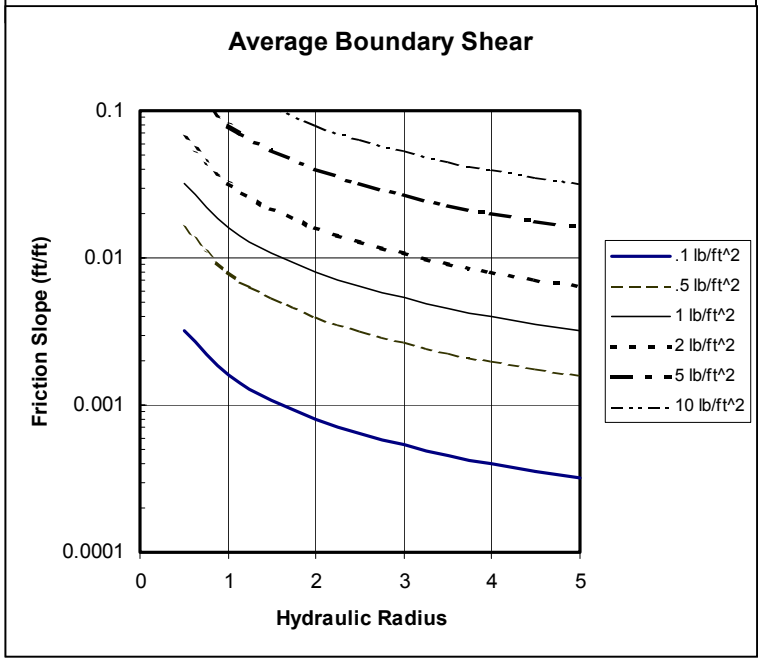
γ = specific weight of water ($62.4\ lb/ft^3$)

R = hydraulic radius (A/P, but can be approximated as depth in wide channels)

S_f = friction slope (can be approximated as bed slope if flowing as normal depth)

The local maximum shear can be up to 50% greater than the average shear in straight channels and larger along the outer banks of sinuous channels. Temporal maximums may also be 10 to 20% larger as well.





Variations in published recommendations for limiting velocity and shear exist and some are summarized in the table below as a guide. * It is important to note that many of these recommendations are empirically determined and, therefore, most applicable for the situations in which they were derived. The designer should consider modifying recommendations based on site specific conditions such as duration of flow, soils, temperature, debris and ice load in the stream, plant species, as well as channel shape and planform.

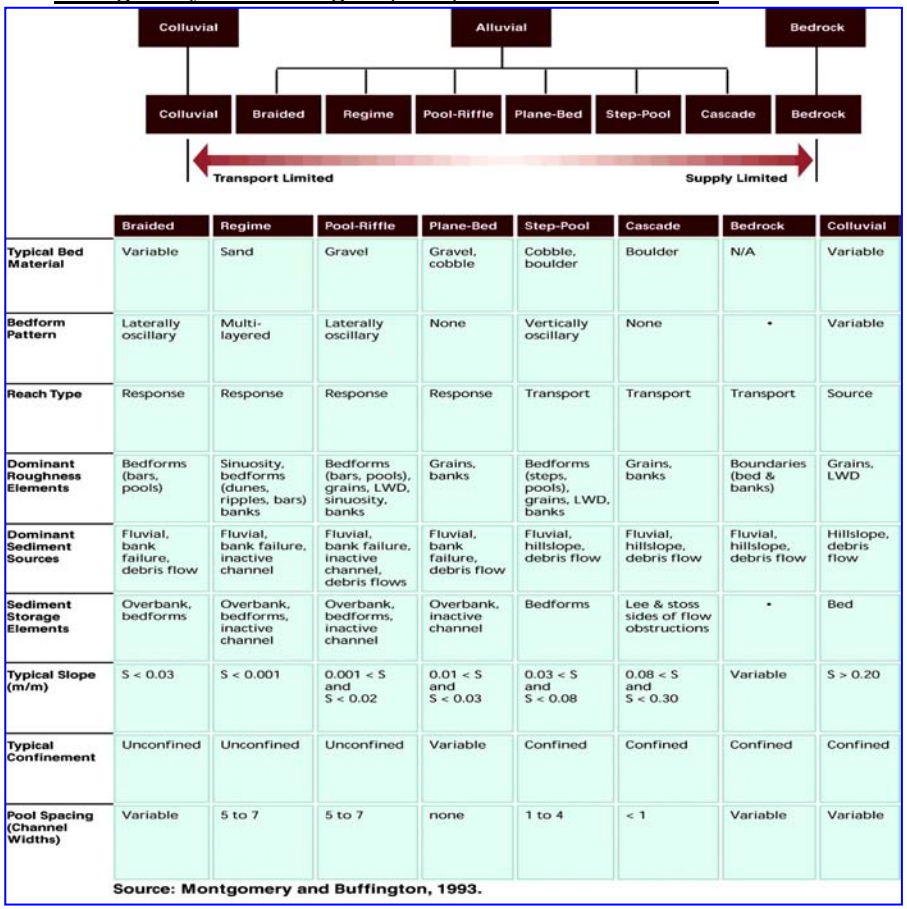
Treatment	shear		Velocity	reference
	lb/ft2	N/m2	fps	
Fascine revetment	1.4	69		Schoklitsch, 1937
Live Fascine (immediately after construction)	1.2	60		Schiechtl and Stern, 1994
Live Fascine (after 3-4 seasons)	1.6	80		Schiechtl and Stern, 1994
Fascine	2.1	103		Gerstgraser, 1999
Wattle (woven, coarse sand between)	0.2	10		Schoklitsch, 1937
Wattles (woven, gravel between)	0.3	15		Schoklitsch, 1937
Wattles (woven, parallel or oblique to current)	1.0	49		Schoklitsch, 1937
Wattle fence (immediately after construction)	0.2	10		Schiechtl and Stern, 1994
Wattle fence (after 3-4 seasons)	1.0	50		Schiechtl and Stern, 1994
Wattle fence	1.0	49		Gerstgraser, 1999
Willow Brush Layer (immediately after construction)	0.4	20		Schiechtl and Stern, 1994
Willow Brush Layer (after 3-4 seasons)	2.9	140		Schiechtl and Stern, 1994
Cuttings of willows/willow stakes	2.0	100	9.8	Gerstgraser, 1999
Willow posts			5 to 8	USACE TR EL 97-8
Live Stakes in riprap (immediately after construction)	4.0	200		Schiechtl and Stern, 1994
Live Stakes in riprap (after 3-4 seasons)	6.0	300		Schiechtl and Stern, 1994
Live cuttings in coarse gravel (immediately after construction)	1.0	50		Schiechtl and Stern, 1994
Live cuttings in coarse gravel (after 3-4 seasons)	5.0	250		Schiechtl and Stern, 1994
Brush mat (immediately after construction)	1.0	50		Schiechtl and Stern, 1994
Brush mat (after 3-4 seasons)	6.1	300		Schiechtl and Stern, 1994
Willow Brush mat (immediately after construction)	4.1	200		Florineth, 1982
Willow Brush mat (after 3-4 seasons)	8.2	400		Florineth, 1982
Brush Mattress w/willows	6.5	320		Gerstgraser, 1999
Stone sill with live joint plantings	3.0	150		Schiechtl and Stern, 1994
Rootwads			8	USACE TR EL 97-8
Sandy Loam	0.0		1.75	Temple, 1980
Silt loam	0.0		2	Temple, 1980
Alluvial silts	0.0		2	Temple, 1980
Ordinary firm loam	0.0		2.5	Temple, 1980
Very light loose sand, no vegetation or protection			1 to 1.5	Fortier and Scobey, 1926
Average sandy soil			2 to 2.5	Fortier and Scobey, 1926
Stiff clay, ordinary gravel soil			4 to 5	Fortier and Scobey, 1926
Deciduous tree plantings (immediately after construction)	0.4	20		Schiechtl and Stern, 1994
Deciduous tree planting (after 3-4 seasons)	2.4	120		Schiechtl and Stern, 1994
Bermuda grass, erosion resistant soils, 0-5% slope			8	USDA, 1947
Bermuda grass, erosion resistant soils, 5-10% slope			7	USDA, 1947
Bermuda grass, erosion resistant soils, over 10% slope			6	USDA, 1947
Bermuda grass, easily eroded soils, 0-5% slope			6	USDA, 1947
Bermuda grass, easily eroded soils, 5-10% slope			5	USDA, 1947
Bermuda grass, easily eroded soils, over 10% slope			4	USDA, 1947
Grass Mixture, erosion resistant soils, 0-5% slope			5	USDA, 1947
Grass Mixture, erosion resistant soils, 5-10% slope			4	USDA, 1947
Grass mixture, easily eroded soils, 0-5% slope			4	USDA, 1947
Grass mixture, easily eroded soils, 5-10% slope			3	USDA, 1947
Grasses: Lespedeza sericea, Weeping lovegrass, Yellow bluestem, Kudzu, Alfalfa, Crabgrass, Common lespedeza; erosion resistant soil, 0-5% slope unless on side slopes			3.5	USDA, 1954
Grasses: Lespedeza sericea, Weeping lovegrass, Yellow bluestem, Kudzu, Alfalfa, Crabgrass, Common lespedeza; easily erodible soil, 0-5% slope unless on side slopes			2.5	USDA, 1954

*More information on allowable shear stresses applicable for grass lined channels can be found in ARS 667, “Stability Design of Grass-Lined Open Channels”.

Fluvial Geomorphology and Classification

Fluvial geomorphology techniques provide insight relative to general responses of a river system to a variety of imposed changes. These techniques are important in analyzing the stability of the existing stream system and in identifying the source of instabilities. Fluvial geomorphology techniques also provide generalized guidance related to appropriate cross-section geometry and channel planform. Some of the techniques are expressed with classification schemes that can aid in communication as well as stratifying data. It is important to recognize that the science of fluvial geomorphology is primarily based on observation. As a result, predicted trends and changes tend to represent average conditions. Assessment and design for a specific project area requires use of physically based calculations. Some of the most popular techniques are summarized on the next pages; however, this collection is neither exclusive nor exhaustive.

