USDA NRCS
Natural Resources Conservation Service

United States
Department of
Agriculture

Natural Resources
Conservation Service

Aberdeen, Idaho

March 2008

Aberdeen Plant Materials Center

2007 Annual Technical Report

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 currently maintains 13 cultivars and 31 pre-variety (Selected Class) releases. 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 2007.

The following documents and presentations were developed during FY 2007 and may be obtained by contacting the Aberdeen Plant Materials Center:

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PRESENTATIONS

Date 10/2/2006
Title: PMC Tour
Presenter: St. John **Location** Aberdeen PMC

Date 11/8/2006

Title: Cub River Fluvial Geology discussion
Presenter: Hoag, JC and R Sampson **Location** Preston, ID

Date 11/14/2006
Title: Streambank Soil Bioengineering Technical Training at Woodland, CA
Presenter: Hoag, JC and J Fripp **Location** Esparto, CA

Date 11/16/2006
Title: PMC tour for Upper Uncompahgre Project Personnel.
Presenter: Bair, Cornforth, St. John **Location** PMC

Date 11/16/2006
Title: Streambank Soil Bioengineering Technical Training field exercise for Guinda, CA
Presenter: Hoag, JC and J Fripp **Location** Guinda, CA

Date 11/28/2006
Title: Streambank Soil Bioengineering Technical Training in St. George, UT
Presenter: Hoag, JC and T Moody **Location** St. George, UT

Date 11/29/2006
Title: Poisonous Plants
Presenter: Derek Tilley **Location** Aberdeen PMC

Date 11/29/2006
Title: Small Lot Seed Cleaning Equipment Training
Presenter: Cornforth, Bair **Location** Aberdeen PMC

Date 11/30/2006
Title: Aberdeen PMC Poster Presentation
Presenter: St. John **Location** Reno, Nevada

Date 11/30/2006
Title: Streambank Soil Bioengineering Technical Training field exercise at St. George, UT
Presenter: Hoag, JC and T Moody **Location** St. George, UT

Date 12/5/2006
Title: Streambank soil Bioengineering Technical Training at Laredo, TX
Presenter: Hoag, JC and J Fripp **Location** Laredo, TX

Date 12/7/2006
Title: Streambank Soil Bioengineering Technical Training field exercise at Laredo, TX
Presenter: Hoag, JC and J Fripp **Location** Laredo, TX

Date 1/25/2007
Title: Utah Plant Materials Committee - 2006 Activities update
Presenter: L. St. John **Location** Ogden, UT

Date 1/25/2007
Title: Research at the Aberdeen PMC (2006)
Presenter: Tilley, DJ **Location** Ogden, UT

Date 1/30/2007

Title: Streambank Soil Bioengineering Technical Training at Los Angles, CA
Presenter: Hoag, JC and J Fripp **Location** Pasadena, CA

Date 1/31/2007
Title: Weed suppression and native plant community restoration
Presenter: Derek Tilley **Location** Nampa, ID

Date 2/1/2007
Title: Streambank Soil Bioengineering Technical Training field exercise in Los Angles, CA
Presenter: Hoag, JC and J Fripp **Location** Pasadena, CA

Date 2/15/2007
Title: Aberdeen PMC report of Activities 2006: Great Basin native plant selection and increase project
Presenter: Derek Tilley **Location** SRM annual meeting, Reno, NV

Date 2/27/2007
Title: Streambank soil bioengineering Technical training for Arizona
Presenter: Hoag, JC and J Fripp **Location** Mesquite, NV

Date 2/28/2007
Title: Streambank Soil Bioengineering Technical Training for AZ NRCS Engineers
Presenter: Hoag, JC and J Fripp **Location** Mesquite, NV

Date 3/1/2007
Title: Streambank Soil Bioengineering Technical Training tour of AZ and UT projects
Presenter: Hoag, JC and B Smart **Location** St. George, UT

Date 3/13/2007
Title: Streambank soil bioengineering technical training at San Antonio, TX 2007
Presenter: Hoag, JC and J Fripp **Location** San Antonio, TX

Date 3/15/2007
Title: Streambank soil bioengineering field exercise at San Antonio, TX 2007
Presenter: Hoag, JC and J Fripp **Location** San Antonio, TX 2007

Date 3/16/2007
Title: Native Plant Center in Aberdeen
Presenter: Aaron Kunz, News **Location** Aberdeen PMC

Date 3/20/2007
Title: Installation of bioengineering practices on the Ft. Hall Indian Reservation
Presenter: Hoag, JC **Location** Snake River, Ft. Hall Indian Reservation

Date 4/2/2007
Title: Evaluation of Morris Creek bioengineering treatments near Idaho City, ID
Presenter: Hoag, JC **Location** Idaho City, ID

Date 4/5/2007
Title: Aberdeen PMC Highlights
Presenter: St. John **Location** West Regional Teleconference

Date 4/10/2007
Title: Evaluation and long term planning of windbreaks on the Camas NWR
Presenter: Hoag, JC **Location** Camas NWR, Hamer, ID

Date 4/19/2007
Title: Wetland restoration and enhancement NEDC training course at Hastings, NE
Presenter: Hoag, JC, N Melvin, K **Location** Hastings, NE

Date 4/20/2007
Title:PMC Tour for Great Basin Community College
Presenter: St. John and Simonson **Location** Aberdeen PMC

Date 4/28/2007
Title:NRCS enviroscape demonstration
Presenter: Derek Tilley **Location** Environmental Fair, Pocatello, ID

Date 5/30/2007
Title: Analysis of erosion on Birch Creek near Malad, ID
Presenter: Hoag, JC **Location** Malad Idaho

Date 6/19/2007
Title: Overview of Aberdeen Plant Materials Center Activities to Idaho, Nevada and Utah Interagency Plant Materials Meeting
Presenter: St. John **Location** Aberdeen PMC

Date 6/19/2007
Title: Plant Materials Center Field Day
Presenter: St. John, Cornforth **Location** Aberdeen PMC

Date 6/26/2007
Title: Tour for Chinese Academy of Agricultural Sciences
Presenter: St. John **Location** Aberdeen PMC

Date 8/15/2007
Title: Tour for Potato Association of America
Presenter: Cornforth, St. John **Location** Aberdeen PMC

Date 8/30/2007
Title: Pacific Creek streambank protection evaluation
Presenter: Hoag, JC **Location** Grand Teton National Park, WY

Date 8/30/2007
Title: Fox Creek, ID 2005 and 2007 Planting and Restoration Review and Evaluation
Presenter: Hoag, JC **Location** Fox Creek, Driggs, ID

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.*

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USDA Forest Service Region 1 Native Grass and Forb Initial Evaluation – 2007 Progress Report
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Off-Center Activities

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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 the District Seed Increase (DSI) program.

The following table illustrates seed shipments from the Aberdeen Plant Materials Center for Fiscal year 1999 through 2007:

Cultivar	1999	2000	2001	2002	2003	2004	2005	2006	2007	TOTAL POUNDS
					POUNDS PLS					
Anatone bluebunch wheatgrass	-	-	-	-	-	20	250	350	400	1020
Appar blue flax	115	320	300	470	65	0	848	955	150	3223
Bannock thickspike wheatgrass	610	275	250	550	25	0	1110	900	240	3960
Delar small burnet	0	451	150	75	0	1250	945	490	100	3461
Ephraim crested wheatgrass	50	260	455	696	0	200	0	1300	300	3261
Goldar bluebunch wheatgrass	370	175	100	375	250	200	200	170	250	2090
Magnar basin wildrye	901	517	1035	490	150	245	0	0	490	3828
Maple Grove Lewis flax	-	-	-	-	-	240	280	70	0	590
Nezpar Indian ricegrass	100	900	150	75	340	0	300	500	700	3065
P-27 Siberian wheatgrass	25	150	200	500	0	0	0	0	200	1075
Penstemon "Clearwater Selection"	0	1	10	1	10	4	8	0	0	34
Penstemon "Richfield Selection"	5	5	1	7	6	3	11	25	6	69
Paiute orchardgrass	250	101	450	200	0	0	0	75	200	1276
Regar meadow brome	800	670	1061	207	50	50	0	650	50	3538
Rush intermediate wheatgrass	1000	215	525	0	0	0	800	300	500	3340
S.R.P. fourwing saltbush	-	-	-	25	5	2	16	0	0	48
Sodar streambank wheatgrass	100	860	500	500	200	0	625	775	250	3810
Tegmar dwarf intermediate wheatgrass	0	100	0	0	0	200	0	0	0	300
Northern Cold Desert winterfat	-	-	-	8	3	8	20	5	4	48
TOTAL POUNDS	4,326	5,000	5,187	4,179	1,104	2,422	5,413	6,565	3,840	38,036

March 29, 2007

Aberdeen Plant Materials Center

2007 FIELD ANNUAL PLAN OF OPERATION

HOME FARM

Field	Acres	Crop	Operation
1	1.7	Display Nursery	Establish new grass display nursery.
2E	1.3	Anatone (2007)	Establish and manage for Certified seed production.
2W	1.0	Mountain Brome (Grand Teton NP - 2006)	Manage for seed production.
3	1.8	Anatone Bluebunch (2005)	Manage for Certified seed production.
4	1.4	Constructed Wetland Ponds	Determine best method to eliminate volunteer plants and implement.
5	2.4	Green Manure	Establish annual legume for plowdown.
6	2.4	Anatone Bluebunch (2004)	Manage for Certified seed production.
7	3.2	Delar (2006)	Manage for Foundation seed production.
8	3.2	Green Manure	Establish annual legume for plowdown.
9	3.2	Maple Grove (2005)	Cooperate with U of I for herbicide testing.
10	3.2	Maple Grove (2006)	Manage remaining crop for Certified seed production. Fallow area plowed under.
11N	1.1	Potatoes	U of I will plant potatoes.
11S	0.2	9076402 Mutton grass (2002)	Manage for increase and potential release.
12	1.4	USFS Forbs (2004) Great Basin Forbs (2005)	Evaluate for potential release. Evaluate for potential release.
13N	0.1	Penstemon (2003)	Manage for Certified seed production.
13S	0.25	Sandberg Bluegrass (Grand Teton NP - 2006)	Manage for seed production.
14	1.2	Woody Display Nursery (1995)	Maintain display of woody conservation plants. Manage Durar/Covar cover crop.
15	1.4	Field windbreak (2000)	Maintain Simon poplar field windbreak.
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.
20	1.5	Grass Display Nursery (2002)	Manage for display.

Aberdeen Plant Materials Center

2007 FIELD ANNUAL PLAN OF OPERATION

FISH AND GAME FARM

Field	Acres	Crop	Operation
21W	2.3	Alfalfa (2001)	Manage for hay production and wildlife benefits.
21E	1.4	Pipe yard (2004)	Maintain permanent yard for pipe storage.
21N	1.3	Bozoisky Cover crop (1985)	Maintain as needed for permanent cover.
22W	4.1	Wildlife Food Plot	Establish and maintain wheat for wildlife use.
22E	1.3	Willow IEP (1984)	Maintain as needed.
23W	2.4	Bozoisky Cover crop	Establish and maintain as needed for permanent cover.
23M	--	Windbreak	Maintain and irrigate as needed.
23E	2.2	Bannock (2005)	Manage for Foundation seed production.
24	1.1	Windbreaks	Maintain and irrigate as needed.
24W	2.2	Wildlife Food Plot	Establish and maintain corn for wildlife use.
24E	1.5	Durar Cover Crop	Maintain as needed for permanent cover.
25	5.1	Alfalfa (2003)	Manage for hay production and wildlife benefits.
26W	1.0	Bozoisky Cover crop (2005)	Maintain as needed for permanent cover.
26E	2.7	Willow Cutting Nursery (1994)	Maintain as needed.
27W	2.2	Bozoisky Cover crop (2005)	Maintain as needed for permanent cover.
27M	1.2	Bozoisky Cover crop	Establish and maintain as needed for permanent cover.
27E	1.0	Slender Wheatgrass (Grand Teton NP - 2006)	Manage for seed production.
28	5.3	Alfalfa (2004)	Manage for hay production and wildlife benefits.
29W	1.3	Willows (1994)	Evaluate and permanently mark plots.
29E	3.7	Fallow	Fallow as needed for weed control.

FISH AND GAME FARM (continued)

Field	Acres	Crop	Operation
30W	0.7	Windbreak/Guard Row	Maintain and irrigate as needed.
30W	2.5	Wildlife Food Plot USFS Grasses (2005) Mutton grass (2006)	Establish and maintain corn for wildlife use. Evaluate for potential release. Evaluate advanced evaluation planting.
30E	2.3	USFS Grasses (2004)	Evaluate for potential release.
31	1.5	Wildlife Food Plot	Establish and maintain corn for wildlife use.
	3.75	DOD Western w.g. (2005)	Maintain for seed increase.
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
410W	2.0	DOD Siberian w.g. (2005)	Maintain for seed increase.
410E	2.0	DOD Slender w.g. (2005)	Maintain for seed increase.
411	4.5	Nezpar (2007)	Establish and maintain for Foundation seed production.

PEARL FARM

Field	Acres	Crop	Operation
S1	5.0	Alfalfa (2006)	Maintain for hay production and to improve soil quality.
S2	5.0	Alfalfa (2006)	Maintain for hay production and to improve soil quality.
S3	5.0	Alfalfa (2006)	Maintain for hay production and to improve soil quality.
S4W	1.0	Buckwheat IEP	Manage according to project plan.

Aberdeen Plant Materials Center

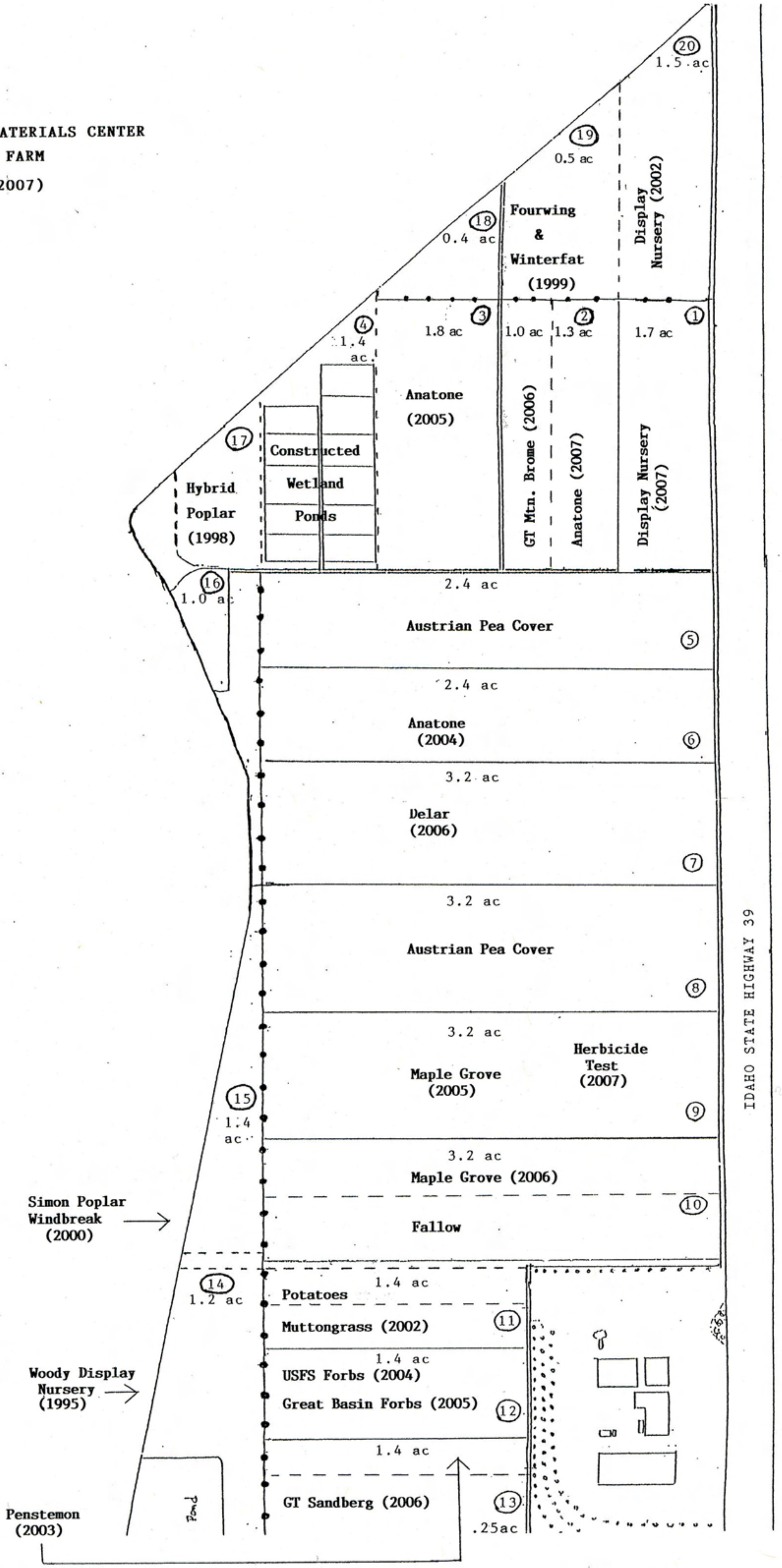
2007 FIELD ANNUAL PLAN OF OPERATION (continued)

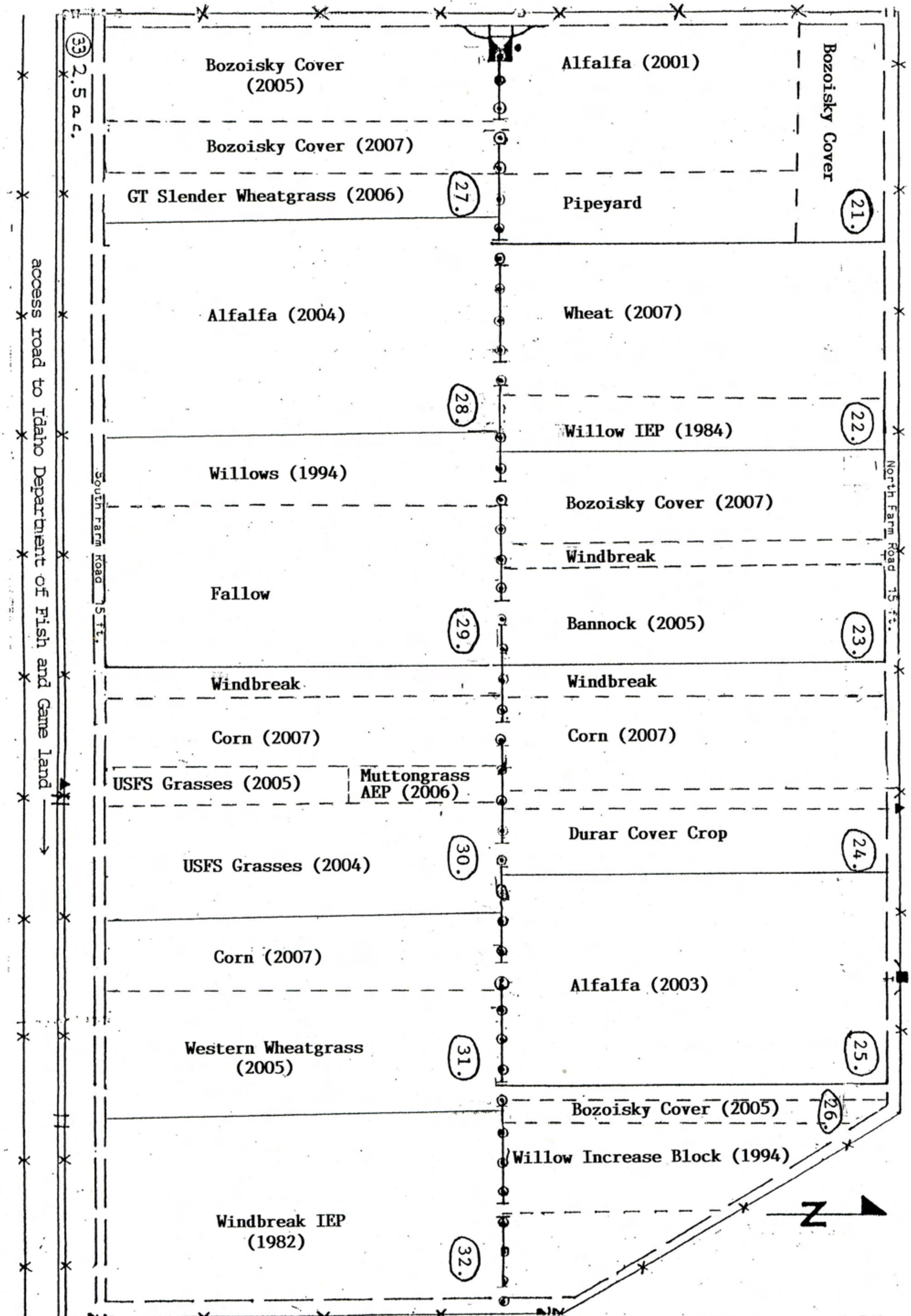
PEARL FARM (continued)

Field	Acres	Crop	Operation
S4E	1.0	Fallow	Fallow as needed for weed control.
S5W	2.5	Alfalfa	Establish and maintain for hay production and to improve soil quality.
S5E	2.5	Fallow	Fallow as needed for weed control.
S6W	2.5	Magnar (2006)	Manage for Foundation seed production.
S6E	2.5	Goldar (2006)	Manage for Foundation seed production.
S7W	2.5	Blue Wildrye (Grand Teton NP - 2006)	Manage for seed production.
S7E	2.5	Bannock (2006)	Manage for Foundation seed production.
S8	2.2	Appar	Establish and manage for Foundation seed production.

Maintain two-row windbreak (Rocky Mountain Juniper and Simon Poplar established on south and west farm borders. Establish grass cover along mainline and north border slope and road.

PLANT MATERIALS CENTER
HOME FARM
(2007)



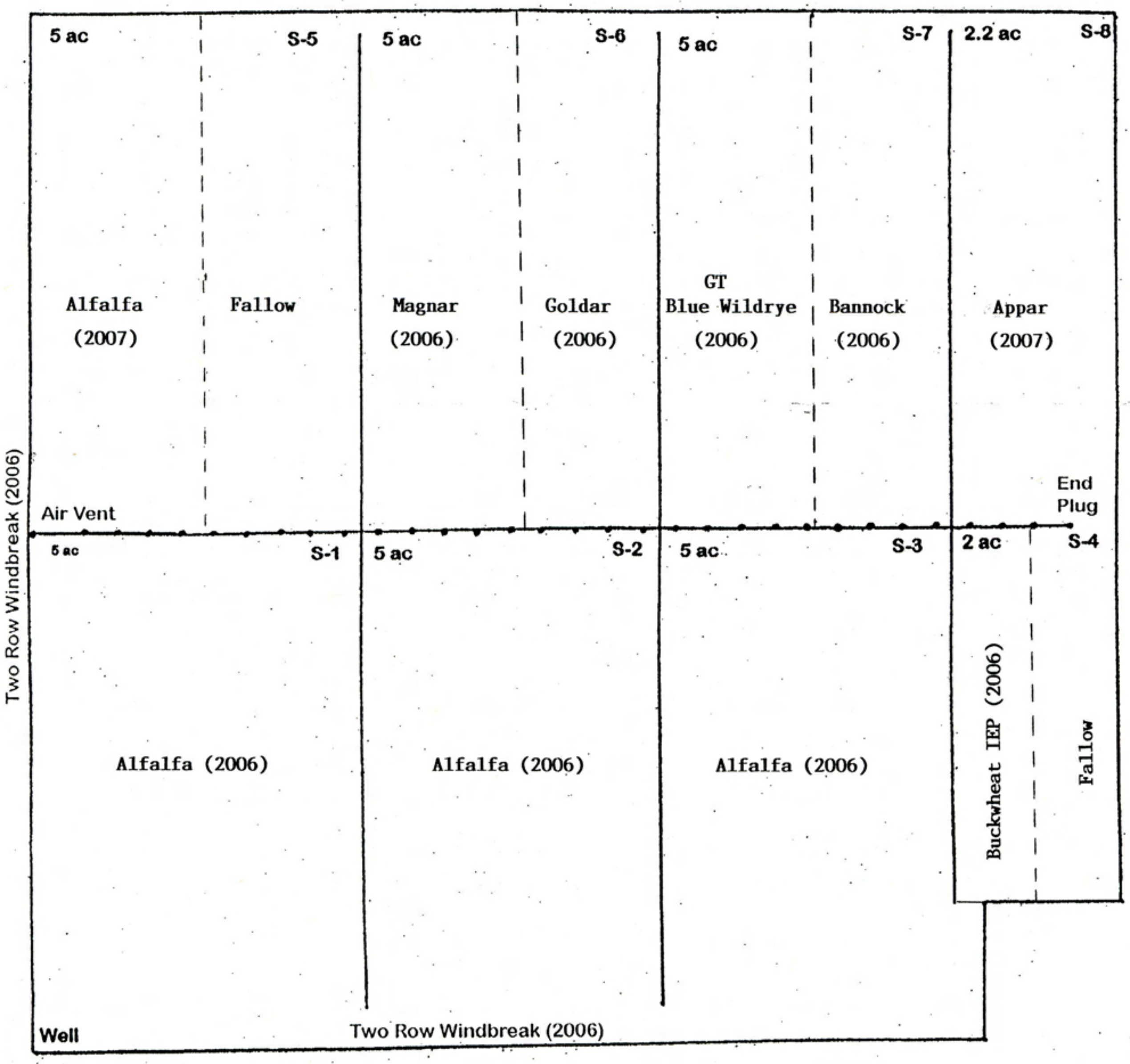


FISH & GAME FARM

(2007)

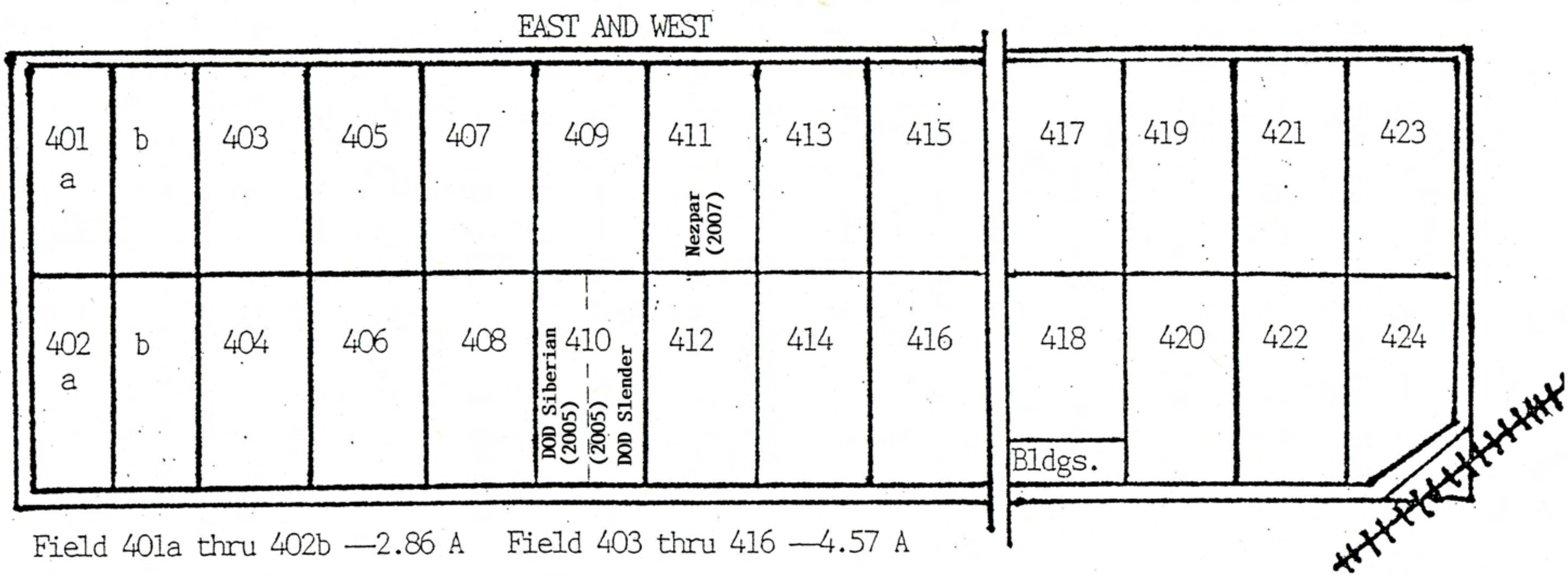
PLANT MATERIALS CENTER
PEARL FARM

(2007)



Scale 1" = 200'

UNIVERSITY OF IDAHO
BREWINGTON FARM (2007)



Field 401a thru 402b —2.86 A

Field 403 thru 416 —4.57 A

Field 417 thru 423 —4.63 A

Field 418 —3.82 A

Field 424 —4.52 A

2007 Progress Report
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 to be 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 that failed to establish 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, 2007 before buds began to break dormancy, the trees were pruned to remove all side branches up to a height of 20 – 25 feet on the trees that were well established 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 13, 2007 and the data is summarized in Table 1. An Abney Level was used to measure plant height. Accession no. 9076418 (OP-367) and 9076421 (52-225) continued to have the best survival. 9076418 (OP-367) was the tallest (mean plant height 18.1 m – 59.4 feet) and also had the largest D.B.H. (mean 34.6 cm – 13.6 inches). This accession continues to appear to be the best adapted to the soil and climate in the Snake River Plains of southeastern Idaho. Accession no. 9076418 (OP-367) also had the best vigor rating from the original planting in 1998. No destructive pests were observed on the plants this year.

Of the plots re-planted in 1999, Robust poplar continued to have the best survival and Siouxland had the tallest average height. Robust also had the largest mean D.B.H. (19.5 cm – 7.7 inches) of the plots that were re-planted in 1999. Imperial, (which had only one surviving plant at the evaluation in 2005), died from wind-throw during the 2006 growing season.

The planting will again be pruned during dormancy in late winter 2008 to reduce side branching and will be evaluated next fall. The plots will be harvested in the fall of 2009 to evaluate wood production.

Table 1.
2007 Evaluation Data
1998 Hybrid Poplar Initial Evaluation Planting

Accession Number	Number Survived	Percent Survival	Plant Height (m) Minimum	Mean	Maximum	D.B.H. [1/] Mean (cm)	Vigor [2/]
9076418 (OP-367)	8	88.9	16.2	18.1	20.1	34.6	2.3
9076419 (184-411)	1	11.1	--	--	11.6	14.5	5.0
9076420 (50-197)	0	0.0	--	--	--	--	9.0
9076421 (52-225)	6	66.7	9.4	15.0	18.6	15.4	6.5
9076422 (15-29)	3	33.3	7.0	10.2	16.0	8.9	7.2
Canam	2	22.2	8.2	11.3	14.3	14.1	4.5
Robust	3	33.3	16.2	16.3	16.5	24.2	2.7
Siouxland	5	55.5	13.4	15.5	16.8	23.9	2.8
Imperial	5	55.5	11.9	13.6	14.9	23.8	3.2

Re-planted Hybrid Poplar 1999

Accession Number	Number Re-planted	Percent Survival	Plant Height (m) Minimum	Avg.	Maximum	D.B.H. [1/] Mean (cm)	Vigor [2/]
9076418 (OP-367)	1	0	--	--	--	--	9.0
9076419 (184-411)	8	12	--	--	10.4	15.2	5.0
9076420 (50-197)	8	0	--	--	--	--	9.0
9076421 (52-225)	1	0	--	--	--	--	9.0
9076422 (15-29)	4	0	--	--	--	--	9.0
Canam	7	57	9.8	11.2	13.4	6.9	7.4
Robust	6	83	11.6	12.1	16.2	19.5	4.8
Siouxland	4	50	13.4	13.9	14.3	9.5	7.5
Imperial	4	0	--	--	--	--	9.0

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

Great Basin Native Plant Selection and Increase Project
2006 Annual Report

Project Title:

- Establishment and Maintenance of Certified Generation 1 (G1) Seed
- Propagation of Native Forbs
- Plant Display Nursery Evaluation
- Develop Technology to Improve the Diversity of Introduced Grass Stands

Project Location: NRCS Aberdeen, ID Plant Materials Center

Principal Investigators and Contact Information:

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Description of Project: Production of Certified Generation 1 (G1) seed of Maple Grove Germplasm Lewis flax, Anatone Germplasm bluebunch wheatgrass, Snake River Plains Germplasm fourwing saltbush and Northern Cold Desert Germplasm winterfat to facilitate commercial seed production. Propagation of native forbs for evaluation and seed increase. Evaluation of display nursery near Boise, ID. Assist in development of technology to improve the diversity of introduced grass stands by evaluating methods to introduce native species into established plant communities.

Project Status:

Seed Production

Maple Grove Germplasm Lewis Flax – A new seed field (3.2 acres) was planted on May 24, 2006. The seed field established in 2005 (also 3.2 acres in size) was contaminated with 'Appar' blue flax so harvested seed could not be certified. This field is now being used to conduct herbicide tolerance trials in cooperation with the University of Idaho. The new field established in 2006 was also contaminated with Appar. It appears that the stock seed to plant both fields was contaminated with Appar. Approximately 2/3 of the new field was plowed out and the remaining plants will be rouged carefully to remove Appar plants. Shipped 70 pounds of Certified seed to commercial growers in 2006.

Anatone Germplasm bluebunch wheatgrass – Currently 5.2 acres are in production. Estimated seed yield from 2006 seed crop is 1,090 pounds. Shipped 350 pounds of Certified seed to commercial growers in 2006.

Snake River Plains Germplasm fourwing saltbush – Estimated seed yield from 2006 crop is 20 pounds. No seed was requested by commercial growers in 2006.

Northern Cold Desert Germplasm winterfat – Estimated seed yield from 2006 crop is 11 pounds. Shipped 5 pounds of Certified seed to commercial growers in 2006.

Propagation Studies

The original project plan in 2005 was to propagate 8,000 plants total of *Lomatium dissectum* (LODI) fernleaf biscuitroot, *Lomatium grayii* (LOGR) Grays biscuitroot, *Lomatium triternatum* (LOTR) nineleaf biscuitroot, *Eriogonum umbellatum* (ERUM) sulphurflower buckwheat, *Penstemon deustus* (PEDE) hotrock penstemon, *Penstemon acuminatus* (PEAC) sharpleaf penstemon, and *Penstemon speciousus* (PESP) sagebrush penstemon in the greenhouse. Approximately 1000 plants each of ERUM and LOTR were to be transplanted at the PMC and remaining plants were to be made available to cooperators for transplanting at field sites. Due to no plant establishment of *Lomatium* species and minimal success with greenhouse propagation of *Penstemon* species, no plants were made available to cooperators. All plants that were successfully propagated in the PMC greenhouse were transplanted at the PMC during the 2005 growing season and direct dormant seeding of *Eriogonum*, *Lomatium* and *Penstemon* accessions were completed at the PMC in November 2005. Weed barrier fabric was installed to control weeds.

On June 13, 2006 and October 27, 2006 the plants that were direct-seeded the preceding fall were evaluated for survival and the results are shown in the following table:

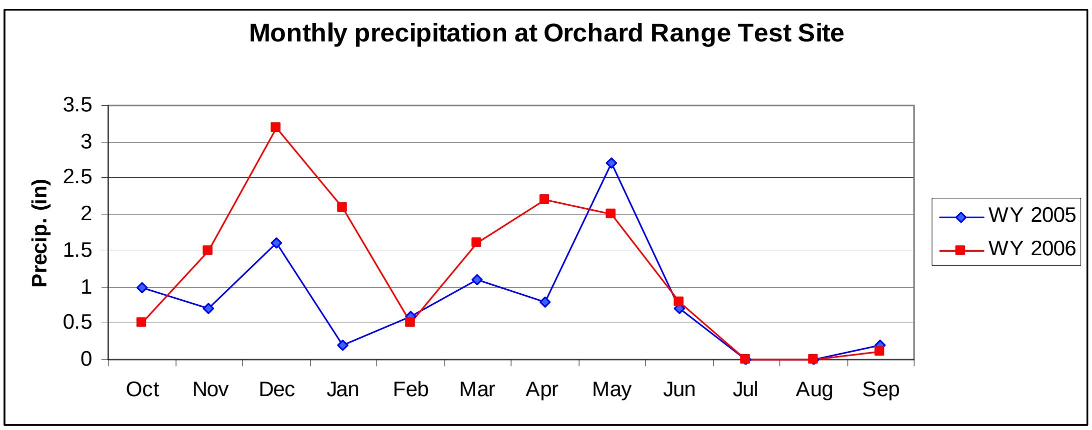
Species	6/13/06 Survival (percent)	10/27/06 Survival (percent)	10/27/06 Plant Height (cm)	Clean seed (grams)
ERUM	40	40	10-15	31.8
LODI	25	dormant		
LOGR	65	dormant		
LOTR	70	dormant		
PEAC	60	68	20-25	1362.0
PEDE	50	58	20-25	1180.0
PESP	60	60	10-20	0.0

The evaluation conducted in June was an estimate of survival and the October evaluation was an actual plant count. By early July, the *Lomatium* plants had gone completely dormant. There was no sign of green-up this fall, so survival of these plants is unknown and will be evaluated in the spring of 2007. Seed was harvested from ERUM, PEAC and PESP and cleaned.

Orchard Display Nursery
Evaluation Summary

Introduction

The Orchard Display Nursery was planted on November 16, 2004 in cooperation with the Great Basin Native Plant Selection and Increase Project. The nursery contains 82 accessions of 27 native and introduced grass, forb and shrub species. Each accession was planted in 7 X 60 foot plots. See Tilley et al (2005) for descriptions of the species and accessions planted. The remaining area was planted to a cover crop mix of 50% Anatone bluebunch wheatgrass, 20% Bannock thickspike wheatgrass, 20% Magnar basin wildrye and 10% Snake River Plains fourwing saltbush. The test site is located on a loamy 10-12 inch precipitation ecological site that historically supported a Wyoming big sagebrush - bluebunch wheatgrass – Thurber's needlegrass plant community. Total precipitation at the Orchard Test Site for water year 2005 was 9.6 inches, and total accumulated precipitation for water year 2006 was 14.4 inches (USDA 2006).



The Bureau of Land Management (BLM) burned the site in the fall of 2002. The site was later sprayed by PMC staff in May 2003 and May 2004 with a Roundup and 2, 4-D herbicide mix to create a weed free seedbed. Due to limited breakdown of dead grass clumps that would inhibit proper seed placement with a drill and to ensure a clean seedbed, the decision was made to cultivate the site with a culti-packer just prior to seeding. Plots were evaluated for initial establishment on April 27 and May 5, 2005. During the first evaluation most plots contained high numbers of Russian thistle (*Salsola* sp.) and moderate amounts of bur buttercup (*Ranunculus testiculatus* Crantz) plants. Russian thistle plants were approximately two to three inches tall and the buttercup plants had already flowered. At the time of the second evaluation, there was a heavy infestation of tumble mustard (*Sisymbrium altissimum* L.). Plots were consequently sprayed again on June 9, 2005 with 16 oz. 2, 4-D and 8 oz. Clarity per acre to control the mustard.

Materials and Methods
The first evaluation of the plots was conducted on April 27, 2005 using a frequency grid based on that described by Vogel and Masters (2001). The grid measured approximately 40x41 inches, having four ten inch columns (to incorporate 1 drill row per column) and five rows, totaling 20 cells. The first grid was laid on the rows approximately two grid lengths (80 inches) into the plot. Counts were made of the cells that contained at least one plant. Grids were subsequently flipped and evaluated three more times giving a total of 80 evaluated cells. Total area for one grid is approximately $1m^2$. Total area evaluated is therefore approximately $4m^2$. A conservative estimate of plant density (plants/m^2) is the total number of cells containing at least one plant divided by four. The second evaluation of 2005 occurred on May 25, 2005. The 2006 evaluation was conducted on May 30. The methods followed for 2006 were the same as described above; however, the frame was evaluated five times for a total of 100 cells or $5m^2$. Total counts were then divided by five for approximate plants/m^2. Numbers for approximate plants/m^2 were then divided by 10.8 to calculate approximate plants/ft^2. It is important to note that because cells with plants were counted and not number of plants per cell, the best possible score is 100 hits per five frames which converts to 20 plants/m^2 or 1.85 plants/ft^2. Actual plant density may be higher than the numbers indicated below. All tables have been arranged with accessions ranked from highest plant density to the lowest at the time of the second evaluation in 2005. Data were not analyzed for significance.