Montgomery and Buffington (1993): Stream Classification *

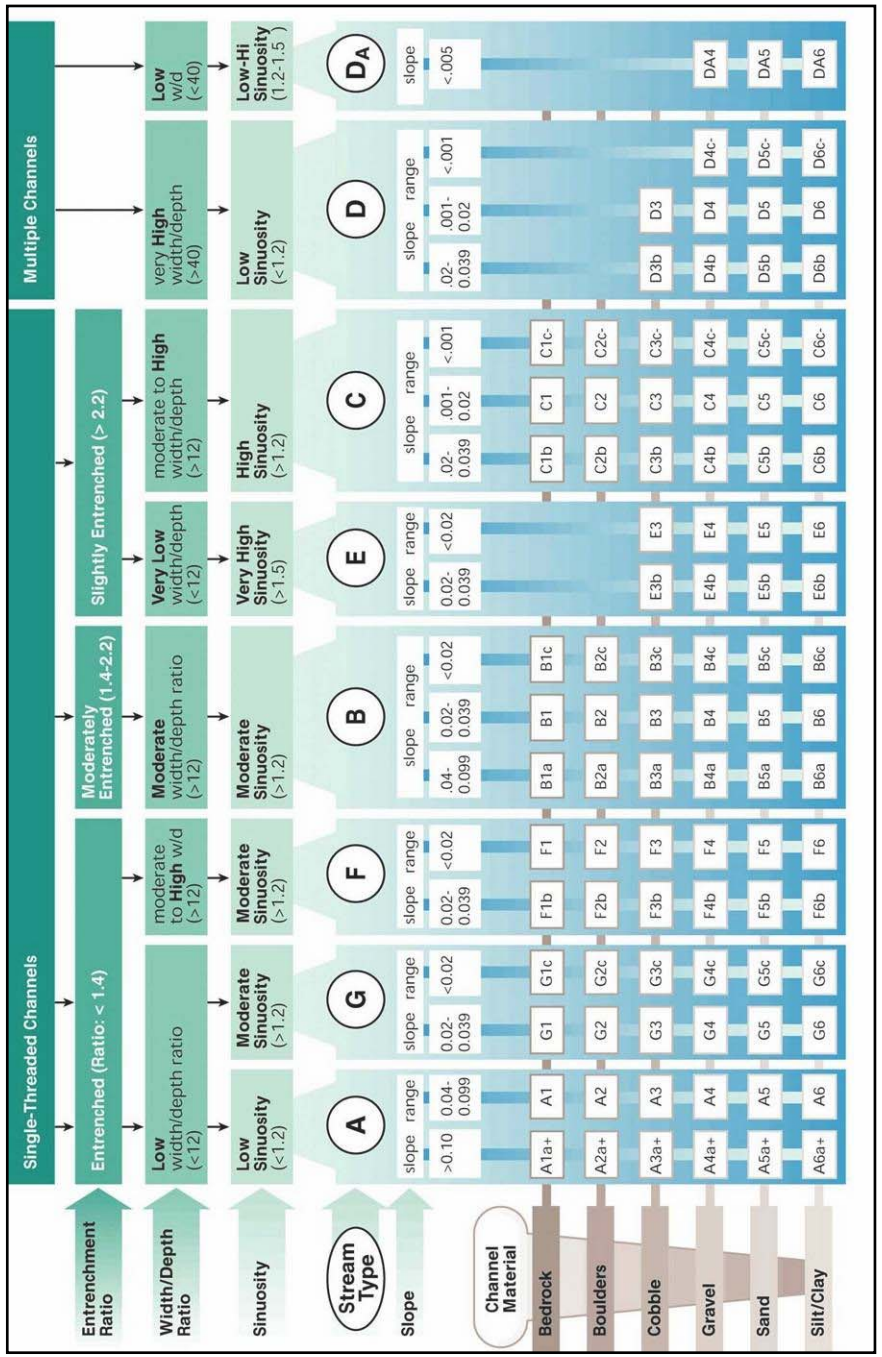


	Braided	Regime	Pool-Riffle	Plane-Bed	Step-Pool	Cascade	Bedrock	Colluvial
Typical Bed Material	Variable	Sand	Gravel	Gravel, cobble	Cobble, boulder	Boulder	N/A	Variable
Bedform Pattern	Laterally oscillary	Multi-layered	Laterally oscillary	None	Vertically oscillary	None	-	Variable
Reach Type	Response	Response	Response	Response	Transport	Transport	Transport	Source
Dominant Roughness Elements	Bedforms (bars, pools)	Sinuosity, bedforms (dunes, ripples, bars) banks	Bedforms (bars, pools), grains, LWD, sinuosity, banks	Grains, banks	Bedforms (steps, pools), grains, LWD, banks	Grains, banks	Boundaries (bed & banks)	Grains, LWD
Dominant Sediment Sources	Fluvial, bank failure, debris flow	Fluvial, bank failure, inactive channel	Fluvial, bank failure, inactive channel, debris flows	Fluvial, bank failure, debris flow	Fluvial, hillslope, debris flow	Fluvial, hillslope, debris flow	Fluvial, hillslope, debris flow	Hillslope, debris flow
Sediment Storage Elements	Overbank, bedforms	Overbank, bedforms, inactive channel	Overbank, bedforms, inactive channel	Overbank, inactive channel	Bedforms	Lee & stoss sides of flow obstructions	-	Bed
Typical Slope (m/m)	S < 0.03	S < 0.001	0.001 < S and S < 0.02	0.01 < S and S < 0.03	0.03 < S and S < 0.08	0.08 < S and S < 0.30	Variable	S > 0.20
Typical Confinement	Unconfined	Unconfined	Unconfined	Variable	Confined	Confined	Confined	Confined
Pool Spacing (Channel Widths)	Variable	5 to 7	5 to 7	none	1 to 4	< 1	Variable	Variable

Source: Montgomery and Buffington, 1993.

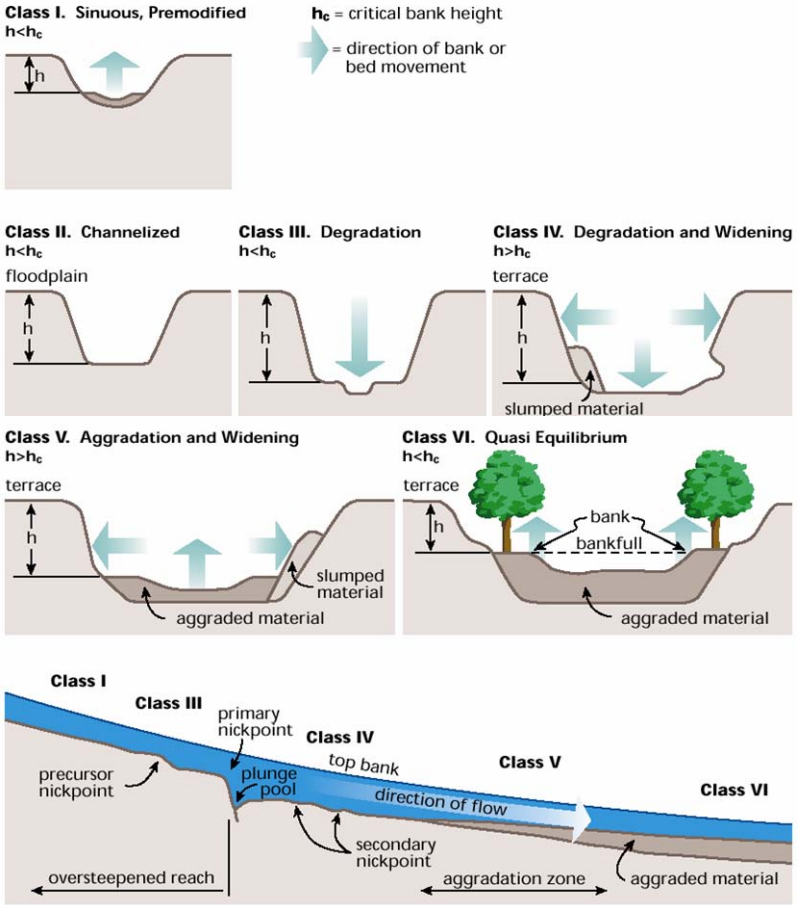
* Figure from Stream Corridor Restoration: Principles, Processes, and Practices, 1998

Rosgen (1993) stream classification *



* Figure from Stream Corridor Restoration: Principles, Processes, and Practices, 1998

Simon (1989) Channel evolution model.*



The channel evolution model (CEM)** above illustrates the importance of establishing or assuring a stable grade before initiating any bank protection project. A channel that is actively degrading (Class 3 above) may potentially undermine any project that is placed on the banks. Note that a stage II is not necessarily found in all channels and that it does not necessarily initiate a stage III. Also, keep in mind that it is possible to skip steps and that physical contraints may limit the ablity of the channel to evolve in any one direction.

* Figure from Stream Corridor Restoration: Principles, Processes, and Practices, 1998

** The Schumm CEM does not include the constructed reach of the presented Simon CEM.

Treatment Strategies Based on Classification

Stream classification can be used not only to assess general trends in stream behavior but also to provide a guide to the selection of treatment strategies. The two tables provided below have been developed as such a guide*. Since every stream system is unique, these are only general trends and there are certainly exceptions.

Treatment Strategies Based on Stream Classification* for Low Banks (< 8 ft) on Low Gradient Streams in Valley Floor Landscapes

Simon[1] CEM Stage	Rosgen Classifi-cation	Treatment Strategies	Typical Practices[2]
I Stable[3]	C, E	Maintain existing watershed runoff volumes and patterns and sediment loads. Maintain or improve existing riparian corridor vegetation. May need to implement soil bioengineering in isolated spots.	Spot treatments with fascines, live stakes, seedlings, rooted stock, or grasses.
III Down-cutting	Gc, F?	Reduce watershed runoff and sediment loads. May need to raise channel bottom to reconnect stream to floodplain and reestablish sinuosity, or may need to establish grade control structurally. May need to reestablish or improve riparian corridor vegetation. DO NOT IMPLEMENT SOIL BIOENGINEERING ALONE.	May need to either fill channel and realign or install grade control; then whatever soil bioengineering is required.
Early IV Widening following down-cutting	F	May need to reduce watershed runoff and sediment loads. May need to create more floodplain (excavation) and shape banks enough to place toe protection. May need to reestablish or improve riparian corridor vegetation. DO NOT IMPLEMENT SOIL BIOENGINEERING ALONE.	May require minor grading with permanent toe pro-tection; then whatever soil bioengineering is required.
IV[4] Widening w/o down-cutting	C, E[4]	Maintain existing watershed runoff volumes and patterns and sediment loads. Reestablish or improve existing riparian corridor vegetation. Consider physically modifying channel width. May need to shape banks enough to place temporary toe protection. Implement soil bioengineering where needed.	May require minor grading with tempo-rary toe protection; then whatever soil bioengineering is required.
Late IV Widening	F, Bc	Maintain existing watershed runoff and sediment loads. May need to create more floodplain (excavation) and shape banks enough to place toe protection. May need to reestablish or improve riparian corridor vegetation. DO NOT IMPLEMENT SOIL BIOENGINEERING ALONE.	Minor grading with permanent toe pro-tection; then whatever soil bioengineering is required.

* Based on information provided by Lyle J. Steffen, Geologist, USDA-NRCS, Lincoln, NE

Early V Deposition	F, Bc	Maintain existing watershed runoff and sediment loads. May need to create more floodplain (excavation) and shape banks enough to place toe protection. Improve riparian corridor vegetation. Implement soil bioengineering where needed.	Minor grading with permanent toe protection; then whatever soil bioengineering is required.
Late V Deposition	Bc, C, E	Maintain existing watershed runoff and sediment loads. May need to shape some banks enough to place toe protection. Improve riparian corridor vegetation. Implement soil bioengineering where needed.	Minor grading with permanent toe protection; then whatever soil bioengineering is required.
VI Stable[2]	C, E	Maintain existing watershed runoff volumes and patterns and sediment loads. Maintain or improve existing riparian corridor vegetation. May need to implement soil bioengineering in isolated spots.	Spot treatments with fascines, live stakes, seedlings, rooted stock, or grasses.