Native Grasses
There were forty-seven accessions of native grasses planted. Overall the native grasses established well considering the limited amount of precipitation received over the winter and early spring of 2005. Especially good stands were seen in the bluebunch wheatgrass and Snake River wheatgrass plots during 2005. There was a marked decrease in plant density between the first and second evaluations with some notable exceptions. Seven of nine bluebunch wheatgrass accessions and three of four Snake River wheatgrass accessions increased in density from the first evaluation to the second. This is possibly due to receiving 2.5 inches of precipitation during that period and/or from a lack of pressure by black grass bugs (*Labops* sp.). Most of the native grasses decreased in density from 2005 to 2006 with the exception of Covar sheep fescue and all of the Sandberg bluegrass accessions. These may have been plants that germinated late in the first growing season or, more likely, were too small to notice under the heavy growth of mustards and were more easily observed in 2006.

In 2005 the best performing Indian ricegrass accession was White River, having a plant density of 0.56 plants/ft^2 during the first evaluation and 0.17 plants/ft^2 during the second evaluation. By 2006 there were no plants of any Indian ricegrass accessions observed in the evaluation grids and very few seen within their respective plots. In 2006 all squirreltail accessions had decreased density. Fish Creek maintained the best plant density with 0.26 plants/ft^2. Bannock thickspike wheatgrass had a density of 1.04 plants/ft^2 and increased slightly to 1.07 plants/ft^2 at the second evaluation. In 2006

Bannock had dropped to nearly half of the original density to 0.58 plants/ft^2. Revenue and San Luis slender wheatgrass both showed zero plants/ft^2 in 2006. Pryor slender wheatgrass similarly dropped in density but had 0.02 plants/ft^2. The western wheatgrass accessions had less dramatic declines in density from 2005 to 2006, but still showed poor stands with Rodan having the highest density of 0.13 plants/ft^2.

The bluebunch wheatgrass accessions had the highest average densities of all the native grasses. All decreased slightly in density from 2005 to 2006, but still maintained good stands. P-12, Wahluke and Jim Creek all had densities over 1.00 plants/ft^2. Columbia, Anatone, P-7 and P-15 had densities between 0.50 and 1.00 plants/ft^2 while P-5 and Goldar both shared low densities. The three Snake River wheatgrass accessions dropped to just over 0.50 plants/ft^2. The basin wildrye accessions densities also decreased; U108-02 and Trailhead retained the highest densities at 0.24 and 0.26 plants/ft^2 respectively. Sheep fescue stands remained poor from 2005 to 2006 with Covar slightly increasing from 0.00 to 0.07 plants/ft^2. Thurber's needlegrass had no plants in the evaluated grids. All five of the Sandberg bluegrass accessions increased in density from 2005 to 2006. The best stands were observed in the High Plains and Mountain Home plots with respective stands of 0.54 and 0.35 plants/ft^2.

		4/27/05	**5/25/05**	**5/30/06**
Species	**Name or accession**	**Plants/ft²**	**Plants/ft²**	**Plants/ft²**
Indian ricegrass	Rimrock	0.37	0.20	0.00
	White River	0.56	0.17	0.00
	Nezpar	0.42	0.17	0.00
	Ribstone	0.14	0.09	0.00
	Paloma	0.05	0.00	0.00
Squirreltail	Fish Creek	0.97	0.54	0.26
	Shaniko Plateau	0.81	0.52	0.06
	Sand Hollow	0.37	0.20	0.19
	Toe Jam Creek	0.58	0.17	0.00
	9019219	0.02	0.02	0.00
Thickspike wheatgrass	Bannock	1.04	1.07	0.58
	Critana	0.90	0.56	0.24
	Schwendimar	0.69	0.52	0.39
	Sodar	0.37	0.30	0.15
Slender wheatgrass	Revenue	1.00	0.93	0.00
	San Luis	0.60	0.69	0.00
	Pryor	0.30	0.30	0.02
Western wheatgrass	Rodan	0.28	0.35	0.13
	Rosana	0.05	0.20	0.04
	Arriba	0.16	0.15	0.06
Bluebunch wheatgrass	P-12	1.34	1.59	1.04
	Wahluke	0.97	1.26	1.02
	Columbia	1.30	1.23	0.84
	P-7	0.93	1.15	0.67
	Anatone	0.81	1.15	0.80
	Jim Creek	0.83	1.02	1.02
	P-15	0.60	0.93	0.54
	P-5	0.42	0.61	0.22
	Goldar	0.51	0.37	0.33
Snake River wheatgrass	Expedition	1.27	1.44	0.54

	Secar	1.00	1.11	0.76
	SERDP	1.02	0.94	0.67
	E-26	0.21	0.23	0.22
Basin wildrye	U108-02	0.56	0.57	0.24
	Trailhead	0.60	0.52	0.26
	U100-01	0.53	0.41	0.11
	U70-01	0.30	0.22	0.02
	Magnar	0.28	0.22	0.04
	Washoe	0.21	0.09	0.09
Sheep fescue	Initial Point	0.21	0.04	0.02
	Covar	0.16	0.00	0.07
Thurber's needlegrass	Thurber's	0.00	0.00	0.00
Sandberg bluegrass	High Plains	0.25	0.00	0.54
	Sherman	0.00	0.00	0.02
	Mountain Home	0.00	0.00	0.35
	Toole County, MT	0.00	0.00	0.04
	Hanford Source	0.00	0.00	0.19

Introduced Grasses

Although many of the introduced grass accessions had fair emergence, we noted an outbreak of black grass bugs at the time of the first evaluation in 2005. The infestation appeared limited to the introduced grass section of the nursery. Plants were covered with yellow spots making the plants appear yellow-green overall. Although most of the stands of the introduced grasses decreased from the first to the second evaluation, many stands had recovered and increased by 2006 indicating that many plants thought to be dead during the second evaluation in 2005 were still alive. However, the plants of the crested wheatgrass plots were very small when compared to the other wheatgrass accessions in the nursery and still appear to be recovering from black grass bug pressure.

In 2006 all of the crested wheatgrass accessions increased in density or remained approximately where they were in 2005. Ephraim rose from 0.28 to 1.23 plants/ft^2; however, many of the plants were small in size due to the black grass bug infestation during the spring of 2005. Both Siberian wheatgrass accessions similarly increased from 2005 to 2006, but the three pubescent wheatgrass accessions decreased with the highest density in 2006 coming from Manska at 0.28 plants/ft^2. Rush intermediate wheatgrass, along with Prairieland and Eejay Altai wildrye had zero plants in 2006. Pearl Altai wildrye had 0.02 plants/ft^2. The Russian wildrye accessions all increased in density with the exception of Tetracan which decreased slightly. The best stand was recorded in the Bozoisky Select plot with 0.58 plants/ft^2.

		4/27/05	**5/25/05**	**5/30/06**
Species	**Name or accession**	**Plants/ft^2**	**Plants/ft^2**	**Plants/ft^2**
Crested wheatgrass	Nordan	1.30	1.19	1.10
	Ephraim	0.65	0.28	1.23
	Hycrest	0.39	0.24	0.15
	CD-II	0.56	0.24	0.20
	Roadcrest	1.30	0.07	0.52
	Douglas	0.28	0.04	0.09
Siberian wheatgrass	Vavilov	0.65	0.20	0.61
	P-27	0.09	0.02	0.33

Pubescent wheatgrass	Manska	0.69	0.65	0.28
	Greenleaf	0.60	0.59	0.15
	Luna	0.79	0.54	0.13
Intermediate wheatgrass	Rush	0.60	0.56	0.00
Altai wildrye	Prairieland	0.56	0.39	0.00
	Eejay	0.16	0.28	0.00
	Pearl	0.35	0.15	0.02
Russian wildrye	Bozoisky Select	0.72	0.54	0.58
	Mankota	0.46	0.28	0.32
	Tetracan	0.42	0.20	0.17
	Syn-A (Bozoisky II)	0.21	0.13	0.24

Forbs and Shrubs

Despite some good stands in 2005, all of the forb and shrub accessions except for Eagle yarrow had zero plants during the 2006 evaluation. Eagle had 0.07 plants/ft^2 in the frequency grids along with a small stand of plants at one end of the seeded plot.

		4/27/05	**5/25/05**	**5/30/06**
Species	**Name or accession**	**Plants/ft²**	**Plants/ft²**	**Plants/ft²**
Western yarrow	Eagle	0.51	0.50	0.07
	Great Northern	0.19	0.09	0.00
Utah sweetvetch	Timp	0.14	0.02	0.00
Firecracker penstemon	Richfield Selection	0.02	0.02	0.00
Scarlet globemallow		0.00	0.00	0.00
Lewis flax	Maple Grove	0.42	0.15	0.00
Blue flax	Appar	0.90	0.26	0.00
Wyoming big sagebrush		0.02	0.02	0.00
Fourwing saltbush	Snake River Plains	0.00	0.00	0.00
	Wytana	0.00	0.00	0.00
	Rincon	0.00	0.00	0.00
Gardner's saltbush	9016134	0.00	0.00	0.00
Winterfat	Hatch	0.28	0.17	0.00
	Northern Cold Desert	0.00	0.00	0.00
	Open Range	0.00	0.00	0.00
Forage kochia	Immigrant	0.00	0.00	0.00

Cover Crop

The cover crop consisted of a four species mix which contained: 50% Anatone bluebunch wheatgrass, 20% Bannock thickspike wheatgrass, 20% Magnar basin wildrye and 10% Snake River Plains fourwing saltbush. Four grids were examined during the first evaluation in 2005, one on each side of the nursery, and five grids were evaluated at the time of the second evaluation in 2005 and the 2006 evaluation. Total plant density was estimated at 0.37 plants/ft^2 at the first evaluation and 0.57plants/ft^2 at the second evaluation. In 2006 the cover crop density was 0.13 plants/ft^2.

Discussion

Despite large amounts of Russian thistle, native and introduced grasses had fair to good emergence and plant density during the establishment year. Germination and emergence might have been increased with more precipitation during March and April, 2005 but emergence was good with the rain that was received. The majority of the plots showed decreased stands from 2005 to 2006. The low precipitation at the site, especially the lack of moisture in July and August of 2005, seems to have eliminated many of the less drought tolerant accessions. One concern is the effect of black grass bugs on the introduced grasses. Plants subjected to black grass bug are normally affected by decreased seed yield and a reduction in palatability. Infestations rarely result in the death of established plants, but in low water years establishing plants may be under enough stress to kill the establishing seedlings (Hammon and Peairs 2001). The second evaluation in 2005 indicated a loss in plant densities; however it appears that many of the plants survived, although stunted, through 2006. Future evaluations will provide more information on plant establishment, persistence and longevity. The PMC staff will continue to evaluate plant performance at the site.

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Develop Technology to Improve the Diversity of Introduced Grass Stands

The PMC assisted Brigham Young University (BYU) Provo, UT and the Agricultural Research Service (ARS) Burns, OR in developing technology to improve the diversity of introduced grass stands by evaluating methods to introduce native species into established introduced plant communities. In 2005, the PMC modified a Truax Roughrider range drill, mixed the seed and rice hull mixtures and completed the first year of seedings at the sites in Utah and Oregon.

In 2006, modified seed drop boots by the manufacturer were installed on the Truax drill. The Utah sites (Skull Valley and Lookout Pass) were seeded the week of October 24 and the Oregon site (Burns) was seeded the week of October 31, 2006. 12.5 acres were seeded at each site. In addition to these seedings, the PMC also seeded drill comparison trials (approximately 30 acres total) near Elko, NV during the week of November 6, 2006 on recently burned rangeland to compare the Truax drill to the Kemmerer drill, a standard range drill used by BLM. While seeding these projects, the PMC technicians met with Jim Truax (drill manufacturer) to demonstrate the modifications to the drill under field conditions.

The Truax drill is designed to both broadcast and drill seed in the same pass so species that require broadcasting or very shallow planting depth were broadcast and the deeper seeded species were drill seeded in alternating rows. The following table shows the seed and rice hull mixtures:

Utah Broadcast Mix

Species	Pounds PLS/ac	Pounds Bulk Seed/ac
Wyoming big sagebrush	0.20	0.94
Rubber rabbitbrush	0.25	0.75
Eagle yarrow	0.20	0.24
“OR” sandberg bluegrass	0.75	0.95
Rice Hulls		7.41

Utah Drill Mix

Species	Pounds PLS/ac	Pounds Bulk Seed/ac
Fourwing saltbush	1.00	3.48
Appar blue flax	0.75	0.83
Munro globemallow	0.50	0.84
Anatone bluebunch wheatgrass	3.00	3.16
Sanpete bottlebrush squirreltail	2.00	2.82
Nezpar Indian ricegrass	2.00	2.13
Rice Hulls		4.58

Oregon Broadcast Mix

Species	Pounds PLS/ac	Pounds Bulk Seed/ac
Wyoming big sagebrush	0.20	1.33
Rubber rabbitbrush	0.25	2.06
Eagle yarrow	0.20	0.26
Mtn. Home sandberg bluegrass	0.75	1.18
Rice Hulls		4.90

Oregon Drill Mix

Species	Pounds PLS/ac	Pounds Bulk Seed/ac
Fourwing saltbush	1.00	2.28
Appar blue flax	0.75	1.00
Munro globemallow	0.50	0.61
Anatone bluebunch wheatgrass	3.00	3.52
Toe Jam bottlebrush squirreltail	2.00	2.17
Nezpar Indian ricegrass	2.00	2.08
Rice Hulls		4.74

Drill Comparison Broadcast Mix

Species	Pounds PLS/ac	Pounds Bulk Seed/ac
Wyoming big sagebrush	0.20	1.33
Rubber rabbitbrush	0.25	0.65
Eagle yarrow	0.20	0.21
Mtn. Home sandberg bluegrass	0.75	0.91
Rice Hulls		7.01

Comparison Drill Mix

Species	Pounds PLS/ac	Pounds Bulk Seed/ac
Fourwing saltbush	0.69	1.15
Appar blue flax	0.65	0.75
Munro globemallow	0.50	0.59
Anatone bluebunch wheatgrass	3.00	3.54
Bottlebrush squirreltail	1.90	2.06
Nezpar Indian ricegrass	2.00	2.13
Rice Hulls		5.05

The drill comparison trials were seeded at rates of 75 and 125 percent of the rates listed in the table above in order to be able to compare effectiveness of the 2 different drills.

Cover crop mixes were also prepared and seeded at the drill comparison trial sites to provide perennial cover around the plots. Approximately 8 acres of cover crop were seeded at each site and are listed below:

East Humboldt Cover Drill Mix

Species	Pounds PLS/ac	Pounds Bulk Seed/ac
Hycrest crested wheatgrass	2.50	2.78
Bozoisky Russian wildrye	1.50	1.83
Vavilov Siberian wheatgrass	3.00	3.24
Rice Hulls		6.11

Gopher Fire Cover Drill Mix

Species	Pounds PLS/ac	Pounds Bulk Seed/ac
Ladak alfalfa	0.50	0.54
Hycrest crested wheatgrass	1.00	1.11
Bozoisky Russian wildrye	1.00	1.22
Rimrock Indian ricegrass	1.50	1.55
Secar Snake River wheatgrass	2.00	2.51
Bannock thickspike wheatgrass	2.00	2.44
Rice Hulls		5.37

The drill comparison trial is planned to be repeated again the fall of 2007. Location of trial to be determined based on areas that burn during the 2007 fire season in northern Nevada.

IDAHO

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INTRODUCTION

This report summarizes the studies and activities conducted by the NRCS Aberdeen Plant Materials Center during calendar year 2006.

COMPLETED PROJECTS

1. Native Plant Restoration (NPS Craters of the Moon National Monument)

   Seed processing and propagation of 2150 plants from 10 native seed collections. Seed harvested summer, 2004 and 2005. Plant propagation begun late fall 2005. Delivered 230 antelope bitterbrush *Purshia tridentata* and 100 limber pine *Pinus flexilis* September 2006.

ONGOING PROJECTS

1. Department of Defense (U.S. Army)

   Seed production of 3 test species (western wheatgrass, Siberian wheatgrass, and slender wheatgrass) and eventual release. Fields established spring 2005 and first seed harvest summer 2006. 3 year seed increase.

2. Grand Teton National Park
   Seed production of slender wheatgrass, blue wildrye, mountain brome and Sandberg bluegrass for revegetation of disturbed areas following road construction. Fields established spring 2006. 3 year seed increase.

3. Bureau of Reclamation

   Ongoing riparian/wetland work.

4. USDA FS – Ogden

   Ongoing riparian/wetland work.

5. <u>Foundation Seed Production</u> (Utah Crop Improvement Association, Idaho Crop Improvement Association, USDA FS Rocky Mountain Research Station)

   Anatone and Goldar bluebunch wheatgrass, Paiute orchardgrass, Bannock thickspike wheatgrass, Maple Grove Lewis flax, Snake River Plains fourwing saltbush, Northern Cold Desert winterfat, Richfield firecracker penstemon, Clearwater Venus penstemon.

6. <u>Study 01-W08 Seagull Bay Wetland Enhancement</u> (Bureau of Reclamation)

   Planted willows around Seagull Bay wetland to create structure for wildlife and to improve water quality.

7. <u>Study 2000-R18 Medicine Lodge Creek Assessment and Revegetation</u>

   Evaluate stream assessment procedures and develop revegetation plan(s) to restore stream functions.

8. <u>Study 2000-R19 Sheridan Creek Riparian Demonstration Project</u>

   Test bioengineering treatments on an overgrazed stream and restore the natural fish habitat.

9. <u>Study 87-R01 American Falls Reservoir Idaho Shoreline Erosion Control Project</u> (Bureau of Reclamation)

   Develop vegetative techniques to control erosion on shorelines of lakes, reservoirs, and ponds.

10. <u>Study 87-R02 Trout Creek Nevada Riparian Evaluation Site</u>

    Test woody riparian accessions on streams in the arid and semi-arid west. Test planting techniques for woody riparian plants.

11. <u>Study 92-W08 Fairview Wetland Idaho Constructed Wetland System</u> (Idaho State University)

    Determine the effectiveness of various wetland species to remove nutrients from an individual farm's irrigation wastewater. Develop design criteria for sizing system components.

12. <u>Study 96-R13 Trout Creek Nevada Bioengineering Demonstration</u>

    Demonstrate the effectiveness of bioengineering techniques in stabilizing streambanks in low precipitation zones of the arid and semi-arid west. Treatments tested include brush mattress, vertical bundles, fascines, and willow structure to stop headcut.

13. <u>Study 98-01 Hybrid Poplar Initial Evaluation</u>

Identify commercial accessions of hybrid poplar used for fuel and fiber adapted to eastern Idaho and northern Utah.

14. Study 98-R10 Carson River Nevada Riparian and Bioengineering Demonstration

    Demonstrate the effectiveness of bioengineering in conjunction with traditional engineering practices to stabilize streambanks in the arid and semi-arid west.

15. Study 98-W07 Pocatello, ID Stormwater Constructed Wetland System (City of Pocatello)

    Create Constructed Wetland System to treat stormwater from the SE side of Pocatello, ID. This wetland is an attempt to help the city meet the EPA phase II requirements.

16. Study ABPMC-S-0203-RA Mutton bluegrass (9067402) initial seed increase and evaluation

    Seed increase G1 and evaluation.

17. Study ABPMC-T-0315-RI Upper Carson River Bioengineering Demo

    Develop bioengineering treatments to stabilize severely eroding streams in low precipitation areas.

18. Study IDPMC-T-0403-RI Willow cutting soaking trials

    Evaluate efficacy of pre-soaking hardwood cuttings to aid in establishment.

19. Study IDPMC-T-0406-WE Wetland species direct seeding evaluation (National Park Service)

    Evaluate techniques to establish wetland plants through direct seeding.

20. Study IDPMC-T-0505-RA Orchard display and adaptation evaluation (USDA FS Rocky Mountain Research Station)

    Establish and evaluate native and introduced grasses, forbs and shrubs.

21. Study IDPMC-T-0506-RA Great Basin forb propagation and initial evaluation (USDA FS Rocky Mountain Research Station)

    Greenhouse propagation and evaluation of 7 native forb accessions for transfer to RMRS.

22. StudyIDPMC-T-0507-RI Willow Pre-soak field trial

    Compare effectiveness of willow pre-soaking treatments under field conditions. Planted 350 hardwood cuttings of 3 woody riparian species on degraded creek bank at Arbon

Valley, ID.