Treatment Strategies Based on Stream Classification* for High Banks (> or = to 8 ft) on Low Gradient Streams in Valley Floor Landscapes			
Simon[1] CEM Stage	Rosgen Classification	Treatment Strategies	Typical Practices[2]
I Stable[3]	C, E	Maintain existing watershed runoff volumes and patterns and sediment loads. Maintain or improve existing riparian corridor vegetation. May need to implement soil bioengineering in isolated spots.	Spot treatments with fascines, live stakes, seedlings, rooted stock, or grasses.
III Down-cutting	Gc, F?	Reduce watershed runoff and sediment loads. Raise channel bottom to reconnect stream to floodplain and reestablish sinuosity, or establish grade control structurally. May need to reestablish or improve riparian corridor vegetation. DO NOT IMPLEMENT SOIL BIOENGINEERING ALONE.	Either fill channel and realign or install grade control; then whatever soil bioengineering is required.
Early IV Widening following down-cutting	F	Reduce watershed runoff and sediment loads. Create more floodplain (excavation) and shape banks to reduce slope failure hazard and place toe protection. May need to reestablish or improve riparian corridor vegetation. DO NOT IMPLEMENT SOIL BIOENGINEERING ALONE.	Major grading with permanent toe protection; then whatever soil bioengineering is required.

* Based on information provided by Lyle J. Steffen, Geologist, USDA-NRCS, Lincoln, NE

IV[4] Widening w/o down-cutting	C, E[4]	Maintain existing watershed runoff volumes and patterns and sediment loads. Reestablish or improve existing riparian corridor vegetation. Consider physically modifying channel width. May need to shape banks enough to reduce slope failure hazard and to place temporary toe protection. Implement soil bioengineering where needed.	May require grading with temporary toe protection; then whatever soil bioengineering is required.
Late IV Widening	F, Bc	Maintain existing watershed runoff and sediment loads. Create more floodplain (excavation) and shape banks to reduce slope failure hazard and place toe protection. May need to reestablish or improve riparian corridor vegetation. DO NOT IMPLEMENT SOIL BIOENGINEERING ALONE.	Major grading with permanent toe protection; then whatever soil bioengineering is required.
Early V Deposition	F, Bc	Maintain existing watershed runoff and sediment loads. May need to create more floodplain (excavation) and shape some banks to reduce slope failure hazard and to place toe protection. Improve riparian corridor vegetation. Implement soil bioengineering where needed.	Minor grading with permanent toe protection then whatever soil bioengineering is required.
Late V Deposition	Bc, C, E	Maintain existing watershed runoff and sediment loads. May need to shape some banks to reduce slope failure hazard and to place toe protection. Improve riparian corridor vegetation. Implement soil bioengineering where needed.	Minor grading with permanent toe protection then whatever soil bioengineering is required.
VI Stable[3]	C, E	Maintain existing watershed runoff volumes and patterns and sediment loads. Maintain or improve existing riparian corridor vegetation. May need to implement soil bioengineering in isolated spots.	Spot treatments with fascines, live stakes, seedlings, rooted stock, or grasses.

[1]The Schumm CEM does not include the constructed reach of the Simon CEM presented earlier.
[2]Most soil bioengineering practices will be placed on the active floodplain above the top of the low streambanks. Some practices may be placed on the upper part of the bank.
[3]Stable from a geomorphic perspective.
[4]"C" or "E" stream types with higher width/depth ratios than the norm, and with accelerated streambank erosion rates, may be in Stage III due to loss or deterioration of riparian corridor vegetation.

Stone Sizing

The design of stone or riprap requires enginering analysis. Many State and Federal agencies have developed various methods and approaches to the sizing of riprap. Three common techniques for estimating the required stone size are briefly outlined below. The designer is encouraged to review the complete guidance and to assess the relevance of the assumptions used in the technique development. It is important to note that size is only one of many conciderations when designing stone or riprap revetments. The designer needs to also address issues such as material strength, angularity, durability, dimension, gradation, etc.

USACOE – Maynord Method: This technique for the design of riprap revetments is outlined in standard US Army Corps of Engineers (USACE) guidance as provided in EM 1110-2-1601. It is based on a modification to the Maynord equation as follows:

$$d_{30} = SF \times C_S \times C_v \times C_T \times D \times \left[\left(\frac{\gamma_W}{\gamma_S - \gamma_W} \right)^{.5} \times \frac{V}{\sqrt{K_1 \times g \times D}} \right]^{2.5}$$

Where:

d_m = Stone size; m percent finer by weight

SF = factor of safety (usually 1.2 to 1.5))

C_s = Stability coefficient (0.3 for angular rock, 0.375 for rounded rock)

C_v = Velocity distribution coefficient (1.0 for straight channels or inside of bends, calculate for outside of bends)

C_T = Thickness coefficient (use 1.0 for 1 D_{100} or 1.5 D_{50}, whichever is greater))

d = local depth

Γ_x = Specific weight; stone or water

V = local velocity

K_1 = side slope correction

Note that the local velocity can be 120% to 150% of the average channel velocity or higher. The outside bend velocity coefficient and the side slope correction can be calculated as follows:

$$C_v = 1.283 - 0.2\log(R/W) \quad ; \qquad K_1 = \sqrt{1 - \frac{\sin^2\theta}{\sin^2\phi}}$$

Where:

R= center-line bend radius

W = water surface width

θ = angle of rock with horizontal

ϕ = angle of repose (typically 40 degrees)

NRCS (1996): Chapter 16 of the NRCS field handbook contains two techniques for estimating stone size. Figures from this book are shown below. Both are for sizing stone in riprap revetments. The Isbash curve should only be used for quick estimates or for comparisons.

Rock size based on FWS (FWS) – Lane Method.

Procedure:

1. Enter Figure with energy slope (channel grade) and flow depth.
2. Track right to side slope
3. Track up to ratio of curve radius to water surface width
4. Track right to rock size (D75)

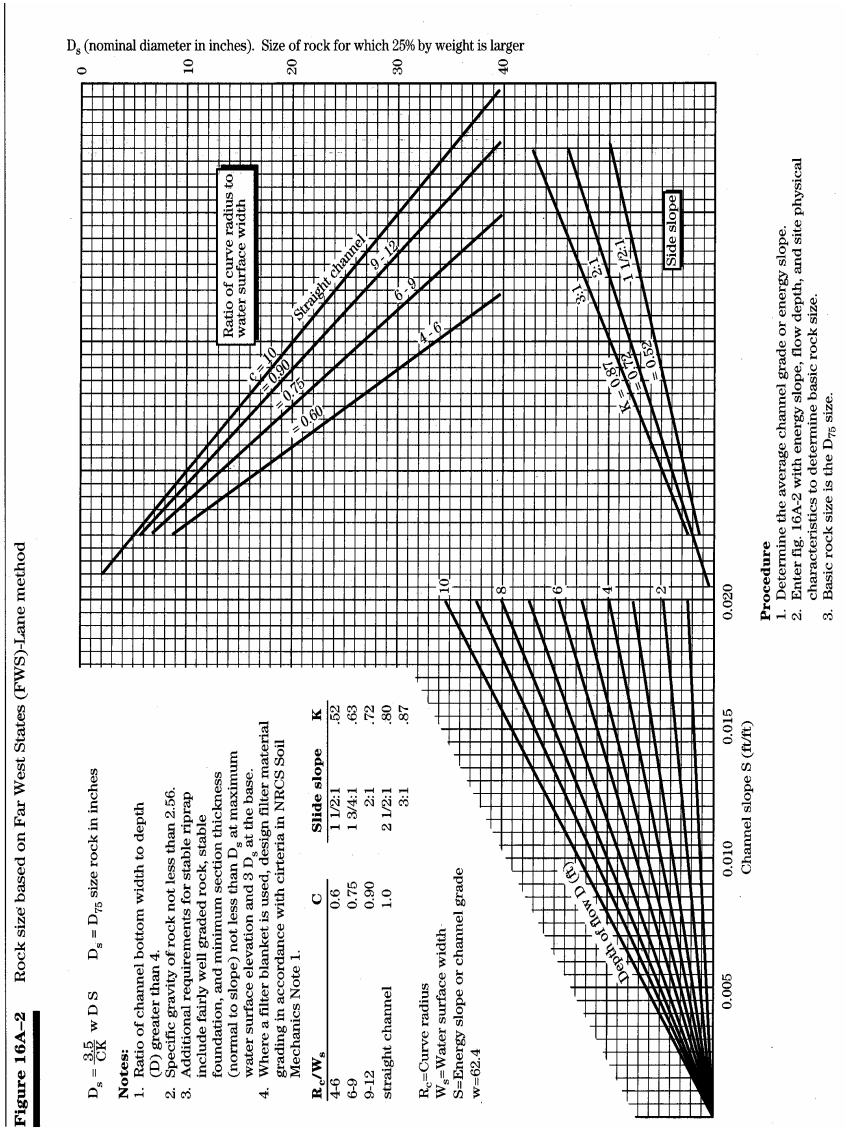


Figure 16A–2 Rock size based on Far West States (FWS)-Lane method

$D_s = \frac{3.5}{CK} w D S$ $D_s = D_{75}$ size rock in inches

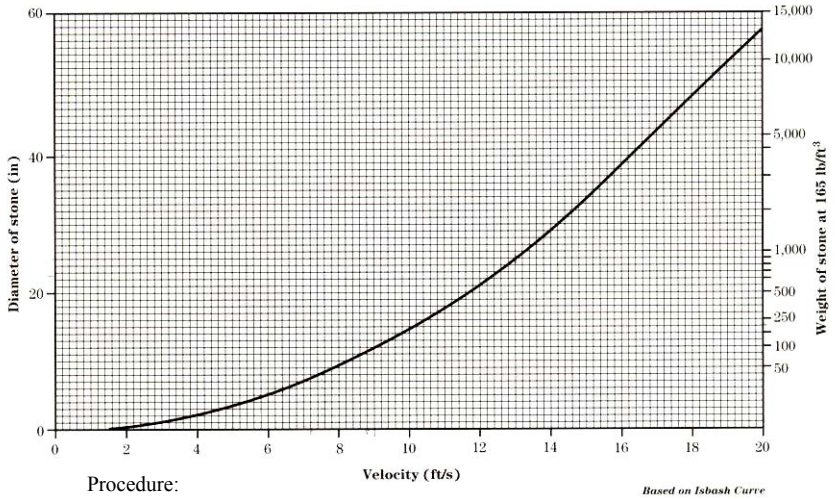
Notes:

1. Ratio of channel bottom width to depth (D) greater than 4.
2. Specific gravity of rock not less than 2.56.
3. Additional requirements for stable riprap include fairly well graded rock, stable foundation, and minimum section thickness (normal to slope) not less than D_s at maximum water surface elevation and 3 D_s at the base.
4. Where a filter blanket is used, design filter material grading in accordance with cirteria in NRCS Soil Mechanics Note 1.

R_c/W_s	C	Slide slope	K
4-6	0.6	1 1/2:1	.52
6-9	0.75	1 3/4:1	.63
9-12	0.90	2:1	.72
straight channel	1.0	2 1/2:1	.80
		3:1	.87

R_c=Curve radius
W_s=Water surface width
S=Energy slope or channel grade
w=62.4

Rock Size based on Isbash Curve:



Procedure:

1. Estimate the design velocity
2. Track right to the basic rock size. This size is the D_{100}.

Gradation: The gradation of stones in riprap affects its resistance to erosion. Specifications typically include two limiting gradation curves. USACE EM 1110-2-1601 (1991) contains standardized gradations for riprap placement in the dry, low turbulence zones. One is provided below.

Limits of Stone Weight, lb[1], for Percent Lighter by Weight

D_{100}(max) (in.)	100		50		15		D_{30}(min) (ft)	D_{90}(min) (ft)
	Max	Min	Max[2]	Min	Max[2]	Min		
Specific Weight = 165 pcf								
12	86	35	26	17	13	5	0.48	0.70
15	169	67	50	34	25	11	0.61	0.88
18	292	117	86	58	43	18	0.73	1.06
21	463	185	137	93	69	29	0.85	1.23
24	691	276	205	138	102	43	0.97	1.40
27	984	394	292	197	146	62	1.10	1.59
30	1,350	540	400	270	200	84	1.22	1.77
33	1,797	719	532	359	266	112	1.34	1.96
36	2,331	933	691	467	346	146	1.46	2.11
42	3,704	1,482	1,098	741	549	232	1.70	2.47
48	5,529	2,212	1,638	1,106	819	346	1.95	2.82
54	7,873	3,149	2,335	1,575	1,168	492	2.19	3.17

An alternate approach is to use quarry run stone. This may offer significant cost advantages over graded riprap. Another advantage is that the sand and gravel size component may serve as a filter. However, it is not suitable in all circumstances. Quarry run stone that is gap graded or with a large size range (D85/D15>7) is generally unsuitable.

Low Head Stone Grade Control Weirs

Description: Low Head Stone Grade Control Weirs are structures designed to maintain the grade of the stream and typically require an engineered design. They are used to stop headcutting, reduce upstream energy, and to prevent bed scour. The establishment of a stable grade in an eroding stream is a critical first step in any stream bank stabilization or restoration effort. Low head stone weirs are typically used in moderate to steep gradient, gravel bed streams. They are not typically used in streams that are subject to braiding or aggradation. Additional cautions include:

- Impacts to flood flows should be considered.
- Changes to the existing profile should be minimized.
- The grade at the lower end of a series of stone weirs should be stable or should be stabilized.
- Caution should be exercised in reaches with a high debris load since the material may build up on the weir stones.
- Aggradation upstream of any grade control may cause stream meandering.

Design and Installation:

- The stone weirs should be located to correspond, as much as possible, to existing riffles and shallow areas. Avoid locating them in deep pools.
- The spacing between the weirs should be calculated. One of the techniques for locating the weirs includes the use of a limiting slope criteria to estimate the minimum spacing as follows:

$$x = \frac{H}{S_o - S_L}$$

Where: x = length between grade control structures
H = amount of drop removed in reach between the weirs
S_o = original bed slope
S_L = limiting slope

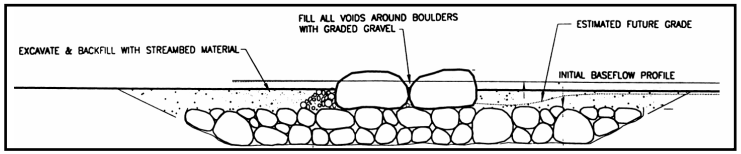
The limiting slope can be calculated or approximated as 0.5 the bed slope in steep streams and 0.7 the bed slope in mild gradient streams. Alternately, the toe of the next upstream grade control can be placed at the same elevation as the crest of the downstream grade control.

- The maximum total drop across the length of riffle that a stone weir can maintain is typically one foot.
- To control the development of this scour hole so that it does not undermine the stones of the weir, a blanket of riprap or graded stone should be provided as bedding and backfill under and around the weir stones. The bedding should extend several feet beyond the boulders.
- Since the stones must be designed for impinging flow, they should be large. It is important to note that most of the common riprap design guidance techniques are for revetments and must be adjusted to reflect impinging flow. Detailed engineering analysis is typically

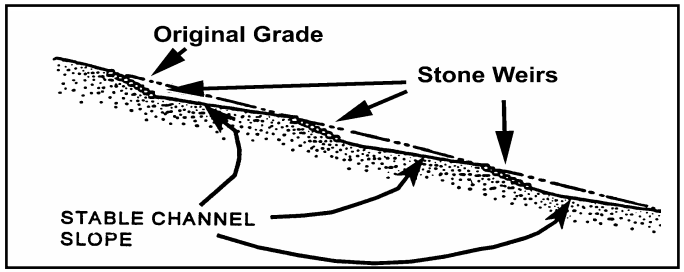
required. Some approximate FHWA guidance is provided in the table below.

Stone Size	Velocity
2 ft	Less than 10 fps
4 ft	10 to 13 fps

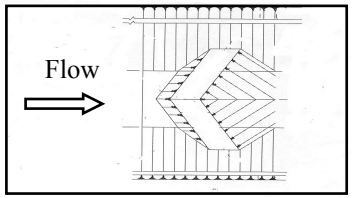
- There are many configurations used in the design of low head stone weirs. Some are perpendicular to the flow with a depressed center and others are at angle to the flow. The configuration may be a chevron "v" shape with the vortex of the "v" pointed upstream. A wide stream (> 50 feet) may necessitate a "w" shape or flattened "u" shape to the weir to minimize the channel length of the structure.
- If a stone grade control structure is to be placed in fine grained, highly mobile and/or rapidly degrading stream reach, an impervious barrier is recommended. This barrier can consist of clay, concrete, or sheet pile and is to prevent the loss of material through the voids between the boulders.
- The entire structure should be keyed into a stone toe protection on the banks to reduce the possibility of flanking.
- Bank protection should be considered at and below the structure.
- The end of a series of weirs should tie into a stable grade. A bedrock outcrop, a bridge sill, a stable channel reach, or the confluence with a larger stable channel can provide this end stability.



Cross Section of a low head stone weir (Detail from USACE-CENAB)



Channel stabilized with a series of low head stone weirs *



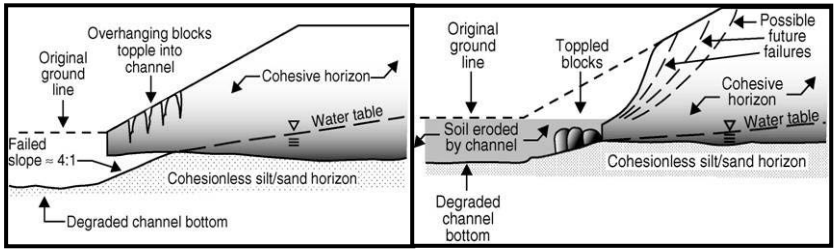
Chevron Weir (Detail from USACE)

* Adapted from WES Stream Investigation and Streambank Stabilization Handbook, 1997

Soil Mechanics Considerations

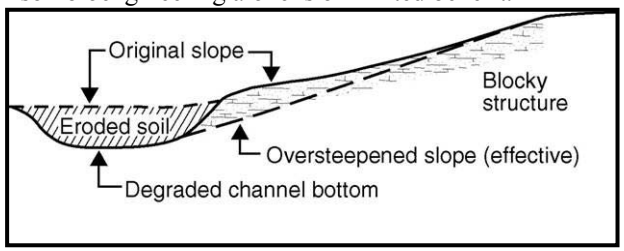
Many channel stability problems result from a combination and interaction of a number of different causes*. These causes can include not only issues related to fluvial erosive forces, but also seepage problems as well as properties of the soil. Three common geotechnical stability problems are briefly outlined below.

Piping/Sapping of Channel Banks: May occur where silts and sands are layered between lower permeability clays. Water flowing from the bank can detach the cohesionless soil particles and carry them out of the channel bank leaving a void that may be pipe or shelf shaped. The overlying soils then fail by toppling into the channel. The slope failure that results is called an *infinite slope failure*. Streambank soil bioengineering measures alone are generally ineffective in preventing a piping/sapping failure from occurring. However, streambank soil bioengineering may be effective in stabilizing the upper and lower banks after a suitable filter layer or drain is installed and after the bank has been graded to a stable slope.

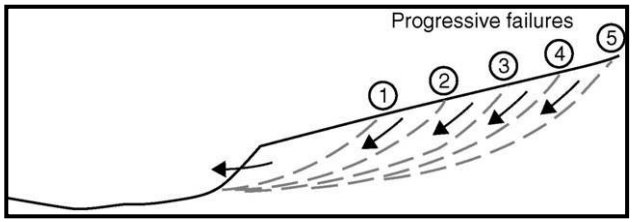


Development of piping/sapping bank failure

Shallow Slope Failure in Block Structure and Highly Plastic Clays: The blocky structure in these types of materials generally results from alternating wetting and drying cycles. The soil structure is further weakened when water enters these cracks and lubricates them. Bank failures are generally arc shaped and occur in successive incidences of slope movement. The slides are generally no more than 3 to 4 feet deep. The ultimate stable slope can be in the range of 4H:1V to 7H:1V. Solutions to a stability problem of this nature may involve replacing the highly plastic soil, soil reinforcement, and shaping the bank. Streambank soil bioengineering alone is of limited benefit.



* Adapted from material provided by Danny McCook, Geotechnical Civil Engineer, NDCSMC



Development of bank failure in blocky structure highly plastic clays

Dispersive Clays: These materials have a different chemical composition than typical clays, which causes them to break down in the presence of water. The erosion patterns are often described as jug shaped. A useful field test for identifying dispersive clays is the crumb test where a small clump of the soil is placed in a glass of distilled water and observed. A rapid formation of a cloud around the soil indicates that it is dispersive. Streambank soil bioengineering alone is generally not effective on sites that are experiencing failures due to dispersive clays. Solutions may involve covering the clays with a protective blanket or chemically altering the soils with lime, fly ash, and gypsum.

Unified Soil Classification

The Unified Soil Classification is a rapid method for identifying and grouping soils. While it was originally developed for military construction projects, it is also used for other civil engineering applications and as a valuable communication tool. There are many charts available that provide typical properties for each group. However, it is important to keep in mind that no visual classification system is a substitute for tests of the soil properties and an engineering analysis of the results.

MT-ENG-211 4/20/81 File Code 210-12 Unified Soils Classification

FINE GRAINED SOILS

More than 1/2 of the material (by weight) is individual grains not visible to the naked eye.

Shine--Rub fingernail or knife on moist soil, high plasticity--shiny surface.

Ribbon--Squeeze soil at plastic limit moisture between thumb and finger, pull apart.

Liquid Limit--Add water to soil clod, break open, slow water entry--high Liquid Limit.

Dry Crushing Strength--Crush an air dried clod with fingers.

Dilatency--Place moist soil on hand, shake horizontally, observe water on surface.

Toughness--Roll 1/8" moist soil threads, pull apart, clays break circumferentially.

Stickiness--Let wet soil dry on hand, ML and MH brush off. CH needs water.

RIBBON	LIQUID LIMIT	DRY CRUSHING STRENGTH	DILATENCY REACTION	TOUGHNESS	STICKINESS	TYPE
None	50 fast	None to slight	Rapid	Low	None	ML
Weak	50 fast	Medium to high	None to very slow	Medium to high	Medium	CL
Strong	50 slow	Slight to medium	Slow to none	Medium	Low	MH
Very Strong	50 slow	High to Very High	None	High	Very High	CH

High Organic Soils--Identify by color, odor, spongy feel, fibrous texture } OL, OH, PT

MT-ENG-211 4/20/81 File Code 210-12 Unified Soils Classification

COARSE GRAINED SOILS

More than 1/2 of the material (by weight) is individual grains visible to the naked eye.