23. IDMPC-T-0605-RA Anatone bluebunch wheatgrass Growth Curves

    Develop growth curves for inclusion in ecological site descriptions.

24. IDPMC-P-0407-RA USDA FS R1 Bluebunch wheatgrass IEP (USDA FS Region 1)

    Evaluate collections of R1 PSSPS for possible selected class release.

25. IDPMC-P-0408-RA USFSR1 Sandberg bluegrass IEP (USDA FS Region 1)

    Evaluate collections of R1 POSE for possible selected class release.

26. IDPMC-P-0409-RA USFSR1 Blue wildrye IEP (USDA FS Region 1)

    Evaluate R1 collections of ELGL for possible selected class release.

27. IDPMC-P-0410-RA USFSR1 Idaho fescue IEP (USDA FS Region 1)

    Evaluate R1 collections of FEID for possible selected class release.

28. IDPMC-P-0411-RA USFSR1 Tufted hairgrass IEP (USDA FS Region 1)

    Evaluate R1 collections of DECA for possible selected class release.

29. IDPMC-P-0412-RA USFSR1 Western Yarrow IEP (USDA FS Region 1)

    Evaluate R1 collections of ACMI for possible selected class release.

30. IDPMC-P-0504-RA Basin Wildrye advanced evaluation

    Evaluate Magnar, Washoe Germplasm and Trailhead against promising accession from Nevada.

31. IDPMC-P-0508-RA Caribou-Targhee NF Slender wheatgrass IEP (USDA FS Caribou-Targhee and Bridger-Teton National Forests)

    Evaluate CT and BT collections of ELTR7 for possible selected class release.

32. IDPMC-P-0509-RA Caribou-Targhee NF Mountain Brome IEP (USDA FS Caribou-Targhee and Bridger-Teton National Forests)

    Evaluate CT and BT collections of BRMA4 for possible selected class release.

33. IDPMC-P-0602-RA Muttongrass (*Poa fendleriana*) AEP

    Compare 9076402 to accessions from other researchers for potential release.

34. IDPMC-P-0615-RA Coffee Point- Basin Wildrye Off-Center Evaluation Nov. 2006

Evaluate released and test material in field conditions at Coffee Point Test Site.

35. IDPMC-P-0616-RA Coffee Point-Sandberg bluegrass Off-Center Evaluation

Evaluate accessions of Sandberg bluegrass under field conditions.

36. IDPMC-P-0617-RA Coffee Point-Bluebunch Wheatgrass Off-Center Evaluation

Evaluate accessions of PSSPS under field conditions.

37. IDPMC-P-0618-RA Coffee Point-Snake River Wheatgrass Off-Center Evaluation

Evaluate SRWG under field conditions.

38. IDPMC-P-0619-RA Coffee Point- Thickspike wheatgrass Off-Center Evaluation

Evaluate releases of ELLAL under field conditions.

39. IDPMC-P-0620-RA Coffee Point- Western Wheatgrass Off-Center Evaluation

Evaluate western wheatgrass under field conditions.

40. IDPMC-P-0621-RA Coffee Point- Slender Wheatgrass Off-Center Evaluation

Evaluate ELTR materials under field conditions.

41. IDPMC-P-0622-RA Coffee Point- Bottlebrush Squirreltail Off-Center Evaluation

Evaluation of bottlebrush accessions under field conditions.

42. IDPMC-P-0623-RA Coffee Point- Shrub Off-Center Evaluation

Evaluation of native shrubs under field conditions.

43. IDPMC-P-0624-RA Coffee Point- Forb Off-Center Evaluation

Observe native forb releases under field conditions.

44. IDPMC-P-0625-RA Coffee Point- Introduced Grass Off-Center Evaluation

Evaluate introduced grass accessions under Idaho field conditions.

45. IDPMC-T-0505-RA Orchard display and adaptation evaluation

Display nursery of native and introduced grasses, forbs and shrubs. Evaluate establishment and performance.

46. IDPMC-T-0601-RA Forb Herbicide tolerance trial (UI Extension)

    In cooperation with U of I to evaluate potential herbicides for weed control in forb seed production.

47. IDPMC-T-0603-Ri Effects of pre-soaking dormant hardwood cuttings of coyote Willow

    Evaluate length of time and water temperatures to increase survivability.

48. IDPMC-T-0604-RA Great Basin Forb Initial Increase and Evaluation

    Develop propagation techniques and evaluate plant growth and seed production characteristics in increase blocks.

49. IDPMC-T-0604-WE Options and cost breakdown for direct seeding wetlands with Baltic rush

    Develop alternatives and costs for direct seeding Baltic Rush.

50. IDPMC-T-0606-RA *Eriogonum* stratification requirements

    Investigate optimum stratification durations for 2 Eriogonum species, *E. umbellatum* and *E. heracleoides*.

51. IDPMC-T-0607-RI Salato Creek Soil Bioengineering Demonstration Site

    Demonstration of soil bioengineering treatments in low precipitation areas of the SW. Soil Bioengineering treatments were combined with harder structures to show how they can fit together and function together.

52. IDPMC-T-0608-RI Restoration techniques for the Hopi Indian Reservation

    Development of riparian planting techniques for the arid SW on the Hopi Reservation. These techniques utilize native culturally significant riparian woody species to restore the riparian areas on the reservation.

53. IDPMC-T-0609-RI Lemhi River Soil Bioengineering Demonstration near Salmon, ID

    Stream bank Soil bioengineering demonstration on the Lemhi River near Salmon, ID. This project evaluates different soil bioengineering treatments that can work at high elevations and in high pH water.

54. IDPMC-T-0610-RI Moose WY streambank soil bioengineering demonstration project

    Demonstration of Stream bank Soil Bioengineering treatments on the Snake River. This project will demonstrate the use of bioengineering treatments in a large river with high velocities and high ice loads.

55. IDPMC-T-0612-WE Stratification requirements for Indian Valley Sedge (*Carex aboriginum*)

56. IDPMC-T-0613-CP Evaluation of Hairy Vetch populations for winter hardiness

    Determine if any of 5 hairy vetch accessions are winter tolerant in ID.

57. IDPMC-T-0614-RA Propagation protocol for containerized *Eriogonum umbellatum* and *E. heracleoides*

    Create greenhouse propagation protocols for ERUM and ERHE2. Study examines stratification requirements, planting depths and irrigation schedules.

PROPOSED OR PLANNED STUDIES

1. Development of ecoregion specific vegetative riparian restoration guidelines following removal of Tamarisk (salt cedar), Russian olive and other invasive species

2. Skull Valley Inter Center Strain Trial

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GRAND TETON NATIONAL PARK

FY2006 Annual Report
Prepared by

NATURAL RESOURCES CONSERVATION SERVICE
PLANT MATERIALS CENTER
ABERDEEN, IDAHO

INTRODUCTION

The Aberdeen Plant Materials Center (PMC) entered into an interagency agreement with Grand Teton National Park (GTNP) in 2006 to produce seed of four native grasses for use in revegetation of disturbed areas following road construction. Seed fields were planted in 2006 and seed will be harvested in 2007 and 2008.

ACCOMPLISHMENTS

GTNP personnel delivered processed seed to the PMC on February 7, 2006 as listed below:

Species	Scientific Name	Bulk Weight (lbs)	Acreage Seeded
Slender wheatgrass	*Elymus trachycaulis*	5.6	1.0
Blue wildrye	*Elymus glaucus*	14.6	2.7
Mountain brome	*Bromus marginatus*	7.0	1.0
Sandberg bluegrass	*Poa secunda*	0.8	0.25

PMC personnel inspected each seed lot for purity and estimated germination for each of the species. Based on inspection and germination, mountain brome and Sandberg bluegrass seed was processed further to improve germination and purity. Seed fields were planted the last week of May 2006. Slender wheatgrass was planted in Field 27E at the PMC Fish and Game Farm. Mountain brome and Sandberg bluegrass were planted in Fields 2W and 13N respectively at the PMC Home Farm. Blue wildrye was planted in Field 6E at the PMC Pearl Farm.

Soil at the Home Farm and Fish and Game Farm is Declo silt loam with pH of 7.4 to 8.4. Soil at the Pearl Farm is Kimama silt loam with pH of 7.4 to 9.0. Average annual precipitation is 9.39 inches and seed fields are sprinkler irrigated to supplement natural precipitation to approximate 16 to 24 inches total annual precipitation. Weeds were controlled as needed during the growing season. All species with the exception of Sandberg bluegrass established well. Sandberg bluegrass plants were established but establishment is spotty.

Seed harvest will begin from these fields in 2007.

Grand Teton National Park Seed Increase. Blue wildrye.
Aberdeen Plant Materials Center, September 6, 2006.

Grand Teton National Park Seed Increase. Mountain brome.
Aberdeen Plant Materials Center, September 6, 2006.

Grand Teton National Park Seed Increase. Slender wheatgrass.
Aberdeen Plant Materials Center, September 6, 2006.

Grand Teton National Park Seed Increase. Sandberg bluegrass.
Aberdeen Plant Materials Center, September 6, 2006.

NATIONAL PARK SERVICE
WETLAND ESTABLISHMENT RESEARCH STUDY

2006 Annual Summary Report
Prepared by

NATURAL RESOURCES CONSERVATION SERVICE
PLANT MATERIALS CENTER
ABERDEEN, IDAHO

Introduction: In 2003 the Aberdeen Plant Materials Center entered into an agreement with the National Park Service to evaluate the efficacy of different methods of direct seeding wetland plant species. Currently, wetland restoration is best accomplished using greenhouse grown or wildland collected plugs. An effective means of direct seeding is highly desirable for ease in planting and potential cost savings.

Accomplishments: A report summarizing the wetland seeding research conducted by the Aberdeen PMC during 2005 was published in the spring 2006 edition of Native Plants Journal under the title: *Comparison of methods for seeding Nebraska sedge (Carex nebrascensis) and Baltic rush (Juncus balticus*).

Technology Development: In 2006, direct wetland seeding research continued in the form of a greenhouse experiment examining inert broadcast carriers and hydroseeding mulches. Our commonly used wetland species produce very small seed, several million seeds/pound in the case of Baltic rush, and are extremely difficult to seed. The trial examined eight seeding treatments. There were four dry methods: no carrier, rice hulls, shop dry (a clay material for soaking up spills), and sand; in addition, there where four wet treatments, Fertile Fibers®, straw mulch, wood mulch and straight tackifier in water. Greenhouse trays were seeded and placed in wetland tanks and subsequently flooded. Plant density data indicate that Fertile Fibers® hydromulch and the use of a straight tackifier/water mix provide significantly better establishment than the other treatments.

The following data were collected from the study.

Seedling Germination

Treatment	Plants/ft² after 1 flood	Plants/ft² after 2 floods
Fertile Fibers	311 a	300 a
Tackifier	211 b	206 a
Straw mulch	74 c	100 b
Rice hulls	67 c	71 b
Shop dry	52 c	55 b
Sand	45 c	48 b
No carrier	44 c	50 b
Wood mulch	31 c	42 b

In 2007 the PMC plans to evaluate the top performing seeding methods in an outdoor trial.

Treatments prior to flooding.

Juncus seedlings after 21 days.

JUNCUS DIRECT SEEDING METHOD EVALUATION, 2006-2008
STUDY NUMBER: IDPMC-T-0604-WE
2006 PROGRESS REPORT

Derek J. Tilley, Range Conservationist (Plants)

February 2007

GOAL: To determine the techniques that are most efficient and cost effective for seeding Baltic rush (*Juncus balticus*), and to develop seeding rates for use with those methods that will provide adequate establishment for wetland revegetation.

This project was designed in incremental steps for ease of evaluation and development of seeding rates. The first experiment (trial 1) was conducted in the PMC greenhouse during the summer of 2006. Trial 1 compared seedling establishment from four hydroseed mulches and four dry, inert carriers. The second trial will take place in 2007 with the most promising treatments from trial 1 and compare each treatment with Submerseed™ pellets, a promising treatment from an earlier trial (Tilley and Hoag 2006), in a controlled outdoor seeding in 4' X 8' tanks. These studies are the precursors to field testing the best methods of direct seeding into the PMC wetland ponds. Due to volunteer wetland seed contamination, the ponds were chemically treated in 2006 and will be fumigated in 2007 to ensure a clean, weed-free seed bed for use in seeding evaluations that will take place in 2008.

TRIAL 1- EVALUATION OF BROADCAST CARRIERS AND HYDROMULCHES

Introduction

Planting seed of very small seeded species has certain inherent difficulties. Commonly available planting equipment requires a minimum volume of seed to prime the seed box. Many wetland species produce very small seed, over 90 million seeds/pound in the case of Baltic rush, and are extremely difficult to seed at a prescribed rate. Inert carriers have been found to be an effective method of increasing the volume of seeded material and facilitating uniform distribution of seed from drills or broadcast spreaders (St. John and others 2005). Recommended dry inert carriers include rice hulls, shop dry and sand. Hydroseed mulches can also act as an inert carrier in liquid form, much like rice hulls used for dryland plantings. The mulch keeps seed in suspension for more uniform dispersal and also provides structure allowing seed and tackifier to more readily attach to the soil surface. Baltic rush was chosen for this study because the seed exemplifies the problems faced in direct seeding wetland species, i.e. very small seed that floats and seed that requires surface planting to allow adequate light for germination.

Materials and Methods

Because tackifier is designed to be used to hold grass and flower seed to dry soils and slopes it was unknown if the glues in tackifier could withstand sustained flooding and if so, at what rate tackifier should be applied for use in wetland seedings. Turbo Tack® tackifier from Turbo Technologies Inc. was tested at 1x, 5x and 10x the recommended rate of tackifier with 100 seeds on Petri dish blotters by mixing seeds and tackifier in water and pouring it onto the saturated blotters. Each treatment contained six replications. The blotters and tackifier were allowed to dry overnight, and the blotters were then put under running water from a faucet to wash away any loose seed. Essentially no seed washout was observed, and no significant differences of seed washout were detected between treatments (data not shown). For ease of measuring and mixing for small scale greenhouse applications a 5x rate of tackifier was used in trial 1.

Trial 1 was initiated on April 17, 2006 and was concluded on May 8, 2006. Eight seeding techniques were evaluated; four dry methods including no carrier, rice hulls, shop dry and sand, and four wet or hydroseeding methods including tackifier (tackifier alone with seed and water), straw mulch, wood mulch and Fertil-Fibers NutriMulch™ hydroseeding pellets. The Fertil-Fibers pellets are designed to act both as mulch and as a slow-release fertilizer. The pellets are made primarily from chicken manure and rice hulls and have a nutrient ratio of 6:4:1 NPK (Quattro Environmental 2007).

Three replications of each treatment were seeded in 12" X 18" (1.5 ft^2) greenhouse trays placed randomly in a 4' X 8' X 1' artificial wetland tank in the PMC greenhouse. Mulch was applied at the recommended rate of 2000 lb/ac or 31.5g/tray (McClure, 2006). Tackifier was applied in all wet treatments at 5X the recommended rate (0.25g/tray) which equates to 16.25 lb/ac. The seed used for this trial was Sterling Selection of Baltic rush with a PLS of 89.1%. To more easily handle the very small amount of seed necessary, it was decided to use a very high seeding rate of 500 PLS/ft^2 (0.055g/tray). Hydroseeding applications were simulated by mixing seed, water, mulch and tackifier into a 2 liter kitchen measuring pitcher. The slurry was mixed and agitated for several minutes allowing tackifier crystals to dissolve and a uniform suspension to be made. The hydroseed slurry was then poured over the soil as evenly as possible. Any large clumps of mulch were smoothed out with a spoon. Hydroseed treatments were applied on April 17 and allowed to dry overnight to allow the tackifier to set (figure 1). Soil in each tray was a 1:1:1 mixture of peat, sand and perlite.

Figure 1. Treatments in greenhouse trays prior to flooding.

The dry treatments were initiated on April 18, so that all treatments could be flooded at the same time. Seed rates for the dry treatments were the same as those for the hydroseed treatments. Seed was mixed with approximately 1 tablespoon of inert carrier (2.0 g rice hulls, 10 g shop dry and 22 g sand). Inert carriers and seed were mixed in a small tray and spread as evenly as possible by hand over the soil. The no-carrier treatment was sprinkled by hand. Following broadcasting, the dry treatments were pressed into the soil with an imprinting jig designed to simulate a packer wheel.

The wetland tank was flooded on April 18 to a depth of approximately 2 inches above the top of the soil, and water was allowed to spill over the edge of the wetland tank. The overflowing of water caused any floating seed, mulch or inert material to be swept over the edge of the tank. This insured that no seed was spread to any other tray in the trial. All treatments were totally submerged for 15 minutes. After the first flooding, the water levels were dropped below the bottoms of the trays so the soil could dry slowly and optimum germination conditions could be met. Seventeen days after planting, on May 4, after the plants had a chance to become established and the soil was beginning to dry, the tanks were flooded again, this time for 24 hours, to test if established plants would wash out. Greenhouse temperatures ranged from 75 to 100° F for the length of the trial.

Seedling emergence was evaluated on May 1 (14 days after planting), and again on May 8 (21 days after planting) following the second flood. Four 2" X 12" strips running the 12" length of each tray were evaluated for seedling emergence. Germinants in each strip were totaled and added together to avoid pseudo replication. This total was then converted to plants/ft².

RESULTS

At the time of the first flooding event, there seemed to be a lot of seed washing out from the dry broadcast treatments, significantly more than from Fertil-Fibers and tackifier treatments. This was confirmed in the plant density evaluation (table 1). Fertil-Fibers had an average plant density of 300 plants/ft², and the tackifier treatment averaged just over 200 plants/ft², 2 to 4 times more germinants than the next highest density, the straw mulch treatment. Straw and wood mulch appeared to be too thick and may have been covering *Juncus* seeds and inhibiting germination. A lighter mixture of straw or wood may be as effective as Fertile Fibers or tackifier. It would be inaccurate to assume at this point that straw and wood mulches don't work, only that they don't work at the tested rates. Fertil-Fibers appear to be a thin enough slurry to not cover seeds, and it also works as an effective inert carrier to disperse seed and hold it to the soil. Results from Fertil-Fibers and tackifier alone seem promising enough to try these methods in the outdoor trial with 100 PLS/ft² as opposed to 500 PLS/ft. This matches the seeding rate to be used with Submerseed pellets and is a more realistic rate for field applications.

Figure 2. Juncus seedlings after 21 days.

Table 1. Seedling Germination

Treatment	5/1 (after 1 flood) Plants/ft²	5/8 (after 2 floods) Plants/ft²
No carrier	44 c	50 b
Rice hulls	67 c	71 b
Shop dry	52 c	55 b
Sand	45 c	48 b
Fertil-Fibers	311 a	300 a
Straw	74 c	100 b
Wood	31 c	42 b
Tackifier	211 b	206 a

Results were similar after the second flood event except seedling emergence in the Fertil-Fibers treatment was not significantly different from the tackifier treatment. No significant gains or losses in number of seedlings were detected between the first and second flooding treatments (data not shown). This indicates that once seed has germinated and have initiated some root growth into the soil, plants are very unlikely to be washed out by low energy flooding.

PROPOSED TRIAL 2- OUTDOOR TRIAL OF BEST PERFORMERS

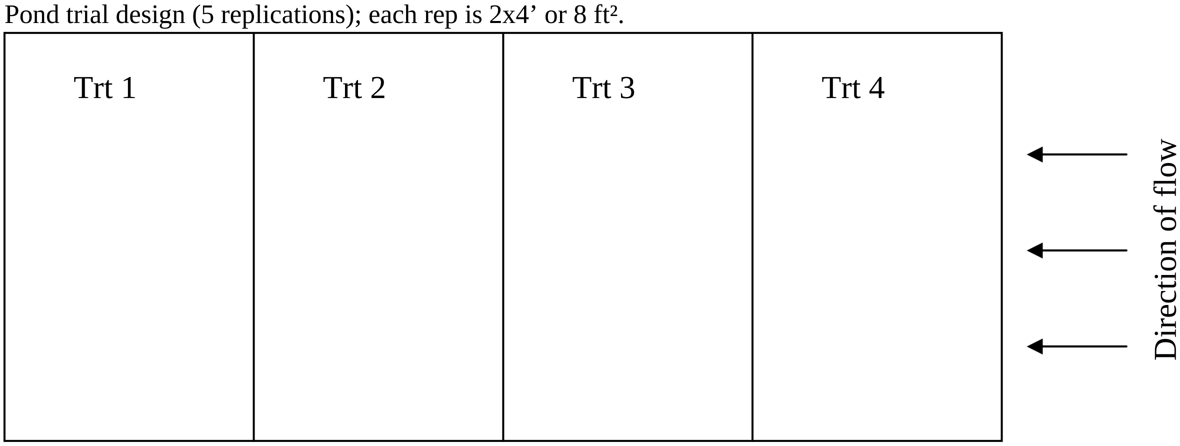
Based on the results from Trial 1 and results from Tilley and Hoag (2006) it is proposed that the following wetland seeding methods be evaluated under controlled, outdoor conditions during the summer of 2007.

- Submerseed
- Broadcast (rice hulls) w/ imprinter
- Hydroseed (tackifier w/o mulch)
- Hydroseed (Fertil-Fibers)

This trial is designed to be a bridging step between greenhouse scale trials and large scale field experiments. The experimental design incorporates a high degree of water control and eliminates the concern of volunteer wetland plant germination.

The four treatments would be planted in five 4' X 8' wetland tanks placed outside at the PMC farm. Each tank would be divided into four 2' X 4' plots, one per each treatment. Each tank would thus represent one of five blocks or replications. Because the plot size is so small, seeding with a broadcaster or hydroseeder would not be feasible; therefore seeding would have to be done in a manner similar to that described for trial 1. However, seed and tackifier rates could be adjusted to the rates recommended for large area plantings and germination rates would more accurately reflect those that might be observed in field plantings.

Pond trial design (5 replications); each rep is 2x4' or 8 ft².



The results of this trial will be used to generate a potential cost analysis between the available methods to revegetate wetlands. Factors such as seed cost, labor, and specialized equipment can be broken down to produce an approximate cost per acre for each method.

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Hairy Vetch Adaptation Trial 2006-2007

Study Number: IDPMC-0613-CP

Derek J. Tilley, Range Conservationist (Plants)
NRCS Aberdeen Plant Materials Center
Aberdeen, Idaho

Introduction

In 2006 the Aberdeen Plant Materials Center (PMC) entered into agreement with Dr. Thomas Devine, ARS Beltsville, MD to investigate the winter hardiness attributes of five accessions of hairy vetch (*Vicia villosa* Roth) at multiple PMCs in the northern region of the United States. Hairy vetch is a legume used as a cover crop by organic farmers in the northern states. In these applications the plants are seeded in late summer and run over with a roller the following spring, at bloom or shortly thereafter, to crimp and thereby kill the plants leaving mulch on the soil surface. The farmer then no-tills the next crop directly into the hairy vetch mulch (sometimes crimping and planting is done in one operation). The vetch provides nitrogen, controls weeds and helps retain moisture in the soil.

Materials and methods

The five hairy vetch accessions investigated were: AUEC, Groff, B-35, K-12 and Nebraska Common. Seed was supplied by Dr. Devine. The trial was located at the PMC home farm 2 miles north of Aberdeen, Idaho. Soil at the site is a Declo silt loam with pH of 7.4 to 8.4. Average annual precipitation is 9.39 inches. The site was disked and smoothed prior to planting. Experimental design was a randomized complete block with three replications. Each plot consisted of a single row, 10 feet long. Rows were spaced 36 inches apart.

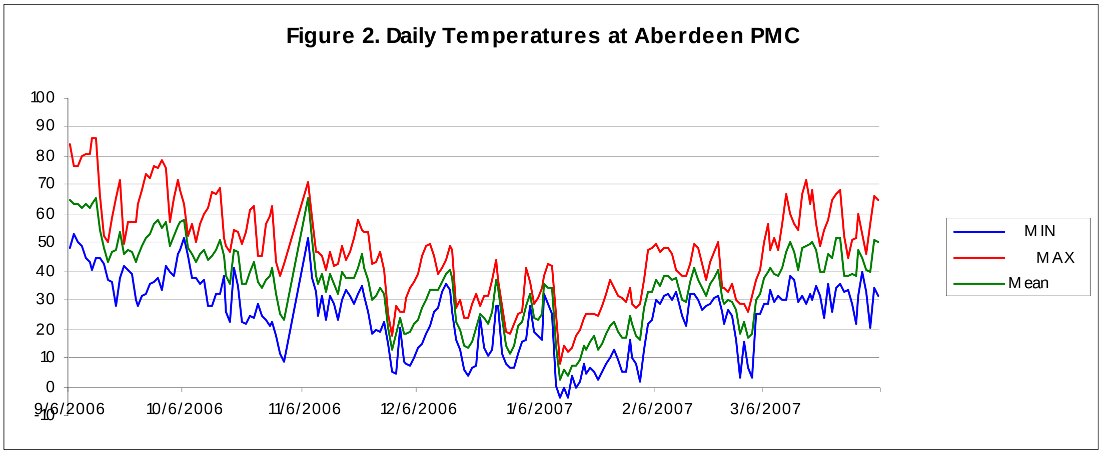
The experimental protocol provided by Dr. Devine included the application of a *Rhizobium* inoculant (Type C) to the seed prior to planting. A search was made for local suppliers of hairy vetch inoculant, but none were found. Because fall was progressing and temperatures were fast approaching the point where it would be too late to plant, it was decided by the PMC that the study could proceed without the use of inoculant. Planting occurred on September 6, 2006 with the use of a garden belt seeder. The seeder was calibrated to plant 6 seeds/ft or 60 seeds/plot. The plots received supplemental irrigation for establishment.

Figure 1. Hairy vetch seedling at time of spring evaluation.

The plots were evaluated for total number of living seedlings, once in the fall prior to winter dormancy on October 27, 2006 and again in the spring after plants had begun to actively grow on April 5, 2007 (figure 1). Survival was recorded as the number of living plants at the time of the second evaluation divided by the number of plants at the first evaluation. Data were analyzed with Statistix 8 analytical software and subjected to an analysis of variance (ANOVA), and significant means were separated with a Tukey’s HSD Test with a significance level of $p \leq 0.05$.

Weather information

Temperatures at the time of planting averaged into the sixties but dropped in the following days and weeks to the fifties (figure 2). The first sub-freezing temperature occurred on September 18. Night time freezing temperatures took place throughout most of the trial. The lowest temperatures were achieved in mid-January where temperatures dropped to sub-zero and reached as low as -4º F.

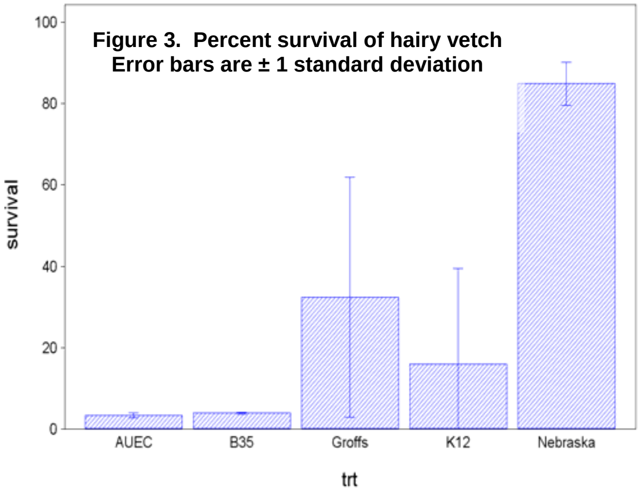


Results and discussion

Nebraska Common had significantly greater survival than all other accessions with a mean survival of 85% (table 1). The next best performers were Groffs (32 %), K-12 (16%), B-35 (4%) and AUEC (3%). Nebraska Common also had a much smaller standard deviation than Groffs or K12 indicating a smaller range of variation between plots (figure 3). According to the Idaho portion of the study, Nebraska Common would appear to be the most cold-tolerant variety and may be suitable for use in the Intermountain West region and other northern states. However, additional plantings would need to be conducted to verify these findings. Data from the other PMCs are also needed to corroborate these results. Raw data and a copy of this report will be sent to Dr. Devine for compilation with results from other investigators.

Table 1. Over-winter survival of hairy vetch cultivars at the USDA-NRCS Plant Materials Center, Aberdeen, ID, 2007.

Accession		% Survival
Nebraska		85 a
Groffs		32 b
K-12		16 b
B-35		4 b
AUEC		3 b



CARIBOU-TARGHEE AND BRIDGER-TETON NATIONAL FOREST
NATIVE GRASS INITIAL EVALUATION
2007 PROGRESS REPORT

DEREK J. TILLEY, RANGE CONSERVATIONIST (PLANTS)
LOREN ST. JOHN, TEAM LEADER ABERDEEN PLANT MATERIALS CENTER

INTRODUCTION

The purpose of this study is to evaluate collections of two species of native short-lived perennial grasses for use in revegetation, stabilization and beautification projects in the USDA Forest Service, Caribou-Targhee and Bridger-Teton National Forests (CTNF and BTNF).

During the summer of 2004, CTNF and BTNF collected 11 accessions of slender wheatgrass (*Elymus trachycaulus* [Link] ssp. *trachycaulus*) and 10 accessions of mountain brome (*Bromus marginatus* Nees ex Steudel). The collections were cleaned by the USDA-NRCS Aberdeen Plant Materials Center (PMC) for evaluation. Appendix 1 lists the accessions collected, the size of each collection and collection location. This progress report summarizes evaluations that took place in 2005 (establishment year) through 2007.

MATERIALS AND METHODS

Harvested seed collections were cleaned at the PMC seed cleaning facilities during the winter of 2004-2005. Appendix 2 provides detailed information on seed cleaning equipment and calibrations used. Estimated viability was obtained using the kerosene heater "popping" method outlined in Ogle and Cornforth (2000) and was used to approximate pure live seed (PLS).

The trial is being conducted at the Aberdeen Plant Materials Center, Fish and Game farm located approximately 5 miles northeast of Aberdeen, Idaho. Experimental design was a randomized complete block with six replications of each accession. Each plot is 20 feet long and contains one row, and plots were planted on three foot centers. Experimental design also contains plots of known industry standards from each species for comparison. Soil at the site is a Declo silt loam with pH of 7.4 to 8.4. Average annual precipitation is 8.75 inches. Ground was plowed in the fall of 2004 and subsequently disked and roller packed in the spring of 2005 prior to planting.

Plots were seeded on May 19, 2005 using a hand-pushed belt seeder calibrated to drill 30 pure live seeds (PLS) per foot of row. Seeds were drilled to an approximate depth of one half inch. Border rows of 'Tegmar' intermediate wheatgrass (*Thinopyrum intermedium* [Host] Barkworth & D. Dewey) were planted on the outside of the blocks to eliminate edge effect. Plots were sprinkler irrigated and fertilized as needed during the growing season for maximum seed production. Natural precipitation was supplemented with irrigation to approximate 16 to 24 in total annual precipitation. Weeds were controlled with herbicide treatments and between row mechanical cultivation.

The initial establishment evaluation was conducted on June 15, 2005 (27 days after planting) when most of the plants from both species had reached a one to two leaf stage. Plots were evaluated for percent stand, plant density and seedling vigor. Percent stand was measured using a twenty foot rope marked with one foot increments stretched the length of the plot and anchored at either end. Plants intercepting the one foot increments were summed and recorded as a percentage. Plant density was measured by counting seedlings found in the middle two feet of row and converted to average plants per foot of row. Seedling vigor was measured on an ordinal scale of one to nine (one being most healthy and nine being dead). Entire plots as well as individual plants within plots were viewed and given a rating based on overall apparent vigor.

The second evaluation was conducted on September 16, 2005. Plots were evaluated for percent stand by the same procedure used in June. Plant width was also evaluated. It was originally planned to record plant height measurements at this time; however, due to weeds reaching seed maturity it was decided to mow the entire field to a height of about four inches on August 5. It is our assumption that plant width measurements should provide a minimal amount of information regarding plant biomass production as well as vigor.

In 2006 (first seed harvest year) plots were evaluated when the seeds within a plot were judged to be ready for harvest, between July 20 and 28. All plots were evaluated for above ground biomass, average plant height and seed yield. Each plot was divided in half lengthwise, and the northern adjacent three feet were harvested for seed production, while the southern three feet were sampled for biomass yield. Seed samples from each species were cleaned to a visually estimated 90% purity. Forage samples were collected in paper sacks and allowed to air dry for a minimum of two weeks prior to weighing.

The 2007 evaluations took place from July 9 through July 25. The evaluations were conducted in the same manner as 2006 and included forage yield, seed yield, height, and in the case of mountain brome, smut presence.

All data from the 2005 evaluations were subjected to an Analysis of Variance (ANOVA) and means were separated using Duncan's Multiple Range Test using the MSTAT-C Microcomputer Statistical Program (Freed et al, 1991). 2006 and 2007 means were separated with a Tukey's multiple comparison test using the Statistix 8 Analytical software.

EVALUATIONS AND DISCUSSION

Slender Wheatgrass

CTNF and BTNF accessions of slender wheatgrass were compared against five previously released varieties; 'AEC Hillcrest', 'Pryor', 'Revenue', 'San Luis', and 'Adanac', and one non-released selection from the U.S. Army (D.O.D.). Of these, three (AEC Hillcrest, Revenue and Adanac) are from collections originally made in Canada. Pryor originates from a collection made in Montana and San Luis was originally collected in Colorado. See Tilley et al (2005b) for a detailed comparison of the characteristics for each released cultivar. The Army accession is a currently unreleased breeding population made of several collections from Colorado. AEC Hillcrest differs from the other accessions by being of the subspecies *subsecundus* and should not be considered directly comparable to the collections made by CTNF and BTNF.

At the first evaluation, percent stand ranged from 25.4 % (accession no. 9076496) to 85.1 (San Luis and Adanac). The high rating from San Luis and Adanac did not, however, differ significantly from several collections with percent stands of 70% or greater. The best plant density rating came from Adanac with 18.1 plants/foot. The poorest density was recorded from accession 9076496 with a density of 2.3 plants/foot. This accession similarly had the lowest seedling vigor rating of 6.7, while the best vigor was observed in Revenue (1.2). Of the CTNF and BTNF accessions 9076495, 9076498 and 9076499 performed the best in the three evaluated categories (Table 1).

At the time of the second evaluation of 2005, the best stand was recorded from Revenue (96.3 %). The other industry releases made up the rest of the top six in this category. Of the CTNF and BTNF collections, 9076495 had the best stand at 86.8 %, followed by 9076494, 9076499 and 9076498 with 86.0, 86.0 and 84.8 % stand respectively. The poorest percent stand rating was recorded from accession 9076496 with 56.3 % stand. With regard to plant width, the three Canadian releases, Adanac, Revenue and AEC Hillcrest were significantly larger than all other collections (4.8, 4.6 and 4.3 inches wide). The largest plants of the CTNF and BTNF collections were recorded by accession 9076502 (3.7 in.) which did not differ significantly from Pryor, D.O.D., 9076495, 9076494, San Luis or 9076497. The smallest plant widths were recorded from accession 9076496 (2.8 in.).

In the 2006 evaluation, biomass yields were lead by the industry standards Adanac, San Luis, Revenue, Pryor and the D.O.D. test material with mean yields ranging from 9400 to 7500 lb/ac. The best yields from the CTNF and BTNF accessions were from accessions 9076494 (5200 lb/ac) and 9076498 (5100 lb/ac). Seed yields were also dominated by released materials. San Luis had the greatest seed yield with 1500 lb/ac. Other top performers were Adanac (1200 lb/ac) and Revenue (1000 lb/ac). Of the CTNF and BTNF accessions, 9076500 and 9076498 had the top seed yields with 700 and 550 lb/ac respectively. Similarly, the releases had the top scores in the height evaluation, with measurements from 47 to 50 inches, while the CTNF and BTNF accessions ranged from 35 to 44 inches in height.

During the 2006 growing season the Canadian release AEC Hillcrest, became visibly different from all other collections as the 2006 growing season progressed. Plants of AEC Hillcrest were smaller in stature, grew in a more decumbent form and had bluer leaves than the other accessions. In the evaluations, AEC Hillcrest scored lowest in forage and height, and third lowest in seed yield.

Forage yields were generally greater in 2007 versus 2006. The Departmetn of Defense accession had the highest yield with over 11,000 lbs/ac, significantly better than all others with the exception of San Luis (8520 lb/ac). FS collections had generally lower yields; the top performer being 9076503 with 6500 lb/ac. Seed yields were also impressivly higher in 2007. D.O.D again had the top rating with nearly 1300 lb seed/ac followed by Pryor at 1060 lb/ac and 9076500 with just under 1000 lb/ac. Revenue had surprisingly low seed yield, only 39 lb/ac. This was most likely due to harvesting too early (at the same time as the other accessions) and the seed had not yet filled out. Plant heights ranged from around 35 inches to 45 inches tall. Taller plants with good seed yield were often lodging at the time of harvest.

Table 1. Slender wheatgrass.

Accession No.	% Est. viability	% PLS[3/]	% stand 6/15	Density[1/] 6/15	Vigor[2/] 6/15	% stand 9/16	Plant width (in.) 9/16
9076493	95	90.25	54.4 c[4/]	6.8 d-f	4.0 b-d	71.0 f	3.1 e-g
9076494	95	90.25	70.2 a-b	13.0 a-c	4.0 b-d	86.0 a-e	3.6 c-e
9076495	90	85.5	77.2 a-b	13.4 a-c	3.0 d-f	86.8 a-d	3.6 c-e
9076496	90	85.5	25.4 d	2.3 f	6.7 a	56.3 g	2.8 g
9076497	95	90.25	64.0 b-c	7.8 c-f	3.3 d-f	77.0 d-f	3.2 d-g
9076498	95	90.25	75.4 a-b	15.3 a-b	3.7 c-e	84.8a-e	3.1 e-g
9076499	85	80.75	71.1 a-b	14.5 a-b	3.0 d-f	86 a-e	3.1 e-g
9076500	95	90.25	51.8 c	4.8 e-f	4.8 b-c	72.8 f	2.9 f-g
9076501	95	90.25	73.7 a-b	10.8 b-e	2.8 d-f	79.8 b-f	3.0 f-g
9076502	90	85.5	51.8 c	8.2 c-f	3.7 c-e	78.8 c-f	3.7 c-d
9076503	85	80.75	52.7 c	8.0 c-f	5.0 b	74.5 e-f	2.8 f-g
AEC Hillcrest	95	91.2	71.9 a-b	13.3 a-c	2.7 e-f	91.0 a-c	4.3 b
Pryor	99.9	91.9	71.9 a-b	12.3 a-d	2.2 f-g	90.3 a-c	3.8 c
Revenue	*	80.1	79.8 a-b	17.9 a	1.2 g	96.3 a	4.6 a-b
San Luis	99	87.12	85.1 a	16.9 a-b	5.2 b	92.0 a-b	3.3 c-f
D.O.D.	98	90.2	79.8 a-b	16.6 a-b	1.3 g	90.2 a-c	3.8 c
Adanac	98	84.3	85.1 a	18.1 a	1.5 g	95.5 a	4.8 a
Critical value (0.05)			13.8	5.4	1.1	10.4	0.5

[1/] Plants per foot of row
[2/] Rated 1-9 with 1best, 9 worst
[3/] Percent PLS based on estimated 95% purity for CTMF collections
[4/] Means followed by the same letter are not significantly different
* Information not available from source

Accession No.	Forage 2006	Seed 2006	Height (in) 2006	Forage 2007	Seed 2007	Height (in) 2007
9076493	3326 d	308 e-f	40.3 d-f	4537 c-d	572 b-g	38 a-d
9076494	5165 b-d	493 d-f	44.0 a-d	6050 b-d	681 b-f	44 a-b
9076495	4093 d	401 e-f	43.8 a-d	5546 b-d	726 a-e	43 a-d
9076496	2496 d	209 f	37.0 e-f	2874 d	163 e-g	36 de
9076497	3939 d	435 e-f	39.7 d-f	4991 b-d	577 b-g	38 b-d
9076498	5133 b-d	550 d-f	41.7 c-e	5495 b-d	967 a-c	42 a-d
9076499	3786 d	376 e-f	35.5 e-f	5243 b-d	535 b-g	43 a-c
9076500	4766 c-d	702 c-e	42.1 b-e	4890 b-d	997 a-c	43 a-c
9076501	4092 d	340 e-f	39.0 d-f	5042 b-d	446 c-g	41 a-d
9076502	2713 d	200 f	37.8 d-f	3933 c-d	284 d-g	37 b-d
9076503	4092 d	349 e-f	39.0 d-f	6504 b-d	814 a-d	44 a-c
AEC Hillcrest	1823 d	303 e-f	34.1 f	3126 d	141 f-g	29 e
Pryor	8384 a-b	544 d-f	49.5 a	7512 b-c	1059 a-b	44 a-b
Revenue	8997 a	1050 b-c	49.2 a-b	7563 b-c	39 g	37 c-d
San Luis	9304 a	1501 a	50.5 a	8520 a-b	851 a-c	45 a
D.O.D.	7464 a-c	846 b-d	47.8 a-c	11243 a	1282 a	42 a-d
Adanac	9457 a	1226 a-b	47.3 a-c	5848 b-d	285 d-g	38 a-d
Critical value (0.05)	varies*	varies	varies	3656	564	7

*indicates missing data values in one or more plots.