Gravelly Soils--More than 1/2 of coarse fraction is larger than 1/4 inch.

CLEAN GRAVELS Will not leave a stain on a wet palm	Substantial amounts of all grain particle sizes	GW
	Predominantly one size or a range of sizes with some intermediate sizes missing.	GP
DIRTY GRAVELS Will leave a stain on a wet palm	Nonplastic fines	GM
	Plastic fines	GC

Sandy Soils--More than 1/2 of coarse fraction is smaller than 1/4 inch.

CLEAN SANDS Will not leave a stain on a wet palm	Wide range in grain size and substantial amounts of all grain particle sizes.	SW
	Predominantly one size or a range of sizes with some intermediate sizes missing.	SP
DIRTY SANDS Will leave a stain on a wet palm	Nonplastic fines	SM
	Plastic fines	SC

Soil Type	Description
CL, CH	Low to high plasticity, generally high clay content, high dry strength, shrink-swell may be a problem depending on clay type. These materials generally provide good to high resistance to erosion.
MH	High plasticity silts, moderate dry strength. These materials generally have fair to good erosion resistance
ML	Low plasticity to non plastic silts. Low dry strength. These materials generally have poor erosion resistance
SC, GC	Grain to grain contact as well as plastic fines add cohesion, which results in these materials having fair to good resistance to erosion.
SM, GM	Low plasticity to nonplastic fines in combination with sand and/or gravel. Low wet and dry strength. Since grain to grain contact is important in coarser soil materials for erosion resistance, these materials generally have poor to fair erosion resistance.
SP, SW	Non plastic poorly to well graded clean sands. May act as a single grain if cemented by a cementing agent (iron oxide, calcium carbonate, or silica). These materials generally have poor erosion resistance if uncemented.
GP, GW	Non plastic poorly to well graded clean gravels. May act as a single grain if cemented by a cementing agent (iron oxide, calcium carbonate, or silica). These materials generally have poor erosion resistance if rounded. Erosion resistance is better if angular.

Sediment Grade Scale

It is often necessary to group sediments into different size classes or grades. Since the points between the different classes are basically arbitrary, many such classifications are available in the engineering and geologic literature. One such* is provided below:

Class Name*	Size Range (mm)	Size Range (in)
Very large boulders	4096 – 2048	160 – 80
Large boulders	2048 – 1024	80 - 40
Medium boulders	1024 – 512	40 - 20
Small boulders	512 – 256	20 - 10
Large cobbles	256 – 128	10 – 5.0
Small cobbles	128 – 64	5.0 - 2.5
Very coarse gravel	64 – 32	2.5 – 1.3
Coarse gravel	32 – 16	1.3 - 0.6
Medium gravel	16 - 8.0	0.6 - 0.3
Fine gravel	8.0 - 4.0	0.3 - 0.16
Very fine gravel	4.0 – 2.0	0.16 - 0.08
Very coarse sand	2.0 – 1.0	
Coarse sand	1.0 – 0.5	
Medium sand	0.5 – 0.25	
Fine sand	0.25 – 0.125	
Very fine sand	0.125 – 0.062	
Coarse Silt	0.062 – 0.031	
Very fine to medium silt	0.031 – 0.004	
Very fine to coarse clay	0.004 – 0.00024	

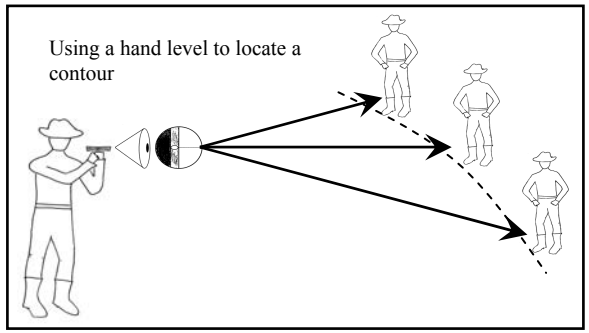
Basic Surveying

Many soil bioengineering techniques require the determination of existing slope of the land as well as locating a contour. Exact determinations require extensive training and equipment; however, some approximations can be accomplished with a minimum of effort and tools.

Equipment: Hand level, tape

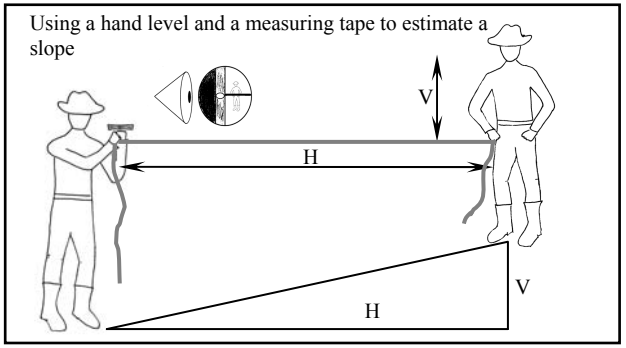
Locating a Contour: To avoid concentrating flow, many soil bioengineering techniques are installed on a contour. A contour line is a line of constant elevation. This can be approximated as follows:

- One man stands straight at one location with the hand level.
- The hand level is held up to one eye so that the bubble is aligned with the cross wire.
- The second man stands up hill to where the contour is to be determined. The first man must be able to see some portion of his body (for example: the top of his boot) through the hand level. This point is mentally 'marked'.
- The second man slowly walks along the approximate contour. The first man tells him to walk up or down slope depending on the relative location of the 'marked' point to the cross wire.
- The second man periodically scuffs the soil to mark the location of the contour.



Determining a Slope: The spacing as well as limiting criteria for many soil bioengineering practices are based on the slope of the ground. These slopes are often expressed as a ratio of a horizontal measurement to a vertical measurement (H:V). The slope is defined along a line that is perpendicular to a contour. This can be approximated as follows:

- Two men stand side by side and determine where the eyes of the first man (with the hand level) would be on the second man.
- The first man holds the hand level so that the bubble is aligned with the cross wire and focuses on the second man. The second man measures from where the first mans eyes would be on him if they were standing beside one another to the point where the cross wire is now aligned. This is the vertical measurement.
- The first man holds one end of the measuring tape at his eye and the second man holds the other end of the measuring tape at the point where the cross hair is aligned. This is the horizontal measurement.



Note: Final design of most projects, typically involve significantly more detailed surveying efforts.

* Abbreviated from ASCE Engineering Practice No. 54

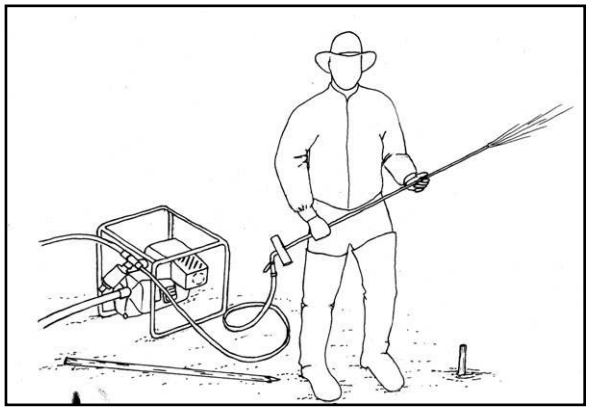
Waterjet Stinger

Adequate hydrology is critical for the success of projects involving live posts and poles. Typically, live posts and poles are installed so that the bottom of the cutting is about a foot below the lowest water table. This can be difficult in semiarid regions since the watertable may be 3 to 6 feet below the surface. A waterjet stinger is a tool used to plant dormant, unrooted cuttings of willows, cottonwoods, dogwoods and other species as part of riparian bioengineering projects*. This piece of equipment uses high pressure water to hydrodrill a hole.

The simple device consists of a nozzle of stainless steel welded to the end of a ½ inch pipe. A T-handle is located at the top to aid in the planting operations. A valve is fixed to the top to control flow. The probe is connected by a garden hose to a pump. A pressure relief valve is included on the pump for safety. The requirements for the pump include:

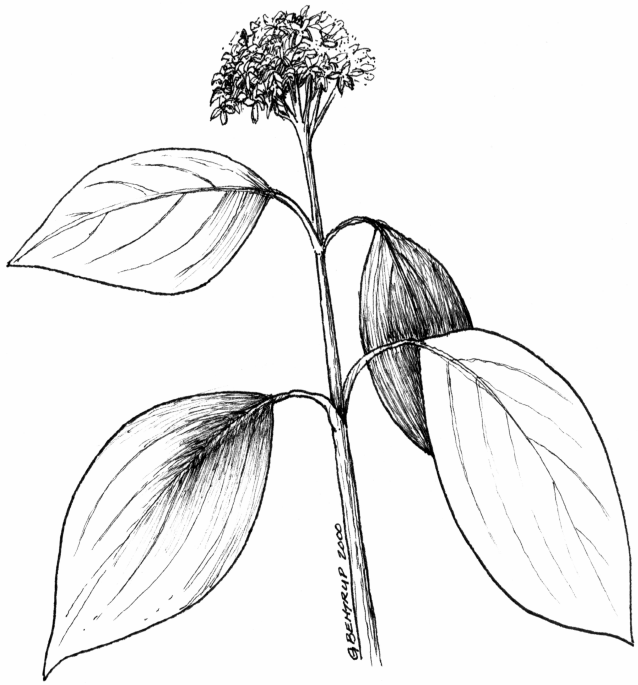
- gasoline powered
- small enough to be transported
- minimum 80 psi output
- 120 gpm output
- minimum vertical lift of 18 feet

The waterjet is operated by placing the nozzle against the ground and turning on the valve. As the water starts to jet out, the waterjet will slowly sink into the ground. If it hits a hard layer, it may slow or stop but the jet should eventually work through it. If medium sized rocks are encountered, the user will need to wiggle the jet back and forth until the water can find a way around it. Once the desired depth is reached, the user should pull the waterjet out of the hole, while continuously rocking it back and forth to create a larger hole. The cuttings should be pushed into the hole immediately after it has been created, to avoid having it collapse or fill with silt.



* More information on the contruction and operation of a waterject stinger can be found in *Riparian/Wetland Project Information Series No. 17* (June 2001).

PLANT DATASHEETS FOR COMMON RIPARIAN WOODY PLANTS OF THE WESTERN UNITED STATES*

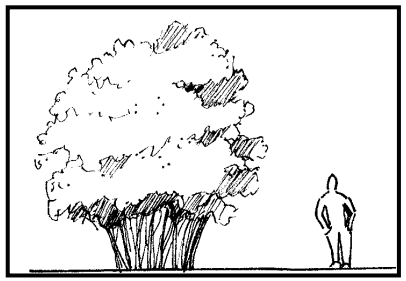


Redosier Dogwood (Cornus sericea)

Different plant species have characteristics that make them suitable for different bioengineering treatments. For example, willows are generally not only adventitiously rootable, but have deep, spreading root systems which facilitate anchoring the soil on stream banks. The following is a partial list of some of the species that are available in the arid and semiarid Great Basin and the Intermountain West of the United States. Information and drawings are modified from *The Practical Streambank Bioengineering Guide* by Bentrup and Hoag (1998).