<u>Mountain Brome</u>

The mountain brome trial included two industry releases, Garnet Germplasm from Montana and 'Bromar' from the Pacific Northwest. See Tilley et al (2005a) for detailed information on these mountain brome releases.

At the first evaluation, the best percent stand and plant density were recorded from Garnet (81.6 % and 22.3 plants/foot). Second best in both categories was Bromar (78.1 % and 14.1 plants/foot) which also had the best possible rating for seedling vigor (1.0). In general, the CTNF and BTNF accessions showed little if any significant differences from one another (Table 2). At the time of the second evaluation there was no significant difference between accessions for percent stand. All plots showed nice, dense stands with vigorous plant growth. There was, however, significant difference detected with regard to plant width. Bromar was significantly larger than all other accessions tested with a width of 6.8 inches. The best performing CTNF and BTNF collection was 9076507 with a width of 5.4 inches.

In the 2006 evaluations, analysis showed no statistical significant differences between accessions for biomass or seed yields. Biomass yield means were all high ranging from 6600 lb/ac (9076513) down to 4100 lb/ac (9076512). Seed yield means, however, had a wide range, 1700 lb/ac (9076506) to 500 lb/ac (9076512). The lack of statistical significance for seed yield is most likely due to the high variability of seed yields in plots, including a number of plots in which no seed was found in the harvested plot. Greatest heights were achieved by Garnet and Bromar, both with means of 45.3 in. The top CTNF and BTNF accessions were 9076506, 9076507, and 9076508, all with heights of 42.3 in.

Because mountain brome is known to be susceptible to head smut (*Ustilago bullata*) the PMC decided to rate the presence of head smut on the inflorescences at the time of seed harvest. This was done by inspecting the plots visually and assigning an overall rating of 1 to 9 with 1 being the best score (no smut present) and 9 being the worst (heavily infested with smut). The best score from the evaluation was obtained by Bromar (1.0) while accession 9076513 had the second best score of 1.8. Interestingly, Garnet, which was released as having superior smut resistance compared to Bromar, came in third with a score of 2.2.

Forage yields for mountain brome in 2007 ranged between 3000 and 6000 lb/ac. The best producer was Garnet (6260 lb/ac) followed by 9076506 and 9076504, both with over 5000 lb/ac. The top two seed yields came from FS accessions 9076505 and 9076506, both with approximately 1100 lb seed/ac. These were followed by Bromar and Garnet with 1000 and 900 lb/ac respectively. 9076505 also had a fair smut score with 2.6, slightly better than Garnet, but worse than Bromar which received a score of 1.2. Heights were not seperable statistically. All were from 42 to 48 inches tall.

Mountain brome plots. Lodging evident in nearly all plots. Photo taken July 2006

Mountain brome infested with head smut. Photo taken July 2006

Table 2. Mountain brome.							
Accession No.	% Est. viability	% PLS	% stand 6/15/05	Density 6/15/05	Vigor 6/15/05	% stand 9/16/05	Plant width (in.) 9/16/05
9076504	85	80.75	72.8 a-c	10.9 b	3.8 a	93.0[1/]	4.9 c-e
9076505	85	80.75	66.7 a-c	11.3 b	3.3 a-b	83.3	5.0 b-e
9076506	90	85.5	66.7 a-c	8.7 b	2.7 a-b	85.7	4.4 d-e
9076507	90	85.5	70.2 a-c	9.8 b	3.8 a	92.0	5.4 b-c
9076508	85	80.75	74.6 a-c	12.8 b	2.8 a-b	93.2	5.0 b-e
9076509	95	90.25	73.7 a-c	12.6 b	3.2 a-b	91.0	4.2 e
9076510	95	90.25	74.6 a-c	12.8 b	2.8 a-b	93.7	5.3 b-d
9076511	90	85.5	59.7 b-c	10.8 b	3.2 a-b	82.5	4.8 c-e
9076512	90	85.5	59.7 b-c	11.9 b	2.3 a-c	88.3	5.1 b-e
9076513	90	85.5	54.4 c	10.1 b	2.2 b-c	78.0	5.2 b-d
Garnet	55	53.35	81.6 a	22.3 a	2.0 b-c	96.7	5.9 b
Bromar	97	96.0	78.1 a-b	14.1 b	1.0 c	94.7	6.8 a
Critical value (0.05)	NA	NA	18.3	5.3	1.4	15.7	0.8

[1/] No significant difference detected between treatments.
[2/] Rated 1-9 with 1best, 9 worst

Table 2 (continued).								
	Forage (lb/ac) 2006	Seed (lb/ac) 2006	Height (in) 2006	Smut 2006	Forage 2007	Seed 2007	Height (in) 2007	smut 2007
Accession No.								
9076504	5300[1/]	1600[1/]	42.0 a-b	2.2 c-e [2/]	5042 a-b	411 d-e	46	3.5 a-b
9076505	4900	1300	39.2 b	5.3 a	4808 a-b	1121 a	46	2.6 a-b
9076506	5500	1700	42.3 a-b	3.5 a-d	5798 a-b	1069 a-b	46	3.7 a-b
9076507	5200	1500	42.3 a-b	2.7 b-e	3719 a-b	505 b-e	48	4.2 a-b
9076508	5600	1300	42.3 a-b	3.7 a-d	4185 a-b	470 c-e	44	4.3 a
9076509	5900	1000	36.7 b	5.7 a	4627 a-b	670 a-e	43	5.2 a
9076510	5200	800	40.5 a-b	4.3 a-c	3378 b	299 e	42	5.5 a
9076511	5300	1300	40.5 a-b	4.8 a-b	4185 a-b	500 c-e	43	4.0 a-b
9076512	4100	500	41.0 a-b	4.2 a-d	3961 a-b	360 d-e	45	4.6 a
9076513	6600	700	41.8 a-b	1.8 d-e	4033 a-b	773 a-e	45	2.5 a-b
Garnet	5600	1400	45.3 a	2.2 c-e	6260 a	896 a-d	48	3.0 a-b
Bromar	4700	700	45.3 a	1.0 e	4739 a-b	996 a-c	47	1.2 b
Critical value (0.05)	varies	varies	varies		varies	varies	NA	varies

SUMMARY
The PMC will continue to evaluate plots through 2008, the final year of the study. At the conclusion of the 2008 evaluation a summary report prepared. At that time the conclusion the PMC will make recommendations for further evaluation or moving forward on a selected class release if promising accessions are found.

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Appendix 1. Seed collection and origin data

Accession No.	Species	Date collected	Cleaned wt. (lbs)	National Forest	District	Location	Elevation (ft)
9076493	ELTR7	8/31/04	1.00	Bridger-Teton	Jackson	Shadow Mt	7,872
9076494	ELTR7	8/10/04	0.85	Targhee	Island Park	Taylor Creek	6,619
9076495	ELTR7	8/31/04	1.06	Bridger-Teton	Jackson	Curtis Canyon	7,662
9076496	ELTR7	8/23/04	0.92	Caribou	Montpelier	Green Canyon	8,309
9076497	ELTR7	9/1/04	0.49	Targhee	Dubois	Bear Trap Creek	7,402
9076498	ELTR7	7/29/04	0.20	Caribou	Westside	Big Springs	6,290
9076499	ELTR7	8/19/04	1.54	Caribou	Soda Springs	Diamond Creek	6,784
9076500	ELTR7	8/3/04	0.70	Caribou	Palisades	McCoy Creek	5,766
9076501	ELTR7	8/11/04	0.57	Targhee	Teton Basin	Dry Creek	6,743
9076502	ELTR7	9/9/04	1.62	Bridger-Teton	Buffalo	Togwotee Pass	8,514
9076503	ELTR7	7/30/04	0.10	Caribou	Palisades	Little Elk Creek	5,990
9076504	BRMA4	8/24/04	0.84	Caribou	Montpelier	Egan Basin	8,135
9076505	BRMA4	8/4/04	1.46	Caribou	Palisades	Moody Meadow	6,307
9076506	BRMA4	8/3/04	0.76	Caribou	Palisades	McCoy Creek	5,766
9076507	BRMA4	7/30/04	0.24	Caribou	Palisades	Little Elk Creek	5,990
9076508	BRMA4	8/11/04	0.36	Targhee	Teton Basin	Dry Creek	6,743
9076509	BRMA4	8/31/04	2.04	Bridger-Teton	Jackson	Shadow Mt.	7,872
9076510	BRMA4	8/10/04	0.94	Targhee	Island Park	Taylor Creek	6,619
9076511	BRMA4	7/29/04	0.20	Caribou	Westside	Big Springs	6,290
9076512	BRMA4	9/9/04	3.60	Bridger-Teton	Buffalo	Togwotee Pass	8,514
9076513	BRMA4	8/19/04	2.25	Caribou	Soda Springs	Diamond Creek	6,784

Geographic illustration of CTNF and BTNF collection locations

Mountain Brome

I. Air Screen Cleaner

1. Screens
    a. top: 5.550
    b. middle: 4.750
    c. bottom: blank
2. Valves
    a. 3.25
    b. 3.5
    c. 5.0
    d. closed
3. Settings
    a. sieve: 10.0
    b. blower 5.0

II. Indent Cleaner (used to remove seeds infected w/ smut)

1. Drum: 7.25

Slender wheatgrass

I. Hammermill

1. Screen: 0.5 inch
2. Air: low

II. Air Screen Cleaner*

1. Screens
    a. top: 3.550
    b. bottom: 6x24
2. Valves
    a. 3.45
    b. 3.50
    c. 4.75
    d. closed
3. Settings
    a. sieve: 2.0
    b. blower: 2.0

*Ran through three times to clean out inert matter.

USDA FOREST SERVICE, REGION 1
NATIVE GRASS AND FORB INITIAL EVALUATION
FINAL PROGRESS REPORT
JANUARY 2008

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INTRODUCTION

The purpose of this study is to evaluate native perennial grass and forb accessions for potential use in revegetation, stabilization and beautification projects in the Rocky Mountain and sagebrush steppe ecosystems of Montana and northern Idaho. Large areas of national forest are in unsatisfactory ecological condition. Many areas are infested with invasive weeds such as cheatgrass, knapweed species, yellow starthistle and leafy spurge. These weeds cause many problems and detract from the health and beauty of the ecosystem. When dry, the weeds provide flash fuels for wildfires which create the potential for soil erosion and degradation of water quality and watershed values. Weeds also decrease plant community diversity, reduce habitat for wildlife and compete with threatened and endangered species. The goal of this study was to identify accessions of native grasses and forbs under evaluation that have potential to be released as germplasm for commercial seed production and use in revegetation projects in the Rocky Mountain and sagebrush steppe ecosystems of Montana and northern Idaho.

In 2003, The USDA-Forest Service, Region 1, (FS R1) collected seed of five native perennial grass species from 41 locations and three native forb species from eleven locations. The collections were sent to the USDA-Natural Resources Conservation Service-Plant Materials Center (PMC) at Aberdeen, Idaho for evaluation. From the collections received at the PMC, 37 grass and ten forb collections were chosen for testing based on seed quality and/or quantity. Total usable collections included: twelve bluebunch wheatgrass (*Pseudoroegneria spicata*), seven blue wildrye (*Elymus glaucus*), thirteen Idaho fescue (*Festuca idahoensis*), one Sandberg bluegrass (*Poa secunda*), three tufted hairgrass (*Deschampsia caespitosa*), eight western yarrow (*Achillea millefolium*), one lupine (*Lupinus* sp.) and one pearly everlasting (*Anaphalis margaritacea*). Appendix 1 lists the accessions collected, collection locations and the size of each seed collection. This report summarizes the evaluations conducted for the seasons 2004, 2005, 2006 and 2007.

MATERIALS AND METHODS

Harvested seed collections were cleaned at the PMC seed cleaning facilities using a wide range of machines and settings. Each accession was treated separately due to differences in the quality of pre-cleaned materials and variation in seed size. Appendix 2 provides general information regarding machine calibration and settings used for each species. Minor adjustments were made to the seed cleaning equipment to achieve the best seed purity for each collection. Estimated viability was obtained using the kerosene heater “popping” method outlined in Ogle and Cornforth (2000). Some collections were also evaluated for viability using standard germination tests.

A seedling emergence trial was conducted in the PMC greenhouse from February to March, 2004 to determine if any accessions emerged more quickly or had better seedling vigor. No significant differences were detected (data not shown).

GRASSES

The native grass field evaluation trial was conducted at the PMC, Fish and Game farm located approximately 5 miles northeast of Aberdeen, Idaho. Experimental design was designed as a randomized complete block with four replications. Individual plots were 20 feet long and contained one row; rows were planted on three foot centers. The experimental design also included plots of known industry standards from each species for comparison. Soil at the site is a Declo silt loam with pH of 7.4 to 8.4. Average annual precipitation is 9.39 inches. The planting site was plowed in the fall of 2003 and then disked and roller packed in the spring of 2004 prior to planting.

Plots were seeded on May 10 and 11, 2004. Bluebunch wheatgrass and Idaho fescue accessions were planted using a Planet Jr. seeder. Blue wildrye, Sandberg bluegrass and tufted hairgrass accessions were planted using a belt seeder. Planting equipment was calibrated to plant approximately 25 Pure Live Seeds (PLS) per foot of row for large seeded species (bluebunch wheatgrass and blue wildrye) and 50 PLS per foot of row for small seeded species (Idaho fescue, Sandberg bluegrass and tufted hairgrass). Seeding depth ranged from ¼ inch for small seeded accessions to ½ inch for the larger seeded accessions. Each species block contained at least two released cultivars to use as standards for comparison. The species used for standards of comparison are listed in the discussion section for each species. Border rows of ‘Tegmar’ intermediate wheatgrass (*Thinopyrum intermedium*) were planted on the outside of the blocks to reduce edge effect. Plots were sprinkler irrigated and fertilized as needed during the growing season for maximum seed production. Natural precipitation was supplemented with irrigation to approximate 16 to 24 in total annual precipitation. Weeds were controlled with herbicides and between row cultivation.

In 2007, irrigation was reduced to approximate low water conditions in the species’ natural habitat to observe accession responses to lower precipitation regimes. In early June no additional irrigation was provided in order to place stress on the plots. This will allowed the evaluation of the effects of simulated drought to help identify accessions that may be more tolerant of drier conditions. Natural precipitation at the test site was supplemented by sprinkler irrigation to total approximately 12 to 14 inches annual precipitation.

The first evaluation was conducted on June 14, 2004 when all grasses had reached the one to two leaf stage. Plots were evaluated for percent stand, plant density and seedling vigor. Percent stand was measured using a twenty foot rope marked with one foot increments stretched the length of the plot and anchored at either end. Plants intercepting the one foot increments were summed and recorded as a percentage. Plant density was measured by counting seedlings found in the middle two feet of row and converted to average number of plants per foot of row. Seedling vigor was measured on a subjective scale of one to nine (one being most healthy and nine being dead). Each plot was assessed and given a rating based on overall apparent vigor.

The second evaluation of 2004 was completed during the week of September 27. All accessions were rated for percent stand and plant volume. Plant volume was measured as plant height x width1 x width2 and recorded in cubic inches. Blue wildrye and bluebunch wheatgrass were also rated for percent of plants in flower per plot to provide some indication of potential seed production for the following year. Idaho fescue, Sandberg bluegrass and tufted hairgrass had not begun flowering at the time of the evaluation. Seed yield data was not collected during the first year of establishment, because seed harvest during the first year of establishment is not generally recommended. All species except blue wildrye were evaluated for plant density as described above for the first evaluation. Plant density for the blue wildrye accessions was not collected during the second evaluation due to very tight and uniform stands that rendered data collection of plant density impossible.

The evaluations conducted during 2005 occurred between June 30 and July 27. Plots were evaluated when the seeds within a plot were judged to be ready for harvest. All plots were evaluated for forage yield, average plant height and seed yield. Sandberg bluegrass and Idaho fescue samples were collected from six feet of row, while blue wildrye, bluebunch wheatgrass and tufted hairgrass samples were collected from three feet of row. Each plot was divided in half lengthwise, and the northern adjacent three (or six) feet were harvested for seed production, while the southern three (or six) feet were sampled for forage yield. Seed samples from each species were cleaned as outlined in appendix 2 which resulted in a visually estimated 90% purity. Forage samples were collected in paper sacks and allowed to air dry for two weeks prior to weighing.

The 2006 evaluations took place from June 19 to July 31. 2007 evaluations occurred from June 27 to July 9. All evaluations were performed as described above.

All data from 2004 and 2005, except plant vigor evaluations, were subjected to an Analysis of Variance (ANOVA) and means were separated using Duncan’s Multiple Range Test using the MSTAT-C Microcomputer Statistical Program (Freed et al, 1991). 2006 and 2007 analyses were completed using an ANOVA followed by a Tukey’s multiple comparison test using Statistix 8 Analytical Software.

FORBS

The native forb evaluation trial was planted on May 19, 2004 at the PMC Home Farm approximately two miles north of Aberdeen. Site information, seedbed preparation and experimental design are identical to the grass trial. There are two industry standards included in the western yarrow plots, Eagle and Great Northern. There are no releases of lupine or pearly everlasting that would be comparable to the collections received for testing, so no standards of comparison were included for these two species. Yarrow plots were seeded with a target rate of 50 PLS per foot using a belt seeder. Lupine plots were seeded at 25 PLS per foot, and pearly everlasting plots were seeded at 50 PLS per foot using a Planet Jr. seeder. A border row of ‘Appar’ blue flax (*Linum perenne*) was planted on either side of the trial to reduce edge effect. The first evaluation was conducted on July 19, 2004. Plants ranged from the two to six leaf stage.

Forb plots were evaluated in the same manner as the grass plots. The first evaluation in 2004 included data collection for percent stand, plant density and seedling vigor. The second evaluation was conducted during the week of September 27, 2004 and data were collected on percent stand, plant density, plant volume and percent flower. Plots were evaluated in 2005 through 2007 for seed yield in the same manner as described for grasses using three feet of row for the sample collection. No data was collected for forage yield, because attempts to clip samples resulted in completely uprooting plants.

DISCUSSION

BLUE WILDRYE
2004 Evaluations

The blue wildrye trial contained three industry releases, Mariposa, Arlington and Elkton. Although all three releases were originally collected in western states, California, Washington and Oregon respectively, there are no releases from the Intermountain or Rocky Mountain regions (Dyer and O’Beck 2005). The first evaluation of blue wildrye showed no significant differences in percent stand between the accessions tested. Plant density showed low levels of significance. Accession 9076447 rated highest (39.0 plants/foot), and Elkton, a western Oregon accession, rated lowest at 16.4 plants/foot. Best vigor was recorded from accessions 9076446, 9076447 and Mariposa (1.8). Poorest vigor rated was 3.8 from Arlington, an accession from western Washington (see Table 1).

During the second evaluation of 2004 there was again no significant difference in percent stand for the blue wildrye accessions. All accessions had stands ranging from 90 to 100% except accession 9076448 which had an average stand of 76.4%. Mariposa, Elkton and accession 9076472 showed high percentages of flowering (93.4, 92.5 and 80.0% respectively). The other industry release, Arlington, had 55% flowering. The remainder of the accessions had little to no flower production ranging from 0.0 to 18.8%. Accessions showed a wide range of plant volumes from 117.3 in^3 (accession 9076439) to 768.0 in^3 (Mariposa) with Mariposa significantly larger than the rest of the plants in the trial.

2005

Plots were evaluated in 2005 for forage production, height and seed production. Analysis showed no significant difference between accessions for forage production. Extrapolated forage yields ranged from 4,441 lb/ac (accession 9076472) to as much as 5,663 lb/ac (accession 9076448). Plants ranged in height from 52 inches (accession 9076445) to 46 inches (Elkton). Mariposa seed yields were significantly greater than all other tested accessions (505 lb/ac). The next best seed producers were accession 9076439 and 9076448 with 348 and 323 lb/acre respectively. Overall, accession 9076448 was among the top three in all categories evaluated in 2005. Accession 9076445 had good forage yield but low seed production. Accession 9076439 is a shorter statured plant but scored in the top three in forage and seed production.

2006

Blue wildrye plots were harvested on July 13. In 2006 all of the characters evaluated for blue wildrye provided lower means than those of 2005 from the prospective accessions. In 2006 there were no significant differences detected between forage yields. Means ranged from 4400 lb/ac (Mariposa) to 2400 lb/ac (Elkton). The top performing FS R1 accession was 9076445 which produced the second largest yield of 4055 lb/ac, followed closely by 9076439 and 9076446 which both yielded 3940 lb/ac. Plant height measurements were all between 41 and 45 in with the exception of Elkton which had a mean height of 36 in. The greatest seed yield came from Mariposa (479 lb/ac) which differed significantly from all other accessions. The top performer for the FS R1 accessions was 9076439 which yielded 117 lb/ac seed.

2007

Forage yields averaged approximately 50% less than the previous year. This could be either a response to the decreased irrigation, or due to blue wildrye's short stand longevity, or both. No significant differences were detected between accessions for forage yields. The highest forage yield came from Arlington (3152 lb/ac) followed by Mariposa (2478 lb/ac). The highest yield from the FS collections came from 9076445 (2471 lb/ac). Seed yields increased and decreased unpredictably among accessions. Plants all flowered well, but many flowers failed to fill with seed. Accession 9076466 had a three fold increase over 2006 with 182 lb/ac, the best yield of the FS collections. Mariposa decreased from 478 to 386 lb/ac but was still the best seed producer in the trial. Plant heights all decreased when compared to 2006 measurements either as a result of the lower irrigation regime or from stand age and between plant competition. Mariposa had the tallest plant average with 41.8 inches. All others were consistently in the 30 to 40 inch range with the exception of Elkton which averaged 27.8 inches.

Table 1. Blue wildrye

Accession No.	% Est. viability	% PLS[3/]	% Stand 6/14/04	Density[1/] 6/14/04	Vigor[2/] 6/14/04	% Stand 9/29/04	% Flower 9/29/04	Plant vol. (in^3) 9/29/04
9076439	79	71.1	92.8[4/]	38.1 a-b[5/]	2.3[4/]	98.6[4/]	1.5 c	117.3 c
9076445	77	69.3	91.5	30.1 a-c	2.8	100.0	0.0 c	132.5 b-c
9076446	80	72.0	91.5	22.8 b-c	1.8	98.6	18.8 c	288.5 b-c
9076447	72	64.8	93.0	39.0 a	1.8	100.0	3.5 c	132.5 b-c
9076448	66	59.4	72.3	22.6 b-c	3.3	76.38	1.8 c	225.0 b-c
9076449	69	62.1	95.8	36.6 a-b	2.0	100.0	3.0 c	193.3 b-c
9076472	82	73.8	87.5	26.0 a-c	3.0	97.2	80.0 a	256.8 b-c
Mariposa	*	94.0	95.8	28.4 a-c	1.8	95.8	93.8 a	768.0 a
Arlington	*	93.0	91.5	31.5 a-c	3.8	100.0	55.0 b	353.5 b
Elkton	*	92.0	95.5	16.4 c	3.5	94.4	92.5 a	299.0 b-c
Critical Value (0.05)			22.1	13.7	1.8	NA	20.1	195.3

[1/] Plants per foot of row
[2/] Rated 1-9 with 1 best, 9 worst; not analyzed for significance
[3/] Percent PLS of USFS R1 collections based on estimated 90% purity
[4/] No significant difference detected between accessions
[5/] Means followed by the same letter are not significantly different
* Data not available from source

Table 1 (continued).

Accession No.	Forage (lb/ac) 2005	Plant height (in) 2005	Seed (lb/ac) 2005	Forage (lb/ac) 2006	Plant height (in) 2006	Seed (lb/ac) 2006	Forag e (lb/ac) 2007	Plant height (in) 2007	Seed (lb/ac) 2007
9076439	5445[4/]	49.25 a-c	348 b	3940[4/]	41.75 a	117.25 b	1715	33.8a-b	96 b-c
9076445	5566	52.00 a	254 b	4055	44.25 a	69.25 b	2471	36.8ab	97 b-c
9076446	4683	48.75 a-c	282 b	3940	43.75 a	56.75 b	2244	38.5 a	182 b
9076447	4889	49.50 a-b	256 b	3825	43.75 a	93.50 b	2320	38.3 a	71c
9076448	5663	51.25 a-b	323 b	3250	45.00 a	54.00 b	2018	38.0 a-b	85 c
9076449	5167	50.75 a-b	236 b	3710	44.00 a	51.25 b	1867	34.3 a-b	85 b-c
9076472	4441	48.50 b-c	218 b	3365	42.50 a	41.25 b	1488	37.8 a-b	65 c
Mariposa	4489	49.75 a-b	505 a	4400	42.50 a	478.50 a	2478	41.8 a	386 a
Arlington	5143	48.25 b-c	303 b	3250	42.00 a	73.00 b	3152	35.3 a-b	144 b-c
Elkton	4646	46.00 c	266 b	2445	36.25 b	68.50 b	1715	27.8 b	67 c
Critical Value (0.05)	NA	2.95	124	NA	3.9	109.15	NA	10.3	108

SANDBERG BLUEGRASS

2004 Evaluations

One collection of Sandberg bluegrass was compared against four industry releases. High Plains, Hanford Source and Mountain Home are all Sandberg bluegrass in the strict sense, while Sherman was originally released as big bluegrass (*Poa ampla*) [Ogle et al[2] 2003; Majerus et al 2007]. The first evaluation showed high levels of significance in all three categories solely due to the fact that accession 9076465 performed so poorly. Mountain Home Source had the best stand (95.5%) and greatest density (36.8 plants per foot), while 'Sherman' had the best vigor (2.5) at the first evaluation (Table 2).

At the second evaluation Sherman dwarfed all other Sandberg bluegrass accessions in the trial. Sherman plants had an average volume of 262.4 in^3, while the next largest, accession 9076465, measured a mere 8.8 in^3. Sherman also had the best stand (95.8%) and plant density (11.9) during the second evaluation. Accession 9076465 continued to perform poorly in percent stand and plant density (25.0 % and 0.75 plants per foot respectively).

2005

As in 2004, Sherman again received the best scores in all categories in the 2005 evaluations. Sherman however was first released as big bluegrass and should possibly for that reason be excluded from the analysis. If Sherman is excluded, accession 907645 scores well in plant height (21 inches), reasonably well in forage production (423 lb/ac) but poorly in seed production (2 lb/ac). It is recommended that FS R1 consider making additional Sandberg bluegrass collections for evaluation and potential release.

Sandberg bluegrass

2006

All of the true Sandberg bluegrass accessions were harvested on June 19, while Sherman big bluegrass was harvested on July 7. In 2006 forage yields compared well with those of 2005 with the exception of accession 9076465 which dropped from 423 lb/ac to 90 lb/ac. The largest forage yield came again from Sherman big bluegrass (4039 lb/ac). Of the true Sandberg bluegrass accessions, the best yield was provided by High Plains (935 lb/ac). 2006 plant heights ranged from 23.75 in (Sherman) down to 14.75 in (Hanford Source). FS R1 9076465 had a mean height of 16.75 in. Seed yields in 2006 were much higher than those of 2005. Sherman was the top seed producer with 857 lb/ac followed by High Plains (602 lb/ac) and Mountain Home (198 lb/ac). 9076465 and Hanford Source followed with 146 and 98 lb/ac seed respectively.

2007

In 2007, rodents had clipped so many of the flowering stems of Sandberg bluegrass plants that a statistical analysis was not possible. Forage yields for Sherman and Mountain Home decreased in comparison to 2006, while others increased. The greatest yield however was still obtained by Sherman big bluegrass at just over 3700 lb/ac. Among the true Sandberg bluegrasses the best forage producer was Mountain Home (602 lb/ac). Accession 9076465 had a 50% increase over 2006, up to 146 lb/ac. Plant heights were similar to those of previous years with Sherman being tallest (28.5 in) and the rest being closely grouped between 14 and 17 inches in height.

Table 2. Sandberg bluegrass

Accession No.	% Est. viability	% PLS[3/]	% stand 6/14/04	Density[1/] 6/14/04	Vigor[2/] 6/14/04	% Stand 9/29/04	Density 9/29/04	Plant vol. (in^3) 9/29/04
9076465	40	36.0	26.5 b[4/]	2.4 b	8.3	25.0 d	0.75 c	8.8 b
Sherman	*	75.8	84.8 a	29.1 a	2.5	95.8 a	11.88 a	262.4 a
High Plains	84	75.6	80.8 a	24.6 a	4.0	76.4 b	9.25 a-b	5.7 b
Hanford	*	85.0	91.5 a	27.5 a	6.0	47.2 c	6.13 b	0.9 b
Mtn. Home	*	74.3	95.5 a	36.8 a	5.0	65.3 b	8.75 a-b	4.5 b
Critical value (0.05)			16.8	12.3	1.2	17.4	4.41	42.2

[1/] Plants per foot of row
[2/] Rated 1-9 with 1 best, 9 worst; not analyzed for significance
[3/] Percent PLS of USFS R1 collections based on estimated 90% purity
[4/] Means followed by the same letter are not significantly different
* Data not available from source

Table 2 (continued).

Accession No.	Forage (lb/ac) 2005	Plant height (in) 2005	Seed (lb/ac) 2005	Forage (lb/ac) 2006	Plant height (in) 2006	Seed (lb/ac) 2006	Forage (lb/ac) 2007	Plant height (in) 2007
9076465	423 b-c	21.00 b	2 b	90.3 b	16.75 b-c	146 c	207 b	14.5 b
Sherman	4816 a	26.25 a	163 a	4039 a	23.75 a	857 a	3705 a	28.5 a
High Plains	859 b	21.75 a-b	26 b	935 b	20.50 a-b	602 a-b	541 b	16.5 b
Hanford	206 c	15.50 c	10 b	155 b	14.75 c	98 c	374 b	15.3 b
Mtn. Home	605 b-c	17.50 b-c	36 b	787 b	17.50 b-c	198 b-c	602 b	14.3 b
Critical value (0.05)	563	4.64	45	849	varies	440	849	6.6

IDAHO FESCUE
2004

The Idaho fescue trial contained three industry releases. Joseph and Nezpurs are both synthetic cultivars comprised of collections made throughout the northwestern United States and Canada. Winchester Source Germplasm is a non-manipulated release from a collection made near Winchester, Idaho in the Idaho Panhandle (Ogle et al 2003a). The first evaluation of Idaho fescue indicated a wide range in stand establishment (Table 3). Accession 9076469 had the best stand averaging 80.5%. Accession 9076469 also ranked first in plant density with 12.0 plants/foot of row. Seedling vigor ratings showed industry release Winchester as the most vigorous with a rating of 2.8. Accession 9076444 had the poorest ratings of stand, density and plant vigor (16.8 % stand, 1.8 plants/foot and 7.8 vigor).

The second evaluation showed industry release Winchester having the best percent stand at 75.0% followed closely by accession 9076469 with 72.2%. Accession 9076444 again had the poorest stand with 16.7%. Accession 9076469 had the greatest plant density rating of 6.8 plants/foot but did not differ significantly from accessions 9076427, 9076438, 9076437 and Winchester (5.1, 5.0, 4.8 and 4.8 plants/foot respectively). Winchester had the largest volume (28.1 in^3) followed by accession number 9076427 with a volume of 22.3 in^3. The smallest plants were those from accession 9076432 at 1.5 in^3.

2005
Despite poor looking stands, accession 9076431 scored in the top two of all categories including best seed production in 2005. Winchester had the highest forage yield at 2287 lb/acre. In second, but not differing significantly, was accession 9076431 with 2154 lb/ac. Accessions 9076473 and 9076469 also had high forage yields (1622 and 1349 lb/ac respectively). High forage yields for accession 9076431 may be attributed (but not limited to) its high seed yield (231 lb/ac). Other high seed producers were Winchester (189 lb/ac) and accession 9076469 (186 lb/ac). On average, the tallest plants were those of Winchester (32.5 inches). Accession 9076431 came in second for plant height with 29.5 inches, followed by accession 9076469 (28.25 inches) and 9076473 (27.75 inches).

2006
All Idaho fescue plots were harvested on June 27. The majority of the Idaho fescue forage yields for 2006 were much greater than in 2005. The top yielding accession again was Winchester (3579 lb/ac) followed by FS R1 accessions 9076469 (2717 lb/ac) and 9076473 (2257 lb/ac). Mean heights ranged from near 18 in to as much as 28.75 in (Winchester). Seed yields for 2006 were dramatically higher than 2005 yields. The highest seed yield of 2006 came from FS R1 accession 9076469 with 744 lb/ac. Other high seed yields came from 9076473 and Joseph with 676 and 672 lb/ac respectively.

2007
There were no significant differences detected between forage yields in 2007, but accession 9076469 and Winchester both had high yields of over 1500 lb/ac. All other accessions had yields ranging from 400 to 800 lb/ac. All yields however were approximately 50% less than those obtained in 2006. Seed yields decreased dramatically compared to previous years. Accession 9076469 and Winchester both had seed yields near 250 lb/ac, while all others had yields of under 200 lb/ac. Heights were slightly less than previous years, typically ranging from 17 to 20 inches. Winchester was taller than all others with an average height of 26.75 inches.

Table 3. Idaho fescue

Accession No.	% Est. viability	% PLS[3/]	% stand 6/14/04	Density[1/] 6/14/04	Vigor[2/] 6/14/04	% Stand 9/29/04	Density 9/29/04	Plant vol. (in^3) 9/29/04
9076427	58	52.2	48.5 c-d[4/]	6.8 a-e	6.0	41.7 b-c	4.1 b-d	4.6 b-c
9076431	61	54.9	39.0 d-e	3.0 d-e	6.3	55.6 a-b	2.4 c-e	11.8b
9076432	76	68.4	48.8 c-d	4.8 b-e	7.0	36.1 b-d	3.0 b-e	1.5 c
9076437	61	54.9	71.0 a	8.8 a-c	4.5	57.0 a-b	4.8 a-b	5.1 b-c
9076438	80	72.0	75.0 a	9.0 a-c	5.3	58.4 a-b	5.0 a-b	1.5 c
9076443	45	40.5	68.3 a-b	7.9 a-d	6.0	54.2 a-c	4.1 b-d	7.0 b-c
9076444	13	11.7	16.8 f	1.8 e	7.8	16.7 d	1.3 e	2.6 b-c
9076453	50	45.0	66.8 a-c	7.9 a-d	5.0	51.4 a-c	4.4 b-c	10.0 b-c
9076462	30	27.0	34.8 d-f	2.3 e	6.8	30.6 c-d	1.9 d-e	5.7 b-c
9076467	71	63.9	48.5 c-d	5.1 b-e	6.3	44.4 b-c	3.3 b-e	3.4 b-c
9076469	68	61.2	80.5 a	12.0 a	3.0	72.2 a	6.8 a	11.8 b
9076471	67	60.3	27.8 e-f	3.9 c-e	6.5	41.7 b-c	2.4 c-e	5.1 b-c
9076473	45	40.5	69.5 a	11.3 a	3.0	59.7 a-b	5.1 a-b	22.3 a
Joseph	*	*	50.0 b-d	4.5 b-e	5.0	54.2 a-c	3.0 b-e	9.5 b-c
Winchester	*	*	73.8 a	9.9 a-b	2.8	75.0 a	4.8 a-b	28.1 a
Nezpurs	*	*	37.3 d-e	1.9 e	7.0	44.5 b-c	1.5 e	5.7 b-c
Critical value (0.05)			17.8	4.7	0.5	20.8	2.0	8.1

[1/] Plants per foot of row
[2/] Rated 1-9 with 1 best, 9 worst; not analyzed for significance
[3/] Percent PLS of USFS R1 collections based on estimated 90% purity
[4/] Means followed by the same letter are not significantly different
* Data not available from source

Table 3 (continued).

Accession No.	Forage (lb/ac) 2005	Plant height (in) 2005	Seed (lb/ac) 2005	Forage (lb/ac) 2006	Seed (lb/ac) 2006	Plant ht (in) 2006	Forage (lb/ac) 2007	Seed (lb/ac) 2007	Plant ht (in) 2007
9076427	841 d-e	24.50 b-e	33 b	1190 b	578 a-c	22.75 a-b	730	117 a-b	19.75 b
9076431	2154 a-b	29.50 a-b	231 a	1248 b	417 a-c	20.25 b	898	175 a-b	20.00 b
9076432	672 d-e	23.25 c-e	61 a-b	1740 a-b	371 a-c	21.75 a-b	734	47 a-b	17.25 b-c
9076437	986 c-e	24.25 b-e	60 a-b	1051 b	302 a-c	22.75 a-b	431	32 a-b	18.25 b
9076438	756 d-e	22.75 d-e	38 b	533 b	566 a-c	20.25 b	340	33 a-b	19.00 b
9076443	811 d-e	24.75 b-e	64 a-b	1510 a-b	458 a-c	19.50 b	709	28 a-b	19.50 b
9076444	351 e	21.00 e	24 b	590 b	182 b-c	20.75 b	410	8 b	17.25 b-c
9076453	799 d-e	25.75 b-e	69 a-b	1740 a-b	287 a-c	23.00 a-b	452	43 a-b	18.75 b
9076462	557 e	25.50 b-e	73 a-b	533 b	154 c	20.50 b	666	76 a-b	12.25 c
9076467	1004 c-e	24.00 c-e	115 a-b	1223 b	615 a-c	18.75 b	570	116 a-b	18.50 b
9076469	1349 c-d	28.25 a-c	186 a-b	2717 a-b	744 a	23.00 a-b	1585	248 a	19.75 b
9076471	551 e	24.00 c-e	69 a-b	1453 a-b	458 a-c	22.00 a-b	730	56 a-b	18.50 b
9076473	1622 b-c	27.75 a-d	83 a-b	2257 a-b	676 a-b	22.25 a-b	645	171 a-b	20.25 b
Joseph	1337 c-d	25.50 b-e	129 a-b	2028 a-b	672 a-b	22.50 a-b	679	159 a-b	21.25 a-b
Winchester	2287 a	32.50 a	189 a-b	3579 a	584 a-c	28.75 a	1617	260 a	26.75 a
Nezpurs	908 d-e	26.00 b-e	48 a-b	1305 b	526 a-c	22.50 a-b	762	79 a-b	19.50 b
Critical value (0.05)	631	1.58	155	2252	509	7.78	NA	varies	5.85

BLUEBUNCH WHEATGRASS

2004

Three industry releases were included in the bluebunch wheatgrass trial. Goldar and Anatone both come from collections from Asotin County, Washington while P-7 is a composite of 25 collections made in Idaho, Nevada, Oregon, Utah, Washington and British Columbia (Ogle et al 2003c). Bluebunch wheatgrass evaluations conducted in June 2004 showed numerous collections outperforming industry standards (Table 4). Accession 9076436 ranked highest for percent stand at 81.8%. Plant density and seedling vigor comparisons showed accession 9076433 as the best with 14.4 plants/foot of row and a 2.5 rating for vigor. Accession 9076463 ranked lowest in all three evaluations (27.8 % stand, 2.5 plants/foot and a vigor rating of 7.0).

Percent stand ranged from 83.3% (accession 9076466) to 33.3% (accession 9076463) at the second evaluation. Accession 9076433 had the best plant density at 5.8 plants/foot followed closely by accession 9076466 with 5.5 plants/foot. Lowest density was recorded by accession 9076463 (1.3 plants/foot). Density measurements may, however, be misleading, because a good stand of very small plants will show a much higher density than a good stand of robust plants (compare accession 9076433 with P-7). Plant volume measurements were dominated by the industry standards. P-7, Anatone and Goldar had the greatest volumes with 147.8, 125.0 and 109.8 in^3 respectively. The next largest plant volume came from accessions 9076426, 9076464 and 9076436 at 64.0 in^3. Accession 9076426, P-7 and Anatone all showed high first-year flower production (65.0, 58.8 and 48.8 %). There was also a large group of accessions that showed very little flower productionthe first growing season: Goldar, 9076450, 9076466, 9076436, 9076441, 9076463, 9076442, 9076433 and 9076434 ranged from 22.5% to 2.5% flower production.