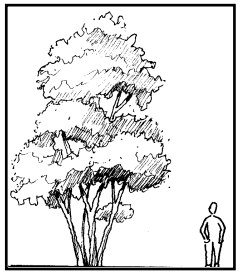
* More information can be found in Bentrup, G. and Hoag, J. C., 1998, *The Practical Streambank Bioengineering Guide*, Plant Materials Center, Aberdeen ID

Yellow Willow - *Salix lutea*



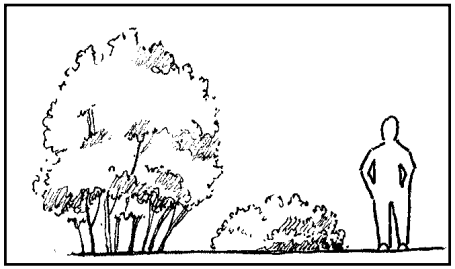
Description: Rounded shrub, occasionally becoming a multi-stemmed tree, up to 20 feet in height. The twigs are yellowish white to gray, not hairy. The leaves are green above and pale with a waxy bloom beneath, margins are finely toothed especially near the apex. Older leaves lack hairs. The stipules are somewhat persistent. It is very common from 2,000 to 4,500 feet. Yellow Willow is commonly found with coyote and pacific willow in a variety of sites from coarse cobble along streams to moist terraces with deep, fine textured soils.
Propagation: Roots easily along the entire stem from hardwood cuttings.

Pacific Willow - *Salix lucida ssp. Lasiandra*



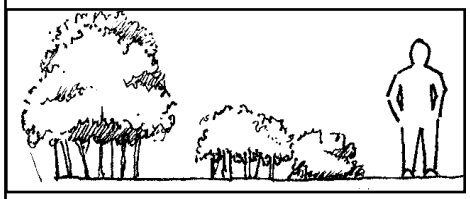
Description: Tree with several main stems and a dense green crown, up to 50 feet in height. Stems often 4 to 12 inches in diameter. The twigs are covered with a fine pubescence. The lower bark is rough and brown. The upper bark is smooth. Leaves are long, lanceolate with finely toothed margins, green on both sides, lacking a waxy bloom. Apex of leaf has a curving point, hence the name whiplash. Distinctive glands are found on the petioles at the base of the leaf. It is common from 2,000 to 6,000 feet (below 6,500). Pacific Willow occurs with black cottonwood and yellow willow and likes moist sandy to gravelly soils.
Propagation: Easy to propagate from 2- to 4-year old stems, older stems root more slowly

Geyer Willow - *Salix geyeriana*
Note: Closely related to Lemmon willow and may be synonymous



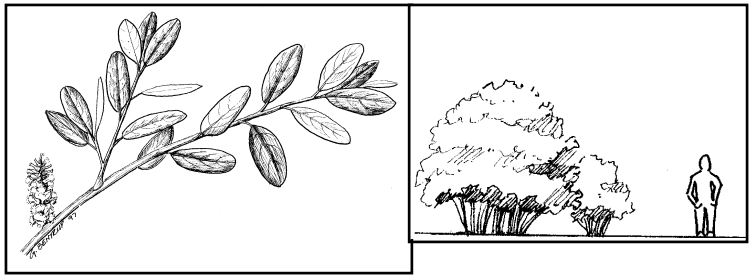
Description: Shrub with numerous straight branches, up to 10 to 15 (20) feet in height arising from a tight basal cluster. The twigs are green and covered with a white waxy coating. The leaves are dark green and hairy above, with a waxy bloom underneath that can be rubbed off. It is found from 4,000 to 8,000 feet, often on side drainages and is most common on deep, fine textured soils. It is usually found with booth willow that will occupy wetter zones while Geyer willow will occupy drier sites.
Propagation: Roots along entire stem and has good rooting

Coyote Willow - *Salix exigua*
Note: Sometimes referred to as sandbar or dusky willow.



Description: Shrub 3 to 15 (27) feet in height, thicket forming with numerous slender stems. New twigs are reddish brown turning to ashy gray when older. Leaves are long and narrow with short petioles, generally green above and pale below. The silvery pubescence on young leaves wears off, becoming dull, grayish green. All of the recognized subspecies and varieties are rhizomatous, thicket-forming willows. Coyote Willow is a very common species from 2,000 to 7,000 feet and is associated with cottonwood, whiplash and yellow willow. It grows on moist soils, from gravel to silt.
Propagation: Roots freely from cuttings, easiest species to propagate.

Drummond Willow - *Salix drummondiana*



Description: Shrub with open growth form, up to 6 to 12 feet in height. The twigs are green to reddish purple and are covered with a whitish waxy bloom. The leaves are narrow at the base, widening out at the middle and rounded at the apex and dark green on top. The underside of the leaves has a pubescence that appears to be a waxy bloom, but will not rub off. Edges of the leaves are rolled under. Drummond Willow is found from 4,500 to 9,000feet, abundant at higher elevations. It is usually associated with Engelmann spruce and subalpine fir on coarse textured soils that are moist and well aerated.
Propagation: Roots along entire stem with good to excellent rooting.

Booth Willow - *Salix boothii*

Description: Many branched shrub with a rounded top. Generally reaches 6 to 10 (20) feet in height. It has numerous basal stems less than 2 inches in diameter, usually with bright yellow bark. The leaves are green on both sides and slightly toothed. A distinctive feature of Booth Willow is that the leaves lack a waxy bloom and have few if any hairs. It is a common willow from 4,500 to 8,000 feet and is usually found with Geyers and Drummond Willow. It prefers moist wet, coarse soil but it also grows on fine-textured soils.
Propagation: Roots well from hardwood cuttings, easy to propagate.

Peachleaf Willow - *Salix amygdaloides*

Description: Tree sometimes up to 90 feet in height with trunks 3 feet in diameter. However, it can be smaller, occurring in clumps and having 1 1/2 to 2 feet diameter trunks. The twigs are smooth, shiny gray to red-brown to orange. Bark is grayish brown, shallowly furrowed, and shaggy. Leaves are alternate, simple, lanceolate, finely toothed, somewhat leathery, yellowish green above and pale beneath without any glands or hairs on the petiole. It is found primarily at low elevations from 2,000 to 6,000 feet and is associated with cottonwoods and coyote willow. Peachleaf Willow prefers loamy soils that are saturated seasonally.
Propagation: Good rooting ability, roots up and down the entire stem. Use smooth bark sections rather than deep furrowed sections.

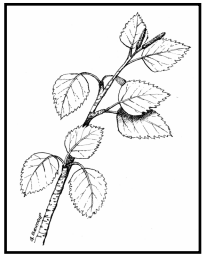
Black Cottonwood - *Populus trichocarpa*

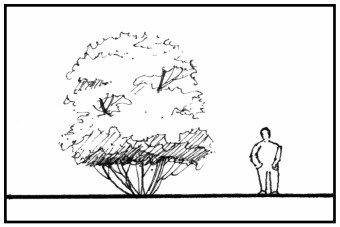
Description: Very tall tree with narrow, rounded, open to pointed crown, up to 160 feet in height. Trunk diameters from 2 to 5 feet. Twigs are yellow-gray. Old bark is thick, grayish-brown, and deeply furrowed. Leaves are alternate, smooth, thick, hairless, wedge shaped, and finely round-toothed. The leaf color is dark green above and silvery with rust colored spots beneath. Leaf stalks are round, a pair of glands are at the base of the leaf. It is common from 3,000 to 5,000 feet. Black Cottonwood occurs with Whiplash and Yellow Willow, grows well on coarse soils that are flooded, i.e., floodplains.
Propagation: Roots easily along entire stem. Use smooth bark sections rather than older, deep furrowed sections.

Narrowleaf Cottonwood - *Populus angustifolia*

Description: Medium-sized tree with narrow, rounded crown, up to 60 feet in height with trunk diameters from 1 to 2 foot. Bark is shallowly fissured with broad, flat ridges. Bark on upper branches is whitish, becoming slightly darker with age. Leaves are eglandular, lance shaped, broadest near the middle, tapering to a pointed tip with finely toothed margins, and bright yellowish green with a flattened leaf stalk. It is found from 4,000 to 7,000 feet and usually occurs with Redosier Dogwood and Alder. Narrowleaf Cottonwood occupies coarse, cobbly soils that flood frequently. It generally prefers wetter sites that drain quickly.
Propagation: Roots easily from hardwood cuttings. Use smooth bark sections.

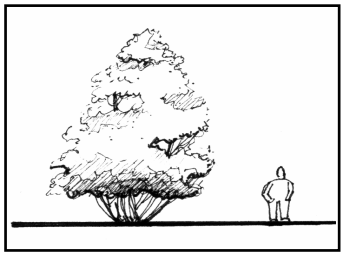
Water (Black) Birch - *Betula occidentalis*





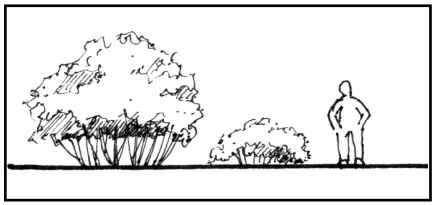
Description: A small tree or large shrub up to 30 feet tall, frequently found in crowded dense thickets; bark is thin, smooth, almost black on young trees, turning reddish-brown with age. Twigs are slender, upright, covered with numerous glands (small bumps). The leaves are alternate, deciduous, with rounded wedge shaped base and pointed tip, leaf base is entire extending to double row of fine sharp-pointed teeth, dark greenish-yellow and shiny above, paler and gland dotted below, sometimes tufts of hair at junctions of veins. Water Birch is a fairly common species that can be found from 4,500 to 10,000 feet. It is typically found along rivers, streams, springs and moist locations on a variety of gravelly, cobbly to medium textured soils.
Propagation: Does not root readily from hardwood cuttings. Most successful when propagated from seed.

Thinleaf Alder - *Alnus incana spp. tenuifolia*



Description: A large shrub up to 40 feet tall; bark is thin, smooth, dirty green-gray and tends to flake when older. Stems are somewhat three sided, sometimes with short rusty hairs, and pith turns rusty color when freshly cut. Leaves are alternate, deciduous dull green on both sides and yellow-green on central vein, not sticky, with double dentate margins. It is found between 2,000 to 7,000 feet in moist mountain woods and streambanks in coarse textured soils.
Propagation: June and July softwood cuttings treated with 8,000 ppm IBA is generally recommended for Alnus species. Field propagation by dormant unrooted hardwood cuttings is very difficult.

Redosier Dogwood - *Cornus sericea*



Description: Open, spreading, multi-stemmed medium to large shrub. It has a loose rounded form and spreads by stolons and natural layering. It generally reaches 7 to 10 feet in height and has horizontal branches at the base. The bark is smooth, with prominent lenticels, and blood-red which provides good color in the winter. Leaves are opposite, dark green above and soft white hairs below when young, and smooth when older with 5-7 prominent upcurving and parallel veins that converge at tip. It is found from 4,500 to 7,000 feet on alluvial terraces and the steep side slopes of canyons. It occurs on moderately to well-drained soils and may require fresh, well-aerated water. Soils are often poorly developed and coarse-textured, resulting in low available water capacity.
Propagation: It is most often grown by unrooted or rooted cuttings. Use rooting hormones and wounding the bark before planting.

Riparian References

There are many publications that are available, which provide more detail on issues related to stream bank soil bioengineering. A partial list is provided below, however, this list is neither inclusive nor exhaustive.

Allen, H.H. and J.R. Leech. 1997. *Bioengineering Guidelines for Streambank Erosion Control*. Environmental Impact Research Program Technical Report. U.S. Army Corps of Engineers Waterways Experiment Station. Technical Report EL-97-8

ASCE. 1975, *Sedimentation Engineering*, Engineering Practice No. 54

Bentrup, G and J.C. Hoag 1998. *The Practical Streambank Bioengineering Guide: a User's Guide for Natural Streambank Stabilization Techniques in the Arid and Semi-arid Great Basin and Intermountain West.* Interagency Riparian/Wetland Project, Plant Materials Center, USDA-NRCS, Aberdeen, ID.

Beschta, R.L. and W.S. Platts. 1986. Morphological features of small streams: significance and function. *Water Resources Bulletin* 22(3):369-379.

Carlson, J.R., G.L. Conaway, J.L. Gibbs, and J.C. Hoag. 1995. *Design Criteria for Revegetation in Riparian Zones of the Intermountain Area*. USDA NRCS Riparian/Wetland Project Information Series #9, Plant Materials Center, Aberdeen, ID.

Chang, H.H. 1992. *Fluvial Processes in River Engineering*. Krieger Publishing Co, Malabar, FL.

Copeland, R.R., D.N. McComas, C.R. Thorne, P.J. Soar, M.M. Jonas, and J.B. Fripp, 2001, *Hydraulic Design of Stream Restoration Projects,* U.S. Army Corps of Engineers. ERDC/CHL TR-01-28

Firehock, K. and J. Doherty, 1995. *A Citizen's Streambank Restoration Handbook.* Save our Streams, Izaak Walton League of America, Inc., Gaithersburg, MD.

Fischenich, J.C. and H.H. Allen 1999. *Stream Management*. US Army Corp of Engineers, Ft. Worth District, Ft. Worth, TX.

Gerstgraser, 1999, *The effect and resistance of soil bioengineering methods for streambank protection*, Proceedings of Conf 30, IECA, Nashville TN

Gordon, N.D., T.A. McMahon, and B.L. Finlayson. 1992. *Stream hydrology: an introduction for ecologists*. John Wiley and Sons, New York, NY.

Gray, D.H. and R.B. Sotir. 1996. *Biotechnical and Soil Bioengineering Slope Stabilization*. John Wiley and Sons, Inc. New York, NY.

Gray, D.H. and A.T. Leiser. 1982. *Biotechnical Slope Protection and Erosion Control.* Van Nostrand Reinhold, New York, NY.

Hoag, J.C. 1993a. *Selection and acquisition of woody plant species and materials for riparian corridors and shorelines.* USDA NRCS Riparian/Wetland Project Information Series #2, Plant Materials Center, Aberdeen, ID.

Hoag, J.C, B. Simonson, B. Cornforth, and L. St. John 2001. *Waterjet Stinger: A tool to plant dormant unrooted cuttings of willows, cottonwoods, dogwoods, and other species.* Riparian/Wetland Project Information Series No. 17. USDA-NRCS Aberdeen Plant Materials Center, Aberdeen, ID. Jan. 2001. 12 p.

Hoag, J.C., F.E. Berg, S. K. Wyman, and R.W. Sampson 2001. *Riparian Planting Zones in the Intermountain West.* Riparian/Wetland Project Information Series No. 16: USDA-NRCS Aberdeen Plant Materials Center, Aberdeen, ID. March 2001. 24p

Kondolf, M. 1995b. Five elements for effective evaluation of stream restoration. *Restoration Ecology* 3(2):133-136.

Leopold, L.B. M.G. Wolman, and J.P. Miller. 1964. *Fluvial Processes in Geomorphology.* Dover Publications, New York, NY.

Leopold, L.B. 1994. *A View of the River.* Harvard University Press, Cambridge, MD.

Lewis, L. 2000. Soil Bioengineering: An alternative for Roadside Management, A Practical Guide. USFS Technology & Development Program, 0077 1801-SDTDC, San Dimas, CA.

Minshall, G.W., S.E. Jensen, and W.S. Platts. 1989. *The ecology of stream and riparian habitats of the Great Basin region: a community profile*. Biol. Rep. 85(7.24). U.S. Department of Interior, Fish and Wildlife Service, National Wetlands Research Center, Slidell, LA.

Olson-Rutz, K.M. and C.B. Marlow. 1992. Analysis and interpretation of stream channel cross-sectional data. *North American Journal of Fisheries Management*. 12:55-61.

Piper, K.L., J.C. Hoag, H. Allen, G. Durham, and C. Fischenich. 2000. *Bioengineering as a tool for restoring ecological integrity to the Carson River*. ERDC TN-WRAP-01-05, Sept. 2001. USACE Waterways Experiment Station, Vicksburg, MS.

Platts, W.S. et al. 1987. *Methods for Evaluating Riparian Habitats with Applications to Management.* General Technical Report INT-221, USDA Forest Service, Rocky Mtn. Research Station, Ogden, UT.

Rosgen, D.L. 1996. *Applied River Morphology*. Wildland Hyrdrology, Pagosa Springs, CO.

Schiechtl, H.M. 1980. *Bioengineering for Land Reclamation and Conservation*. University of Alberta Press, Edmonton, Canada.

Schiechtl, H.M. and R. Stern. 1994. *Water Bioengineering Techniques*. Blackwell Science, Cambridge, MA.

Schoklitsch, A. 1937. *Hydraulic Structures - A Text and Handbook*, The American Society of Mechanical Engineers, New York, NY

Temple, D. 1980, *Tractive Force Design of Vegetated Channels*, ASCE, Transactions, A28Vol 23, No 4

USACE. 1981. *Final Report to Congress: the Streambank Erosion Control Evaluation and Demonstration Act of 1974*. Section 32, PL 93-251.

USACE, 1991, *Hydraulic Design of Flood Control Channels,* EM 1110-2-1601

USACE, 1997, *WES Stream Investigation and Streambank Stabilization Handbook*, D. S. Biedenharn, C.M. Elliot, and C.C Watson

USDA, SCS, 1947 (revised 1954) *SCS Handbook of Channel Design for Soil and Water Conservation*, TP-61
USDA. NRCS, 1992 *Chapter 18 Soil Bioengineering for Upland Slope Protection and Erosion Control*
USDA. NRCS, 1996 *Chapter 16 Streambank and Shoreline Protection*
USDA. 1998, *Stream Corridor Restoration: Principles, Processes, and Practices.*

Acknowledgments

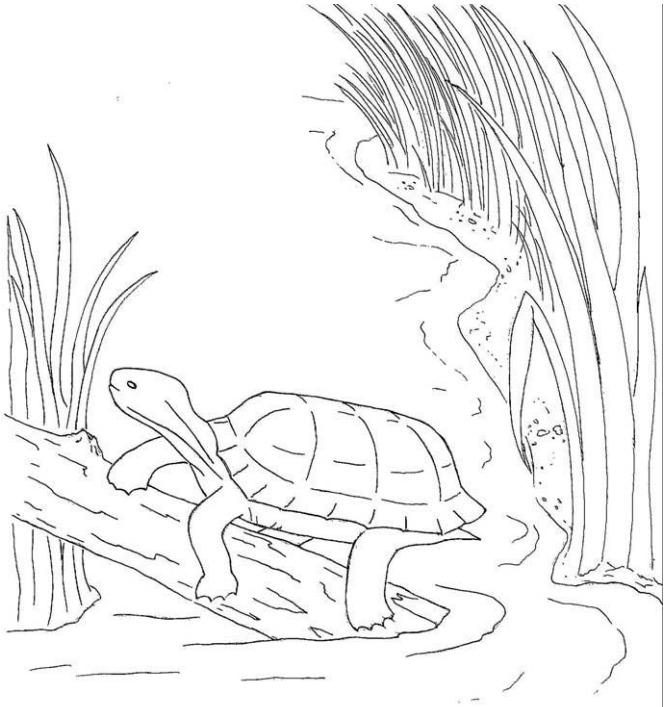
Numerous people provided expert reviews and comments. Their contributions are acknowledged and very much appreciated. The authors hope that they have listed all of the people who have contributed to this effort and trust that those who were inadvertently omitted will understand.

Lee Brooks, ASTCTS, NRCS, Boise, ID
Art Shoemaker, State Conservation Engineer, NRCS, Boise, ID
Terril Stevenson, Geologist, NRCS, Boise, ID
Tom Moody, PE, Natural Channel Designs, Flagstaff, AZ
Stephanie Yard, PE, Natural Channel Design, Flagstaff, AZ
Justin Krajewski, Idaho Soil Conservation Commission, Pocatello, ID
Bruce Sandoval, Civil Engineer, NRCS, Pocatello, ID
Hollis Allen, Ecologist, Allenvironment Consulting, Vicksburg, MS
Nicholas Metes, Program and Training Specialist, AG/ENV Center for Field Assistance and Applied Research, Peace Corps, DC
Kerry Robinson, Hydraulic Engineer, NRCS, WSSI, Raleigh, NC
Dave Burgdorf, Plant Materials Specialist, NRCS, East Lansing, MI
Frank Cousin, Soil Bioengineer, NRCS East Lansing, MI
Leland Saele, Civil Engineer, NRCS, NDSCMC, Ft. Worth, TX
Danny McCook, Geotech Engineer, NRCS, NDCSMC, Ft. Worth, TX
Larry Goertz, Hydraulic Engineer, NRCS, NDCSMC, Ft. Worth, TX
Don Shanklin, Civil Engineer, NRCS, NDCSMC, Ft. Worth, TX
Rosanna Brown, Landscape Architect, NRCS, NDCSMC, Ft. Worth, TX
Wade Anderson, Civil Engineer, NRCS, NDCSMC, Ft. Worth, TX
Jerry M. Bernard, National Geologist, NRCS, Washington, DC
Lyle Steffen, Geologist, NRCS, National Soil Survey Center, Lincoln,NE
Kevin Piper, District Manager, Dayton Valley Conservation District, Dayton, NV
Robbin Sotir, Consultant, Robbin B. Sotir & Assoc., Inc, Marietta, GA

Figures have been provided by:
Gary Bentrup, US Forest Service, Agroforestry Center, Lincoln NE
Valeska Fripp, Earth Team Volunteer, NRCS, NDCSMC, Ft. Worth TX
Juan Renteria, Civil Engineer, NRCS, NDCSMC, Ft. Worth, TX

An editorial review has been provided by:
Cathy Tillman, NRCS, NDCSMC, Ft. Worth, TX

Funds for printing this publication were provided by USDI Bureau of Reclamation, Pacific Northwest Region



View From a Wetland

News and Technology for Riparian and Wetland Management

Interagency Riparian/Wetland Plant Development Project
Natural Resources Conservation Service
Plant Materials Center
Aberdeen, ID

Number 8 (2002)

Project Leader
J. Chris Hoag, Wetland Plant Ecologist

"Good judgment comes from experience, and a lot of that comes from bad judgment."
– Will Rogers

Introduction

This newsletter is part of the Aberdeen Plant Materials Center's continuing effort to provide useable information to the public on wetland and riparian plants, plant establishment, and management. This newsletter is the eighth issue published since the Interagency Riparian/Wetland Plant Development Project was established in 1991.

Riparian/wetland Project

The Project mission is to introduce performance-tested ecotypes to the commercial seed and plant industry and to document technical information to improve the establishment of wetland and riparian herbaceous and woody plants. The Project has collected numerous riparian and wetland plant species in four ecoregions within our Service Area in the arid and semi-arid West. The Project has released 24 performance tested wetland plant ecotypes of six different herbaceous species.

Interagency Riparian/Wetland Plant Development Project website has moved

Many of you have probably noticed that the Interagency Riparian/Wetland Plant Development Project website has moved. The USDA has finally move away from Unix and into a Windows environment. With this move, most of the servers are now windows servers. This means that you will have to put www before the address. In addition, the plant materials program has gone to a frames format on the website. This means that I cannot give you the exact address to the riparian/wetland project papers. You will need to go to the Idaho Plant Materials Center website and in the lower right hand corner, you will see the Riparian/Wetland Project link. Click on it and you will go directly to the riparian/wetland papers. So the new website address is http://www.plant-materials.nrcs.usda.gov/idpmc. Please make a note of this change.

Riparian Ecology and Restoration Workshops

As part of our technology transfer program a two-day Practical Streambank Bioengineering Workshop (renamed from the Riparian Ecology, Restoration, and Management Workshop) was developed. The first day of the workshop is devoted to the classroom where basic riparian dynamics, riparian zone vegetation, plant acquisition, and bioengineering techniques are discussed. The second day is spent at a field location where participants classify the riparian site and install a series of bioengineering structures on an eroding section of streambank.

Each year the Project conducts several workshops in different parts of our service area. If you are interested in attending this course, contact Pat Blaker at the PMC for the next scheduled workshop.

If you are interested in a workshop in your area and you have about 30 people, who would attend the training, contact Chris and we will try to schedule a course in your area.

This year we put on a workshop in Bend, OR for the Deschutes Basin Land Trust. We covered a few different topics at this workshop in addition to streambank bioengineering treatments, like wetland functions, planting willows into grass, and using weed barrier for woody plant establishment. WE demonstrated the waterjet stinger using willows plugs that were small enough to fit into the hole that was hydrodrilled by the waterjet.

Willow Clump Planting: a fantastic streambank bioengineering treatment (Part 2)

Last year, I talked about willow clump plantings and the advantages of using this treatment for streambank stabilization. After publishing the newsletter, I was contacted by Kelly Ellis (Stephan B. Ellis Co., Provo, UT) about some of his experiences. I have worked with Kelly for a number of years and appreciated his willingness to share some of his experiences. "…We had some "lessons learned" with the storing and moving - loading and unloading the clumps. Initially, scooping up the clump off the flatbed trailer was difficult for the hoe operator and was breaking up the clump. Our solution was to use an ASV Posi-track MD-70 to push the clump into the bucket of the hoe. We had some pretty big clumps. The ASV was small enough to fit under the hoe and work as a second hand. We had one track-hoe digging and placing clumps on a low flatbed trailer, a pickup pulling the 12-ton trailer and another track-hoe with the ASV unloading and replanting. On our good day I think we dug and planted over 50 clumps. The restrictions were the tight spaces (canyon project), multiple small wetlands, distance between digging sites, planting sites, and the nursery location (only available site was some distance from all dig/plant sites). Walking time for the track-hoes (back and forth) was a cost killer. All in all, the general contractor and I lost money on this bid item but the results were pretty good, if I do say so myself…."

Deer Repellant Effectiveness

According to a recent publication by the Missoula Technology and Development Center, they evaluated 20 commercially available deer repellents. They planted some highly palatable trees, sprayed them with the repellents and then put some deer in with them. The results indicate that the most effective repellents are those that emit sulfurous odors such as egg or slaughterhouse waste. Repellents that use bittering agents to repel were ineffective while those that had active ingredients that caused pain or irrigation when eaten were probably not in concentrations high enough to be effective. The most effective products generally eliminate browsing for a month and can provide good protection for 2-3 months. Their effectiveness will decline significantly after 3-4 months. An important point of the study is that none of the repellents provided complete protection after the first month.

The effectiveness of the game repellents depends upon other factors and the season. Other factors including deer population density, palatability of species, weather conditions and availability of alternative food sources affected browsing. Under extreme deep perdition, other strategies including exclusion fencing and netting might be a more effective option.

(2001 Tech Tip 0124-2331-MTDC. USDA Forest Service, Technology and Development program, Missoula Technology and Development Center)

Grazing Riparian Areas

Grazing riparian areas has long been an important consideration to livestock operators. Research on when and how to graze these areas has indicated that careful management is extremely important. In addition, certain precautions should be incorporated into the planned grazing system.

Timing is probably the important consideration. Late spring after the spring runoff is the best time to graze a riparian area. Vegetation is growing and there is a lot of feed for the animals. As summer comes on, the woody vegetation will be "sweeter" and the livestock will start to select it over the herbaceous feed. This is the time to move the livestock out of the riparian area.

Some producers like to graze in the fall. This season is the hardest to manage because there is little regrowth of the riparian zone vegetation. Remember that the vegetation that is left after the livestock are removed is all that will be there when the floods hit the next spring. Heavy grazing will remove the main protection for the streambank and floodplain, i.e. the vegetation. A general recommendation is to remove no more than 25-30% of the herbaceous vegetation and less than 10% of the woody plants.

Careful management and constant attention seem to be the best advice for grazing a riparian zone. The key species should be the willows. Remember that the buffer zone along the stream is what will control the streambank erosion and how far the river will move.

New publication- *Streambank Soil Bioengineering Field Guide for Low Precipitation Areas*

Jon Fripp and I have just finished a new publication that we titled - *Streambank Soil Bioengineering Field Guide for Low Precipitation Areas.* It is intended as a pocket field guide for soil bioengineering treatments that are used to reduce streambank erosion. It incorporates a general discussion on riparian planting zones, plant materials selection criteria, and different treatments including installation guidelines and materials requirements. It is based on the *Practical Streambank Bioengineering Guide*.

The Streambank Soil Bioengineering Field Guide is small enough to fit in a field pack. It is printed on water resistant paper so it can be used in most any weather. The information in the field book is meant to provide a quick reference while in the field working on a project. This guide is not intended to be an exhaustive design tool. While the appendix contains overview information, this field guide is not intended for the final design of rock structures such as deflectors, weirs, or riprap revetments nor is it intended to provide sufficient information for a geotechnical slope stability analysis. Rather this field guide should be viewed as a general field reference and review document.

I hope to have the field guide up on the Riparian/Wetland Project website by this summer.

Fertilizing Wetland plants in the Field

Recently I was asked what kind of fertilizer that I recommend for a new planting of wetland plants. Generally, the first question I ask is what deficiencies did the soil test show. Next, I ask what the water quality samples show for the source water. Usually the nutrients in the source water are enough to feed the established wetland plants. Occasionally, a planting will be made in an area where the nutrients are low and the plants need some extra help. In these cases, a foliar fertilizer is recommended rather than a time-release fertilizer. We usually get a faster response and the plants seem to do better with the foliar fertilizer. Also, with a time release fertilizer, it takes at least 65°F temperatures to activate and release the fertilizer.

Use different colored flagging for various wetland plant species when harvesting

If you are harvesting different wetland plant species from sites that are away from the planting site and you are using an inexperienced crew, try using different colored engineering flagging to identify the various species. I have also used different colored paint sprayed onto the large harvested clumps. This way when the trailer arrives at the project site, the planting crew knows that the flagging or paint on the clump corresponds to the same colored flags that are laid out in project wetland based on the planting plan.

Additional Information

All publications are now available on the Internet in Adobe Acrobat format. **NOTICE: We have moved our website address.** You can download each of the papers by going to http://Plant-Materials.nrcs.usda.gov/idpmc. Once at this site, click on Riparian/Wetland Project in the lower left to get to the correct page. If you do not have access to the Internet or would like to receive a hard copy, please contact us.

Bioengineering Information

The Practical Streambank Bioengineering Guide: A user's guide for natural streambank stabilization techniques in the arid and semi-arid Great Basin and Intermountain West. – Available on the Internet at http://Plant-Materials.nrcs.usda.gov/idpmc**.** The Internet version of the Bioengineering Guide is in 4 files written in Adobe Acrobat format.

Individual Wetland Plant Fact Sheets – description, ecology, collection, propagation, management, and uses of:

Nebraska Sedge *(Carex nebrascensis)*
Creeping Spikerush *(Eleocharis palustris)*
Baltic Rush *(Juncus balticus)*
Threesquare Bulrush *(Scirpus pungens)*
Alkali Bulrush *(Scirpus maritimus)*
Hardstem Bulrush *(Scirpus acutus)*

Riparian/Wetland Project Information Series

No. 2 - Selection and Acquisition of Woody Plant Species and Materials for Riparian Corridors and Shorelines.

No. 3 - Use of Willow and Cottonwood Cuttings for Vegetating Shorelines and Riparian Areas.

No. 6 - Seed and Live Transplant Collection Procedures for 7 Wetland Plant Species.

No. 7 - Use of Greenhouse Propagated Wetland Plants Versus Live Transplants to Vegetate Constructed or Created Wetlands.

No. 8 - Constructed Wetland System for Water Quality Improvement of Irrigation Wastewater.

No. 9 - Design Criteria for Revegetation in Riparian Zones of the Intermountain Area.

No. 10 - Perigynium removal and cold-moist stratification improve germination of *Carex nebrascensis* (Nebraska sedge)

No. 11 - Getting "Bang for your Buck" on your next Wetland Project.

No. 12 - Guidelines for Planting, Establishment, Maintenance of Constructed Wetland Systems.

No. 13 – A Reference Guide for the Collection and Use of Ten Common Wetland Plants of the Great Basin and Intermountain West.

No. 14 - Harvesting, Propagating and Planting Wetland Plants.

No. 15 - Costs and considerations of streambank bioengineering treatments.

No. 16 – Riparian Planting Zones

No. 17 – Waterjet Stinger: A tool to plant dormant unrooted cuttings of willows, cottonwoods, dogwoods, and other species

Idaho NRCS PM Technical Notes

No. 6 - The Stinger, a tool to plant unrooted hardwood cuttings of willow and cottonwood species for riparian or shoreline erosion control or rehabilitation.

No. 23 - How to Plant Willows and Cottonwoods for Riparian Rehabilitation.

No. 32 – User's Guide to Description, Propagation and Establishment of Native Shrubs and Trees for Riparian Areas of the Intermountain West.

No. 38 - User's Guide to Description, Propagation and Establishment of Wetland Plant Species and Grasses for Riparian Areas in the Intermountain West.

For a copy, write or call:

Interagency Riparian/Wetland Project
Plant Materials Center
USDA, NRCS
P.O. Box 296
Aberdeen, ID 83210
Phone (208) 397-4133
Fax (208) 397-3104
Email – **chris.hoag@id.usda.gov**