2005

The three industry releases obtained the best three scores in all categories in the 2005 evaluation. None of the FS R1 accessions stood out in any categories for 2005. Accession 9076426 had the fourth best average for forage yield (2432 lb/ac) but came in eighth for plant height (32.25 inches) and seed production (51 lb/ac). The fourth best seed yield came from accession 9076450 with 83 lb/ac, but this accession had the ninth best forage yield at 1682 lb/ac.

2006

Bluebunch wheatgrass plots were harvested between July 11 and July 14. In 2006 the industry releases again had the three top scores for forage and seed yield. In forage, P-7 had the greatest yield with over 5600 lb/ac, followed by Goldar (5089 lb/ac) and Anatone (4974 lb/ac). FS R1 accession 9076463 had the greatest forage yield for the collections with 4011 lb/ac. Plant heights ranged from 34 to 38 in. Seed yields were much greater in 2006 than in the previous year. P-7, Goldar and Anatone had the top three yields with 827, 678 and 518 lb seed/ac respectively. The next closest yield was obtained by accession 9076466 with a mean yield of 418 lb/ac. Currently no outstanding bluebunch wheatgrass collections have been identified with potential for future release.

2007

2007 forage yields increased substantially over those from 2006 and 2005. Yields rose from an average of approximately 2500 lb/ac up to over 4000 lb/ac. The greatest forage yield in 2007 came from P-7 with over 6500 lb/ac. Goldar and Anatone also had high yields of close to 5000 lb/ac. Other accession had yields of around 3000 to 4600 lb/ac. Seed yields likewise were much higher than those of 2006 and 2005. The best yield came from accession 9076433 (734 lb/ac), an accession that only produced 92 lb/ac in 2006. Goldar had the second best yield (714 lb/ac), up from 677 lb/ac in 2006. Accession 9076433 also increased, going from 239 lb/ac up to 649 lb/ac, the third best yield. Heights decreased an average of 5 to 8 inches in all accessions.

Table 4. Bluebunch wheatgrass

Accession No.	% Est. viability	% PLS[3/]	% stand 6/14/04	Density[1/] 6/14/04	Vigor[2/] 6/14/04	% Stand 9/29/04	Density 9/29/04
9076426	76	68.4	70.8 a-c[4/]	9.9 a-b	3.0	75.0 a-c	4.5 a-c
9076428	56	50.4	49.8 c	5.8 b-c	5.0	54.2 b-d	3.3c
9076433	75	67.5	77.8 a-b	14.4 a	2.5	72.2 a-c	5.8 a
9076434	69	62.1	61.3 a-c	7.9 b-c	4.0	73.6 a-c	4.1 a-c
9076436	69	62.1	81.8 a	8.1 b-c	3.3	81.9 a	4.1 a-c
9076441	56	50.4	69.5 a-c	6.8 b-c	4.0	66.7 a-c	3.8 a-c
9076442	86	77.4	70.8 a-c	7.3 b-c	3.0	77.8 a-b	3.8 a-c
9076450	73	65.7	57.0 b-c	6.8 b-c	3.8	50.0 c-d	3.0 c-d
9076463	58	52.2	27.8 d	2.5 c	7.0	33.3 d	1.3 d
9076464	65	58.5	64.0 a-c	10.8 a-b	3.0	77.8 a-b	4.0 a-c
9076466	64	57.6	66.5 a-c	11.4 a-b	2.8	83.3 a	5.5 a-b
Goldar	*	81.5	66.8 a-c	8.0 b-c	2.5	72.2 a-c	3.9 a-c
Anatone	*	*	51.5 c	5.8 b-c	3.5	68.1 a-c	3.5 b-c
P-7	*	*	66.8 a-c	5.5 b-c	3.0	75.0 a-c	3.5 b-c
Critical value (0.05)			20.6	5.3	1.9	21.7	1.8

[1/] Plants per foot of row
[2/] Rated 1-9 with 1 best, 9 worst; not analyzed for significance
[3/] Percent PLS of USFS R1 collections based on estimated 90% purity
[4/] Means followed by the same letter are not significantly different
* Data not available from source

Table 4 (continued).

Accession No.	Forage (lb/ac) 2005	Plant height (in) 2005	Seed (lb/ac) 2005	Forage (lb/ac) 2006	Seed (lb/ac) 2006	Plant ht (in) 2006	Forage (lb/ac) 2007	Seed (lb/ac) 2007	Plant ht (in) 2007
9076426	2432 a-c	32.25 a	51 c-d	3825 a-c	269 c-e	38.00 a	4660 a-b	576	27.75 a-b
9076428	2045 c	31.50 a	44 c-d	2560 b-c	361 c-e	36.75 a-b	2770 a-b	489	27.00 a-b
9076433	1658 c	30.00 a	69 c-d	1986 c	92 e	34.00 b	3910 a-b	734	28.50 a-b
9076434	1670 c	28.00 a	50 c-d	2330 b-c	239 c-e	34.00 b	3820 a-b	649	28.25 a-b
9076436	2348 b-c	30.25 a	48 c-d	3020 a-c	399 b-e	35.25 a-b	3910 a-b	584	26.25 b
9076441	2081 c	32.75 a	49 c-d	2790 b-c	102 e	37.75 a-b	3840 a-b	544	29.50 a-b
9076442	1428 c	32.00 a	46 c-d	3135 a-c	124 d-e	35.50 a-b	4440 a-b	497	28.25 a-b
9076450	1682 c	33.50 a	83 c-d	2330 b-c	290 c-e	37.75 a-b	3380 a-b	422	30.25 a-b
9076463	1525 c	18.00 b	13 d	4011 a-c	199 c-e	37.85 a-b	2330 b	361	27.00 a-b
9076464	1670 c	32.50 a	69 c-d	3480 a-c	288 c-e	37.75 a-b	3610 a-b	527	28.75 a-b
9076466	1972 c	32.50 a	66 c-d	3135 a-c	418 b-d	36.75 a-b	3150 a-b	583	27.00 a-b
Goldar	2916 a-c	35.75 a	157 b	5089 a-b	677 a-b	37.75 a-b	5190 a-b	714	29.25 a-b
Anatone	3630 a-b	33.75 a	102 b-c	4974 a-b	518 b-c	34.75 a-b	4890 a-b	467	28.75 a-b
P-7	3812 a	36.25 a	227 a	5664 a	827 a	37.00 a-b	6560 a	608	31.25 a
Critical value (0.05)	1277	8.45	62	varies	varies	varies	varies	varies	varies

TUFTED HAIRGRASS
2004
The two industry releases used in the tufted hairgrass trial, Willamette and Tillamook, were originally collected in Oregon (Ogle et al 2003b). Percent stand of Willamette tufted hairgrass were significantly higher than all other accessions at the first evaluation (86.0%). Lowest percent stand was observed in accession 9076435 (53.0%). Accession 9076429 had the best seedling vigor rating of 4.8, while accession 9076435 showed the lowest vigor (7.8). Analysis of plant density showed no significant differences (Table 5).

At the second evaluation, Willamette, Tillamook and accession 9076429 had 93.1, 84.7 and 79.1 percent stand but did not differ significantly. Lowest percent stand came from accession 9076435 at 57.0%. Plant density measurements were tight among the tufted hairgrass plots. Densities ranged from 6.3 plants/foot (Willamette) to 4.1 plants/foot (accession 9076435). Plant volume showed a broad range of measurements (Willamette, 68.7 in^3 to accession 9076435, 16.6 in^3) and also did not differ significantly.

2005
Tillamook and Willamette scored significantly better than the FS R1 collections in all three categories. Tillamook and Willamette yielded 4187 and 3660 lb forage/ac respectively. The next best yield came from accession 9076429 which yielded 2323 lb/ac. Accession 9076429 also had the tallest average plants of the FS R1 collections (42.75 in). Tillamook and Willamette both had high seed yields (320 and 267 lb/ac respectively), while accession 9076430 had the best yield of the FS R1 collections (118 lb/ac). Despite being outperformed by the Oregon material, the FS R1 collections had dense, healthy stands and should still be considered for use in northern Idaho and western Montana.

2006
Tufted hairgrass plots were harvested on July 14. All forage yields for tufted hairgrass were lower in 2006 than in 2005. No significance was detected between forage means for 2006. The top forage producer was FS R1 accession 9076435 with 1851 lb/ac. Willamette came in second with 1595 lb/ac. Heights were all similar, ranging between 27 and 31 in, and did not differ significantly. Seed yields for 2006 were much lower than 2005. Tillamook, at 135 lb seed/ac had a significantly higher seed yield than the FS R1 collections which ranged from 42 lb/ac down to 18 lb/ac.

2007
Forage yields for all accessions decreased by a couple hundred pounds from 2006 to 2007. Willamette had the best yield with 1300 lb/ac

followed by Tillamook with 800 lb/ac and accession 9076430 with over 700 lb/ac. Seed yields remained low, with some accessions increasing and others decreasing slightly. Heights also remained similar to those of 2006 ranging from 25 to 35 inches.

Table 5. Tufted hairgrass

Accession No.	% Est. viability	% PLS[3/]	% stand 6/14/04	Density[1/] 6/14/04	Vigor[2/] 6/14/04	% Stand 9/29/04	Density 9/29/04	Plant vol. (in^3) 9/29/04
9076429	49	44.1	68.0 b[5/]	19.0[1/]	4.8	79.2 a-b	5.6a-b	31.0[4/]
9076430	52	46.8	62.8 b-c	17.8	6.5	72.2 b-c	5.5 a-b	48.7
9076435	55	49.5	53.0 c	6.1	7.8	57.0 c	4.1 b	16.6
Willamette	*	81.0	86.0 a	23.0	5.3	93.1 a	6.3 a	68.7
Tillamook	*	81.0	69.8 b	21.8	5.5	84.7 a-b	5.4 a-b	60.2
Critical value (0.05)			11.6	11.6	1.5	16.4	1.8	NA

1/ Plants per foot of row
2/ Rated 1-9 with 1 best, 9 worst; not analyzed for significance
3/ Percent PLS of USFS R1 collections based on estimated 90% purity
4/ No significant difference detected between accessions
5/ Means followed by the same letter are not significantly different
* Data not available from source

Table 5 (continued).

Accession No.	Forage (lb/ac) 2005	Plant ht (in) 2005	Seed (lb/ac) 2005	Forage (lb/ac) 2006	Plant ht (in) 2006	Seed (lb/ac) 2006	Forage (lb/ac) 2007	Plant ht (in) 2007	Seed (lb/ac) 2007
9076429	2323 b	42.75 b	96 c	823[4/]	28.50[1/]	18 b	595 b	25.75 b	20 b
9076430	1894 b	40.75 b	118 c	1145	28.00	42 b	737 ab	28.25 a-b	65 a-b
9076435	1912 b	34.25 c	36 d	1851	27.75	27 b	385 b	26.75 a-b	14 b
Willamette	3660 a	46.75 a	267 b	1595	31.50	68 a-b	1336 a	33.00 a-b	97 a
Tillamook	4187 a	46.00 a	320 a	1051	30.00	135 a	805 ab	35.50 a	115 a
Critical value (0.05)	1076	3.16	51	NA	NA	89	Varies	Varies	9.53

WESTERN YARROW
2004

The yarrow collections were evaluated against two industry releases, Eagle and Great Northern. Eagle originally comes from southwestern Idaho in Ada County, while Great Northern was collected in northwestern Montana in Flathead County, just west of Glacier National Park. Yarrow plots failed to show significant differences in percent stand, plant density or seedling vigor in the first evaluation. Trends, however, showed accession 9076460 first in all but one category in 2004, seedling vigor, where it placed second.

Lupine and pearly everlasting which were also included in the forb trial had essentially no germination (data not shown).

Accession 9076460 recorded the best percent stand at the second evaluation (73.6%), while accession 9076456 had the lowest stand at 29.15% (Table 6). No significant difference was detected for plant density. Means ranged from 3.0 plants/foot (accession 9076458) to 0.3 plants/foot (accession 9076457). Industry standards Great Northern and Eagle had the largest plant volumes (753.8 and 691.5 in^3 respectively). Great Northern also had the greatest percentage of flowering plants (38.8%).

2005

Evaluations were conducted only on seed production because forage yield clipping was uprooting plants. No significant differences were found in seed yields. The top three yields came from accession 9076459 (397 lb/ac) followed by Great Northern (396 lb/ac) and finally accession 9076458 (391 lb/ac).

Western Yarrow

2006

In 2006 height and seed yield were measured for western yarrow. The plots were harvested from July 17 to July 31 when seed production was optimum for each plot. Heights ranged from 27 in (Eagle) down to 14 in (9076457) but no significance was detected. Seed yields had a wide range, 332 lb/ac from 9076459 to 79 lb/ac from 9076457, but again no significance was detected. This is presumably due to the numerous plots from which no seed was found in the designated harvest plot. However, for the second year FS R1 accession 9076459 had the greatest seed yield.

Based on seed production data, accession 9076459 would be a potential candidate for future release as a selected class germplasm. However, its performance is comparable to that of Great Northern which comes from a collection in Flathead County, MT, less than 200 miles from the collection site of 9076459. Also, 9076459 showed poor establishment characteristics during the first year of the trial.

2007

Seed yields increased and decreased among accessions with no apparent pattern. Yields ranged from 160 (accession 9076457) to 316 (accession 9076474.

Table 6. Western yarrow									
Accession No.	% Est. viability	% PLS[3/]	% stand 7/16/04	Density[1/] 7/16/04	Vigor[2/] 7/16/04	% Stand 9/29/04	Density 9/29/04	Plant vol. (in^3) 9/29/04	% Flower 9/29/04
9076454	84	75.6	37.5[4/]	2.4[4/]	4.8	48.6 a-b[5/]	2.4[4/]	441.0 a-b	22.5 a-c
9076456	73	65.7	32.0	1.5	6.0	29.1 b	1.9	342.0 b	16.3 a-c
9076457	86	77.4	32.0	0.3	5.5	31.9 a-b	0.3	679.0 a	22.5 a-c
9076458	80	72.0	59.7	2.8	3.8	63.9 a-b	3.0	595.8a-b	32.5 a-b
9076459	91	81.9	47.2	1.3	4.0	45.9 a-b	1.3	513.3 a-b	37.5 a
9076460	67	60.3	75.0	3.1	3.5	73.6 a	2.9	481.3 a-b	37.5 a
9076474	37	33.3	45.9	2.9	5.8	50.0 a-b	1.8	323.0 b	6.3 c
9076475	71	63.9	45.9	3.0	4.5	48.6 a-b	2.6	507.0 a-b	12.5 b-c
Great Northern	93	71.6	45.9	2.3	2.8	45.9 a-b	1.8	753.8 a	38.8 a
Eagle	*	*	33.3	0.5	5.5	37.5 a-b	0.5	691.5 a	15.0 a-c
Critical value (0.05)			NA	NA	NA	36.8	NA	283.6	21.4

[1/] Plants per foot of row
[2/] Rated 1-9 with 1 best, 9 worst; not analyzed for significance
[3/] Percent PLS of USFS R1 collections based on estimated 90% purity
[4/] No significant difference detected between accessions
[5/] Means followed by the same letter are not significantly different
* Data not available from source

Table 6 (continued).

Accession No.	Seed (lb/ac) 2005	Plant height (in) 2006	Seed (lb/ac) 2006	Seed (lb/ac) 2007
9076454	160[4/]	21.50[4/]	269[4/]	232[4/]
9076456	248	24.75	240	180
9076457	150	14.25	79	162
9076458	391	19.25	331	192
9076459	397	22.75	332	246
9076460	369	25.50	208	126
9076474	280	19.00	106	316
9076475	148	22.00	179	292
Great Northern	396	21.50	301	267
Eagle	339	27.25	327	248
Critical value (0.05)	NA	NA	NA	NA

SUMMARY

Following the 2006 evaluation, the PMC made recommendations of the accessions that showed the potential for further evaluation and release. These included accessions 9076439 blue wildrye, 9076469 Idaho fescue, and possibly 9076459 western yarrow. Following 2007 evaluation, it may be wise to reconsider blue wildrye accession 9076439 due to exceptionally poor performance in forage and seed production during the third year of production when compared with other collections and the standards. Other accessions showed less dramatic reductions in yield despite the lower water schedule.

Because there are currently no blue wildrye releases from the Rocky Mountain or Intermountain West regions, the PMC suggested considering one of the top performing blue wildrye collections for a selected class germplasm. At the time of the 2006 evaluation, all accessions had shown excellent establishment characteristics and growth. Seed yields of FS R1 collections were all lower than the standards, but forage yields have been comparable between the best of the collected accessions and Mariposa, clearly the top performer of the released materials. Accession 9076439 stood out as having consistently high forage and seed yields for 2005 and 2006. However forage yields of 9076439 dropped significantly in 2007 when compared to the other accessions.

Idaho fescue accession 9076469 continues to show excellent promise for potential selected class release. 9076469 had the best establishment in the first year. For all years forage yields of 9076469 have been close, but somewhat lower than, those of Winchester. Seed yields were nearly identical for 2005 and 2007 between 9076469 and Winchester, and 9076469 had the greatest seed yield for 2006 (744 lb/ac) versus 584 lb/ac from Winchester. Geographically, Winchester originated from a in the Idaho panhandle from a location south of Lewiston, ID. Accession 9076469 was collected in the Gallatin National Forest north of Bozeman, MT, over 300 miles to the east. Because of its performance and distance from the most comparable industry release, the PMC recommends that 9076469 should be considered for a selected class germplasm.

Although all FS R1 collections of tufted hairgrass were outperformed by the Oregon materials, the FS R1 accessions had dense, healthy stands, and may still be worth considering for use in eastern-northern Idaho and western Montana as a more local source of this species.

The PMC will maintain seed of the original collections in storage in the event that the forest service would like to increase any of the collections or if the forest service decides to pursue formal release of any of the collections.

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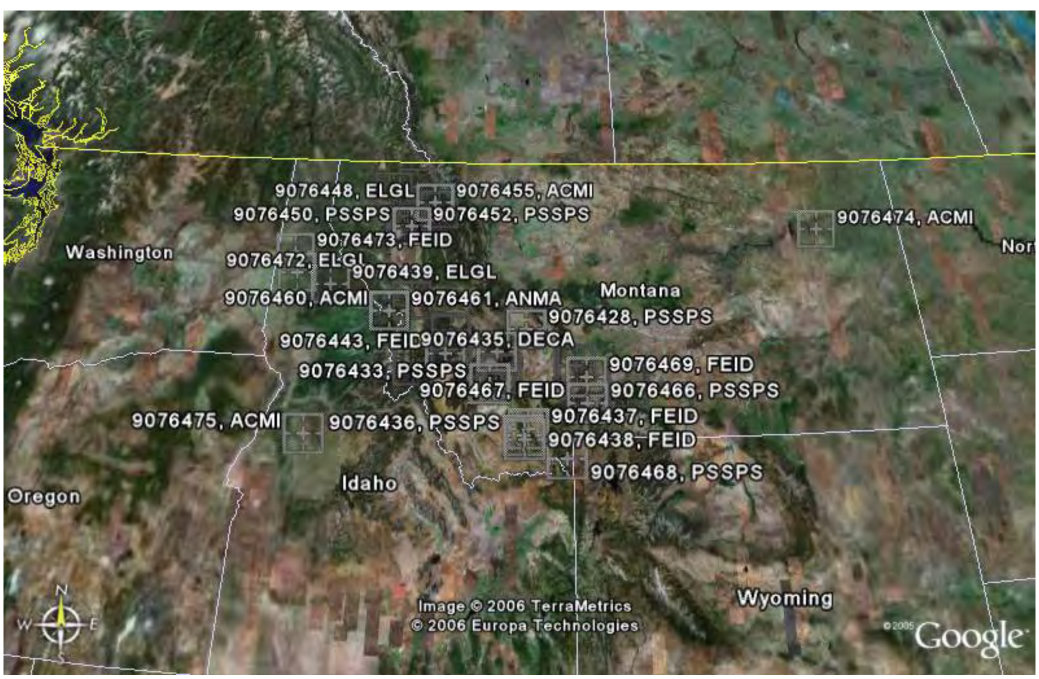
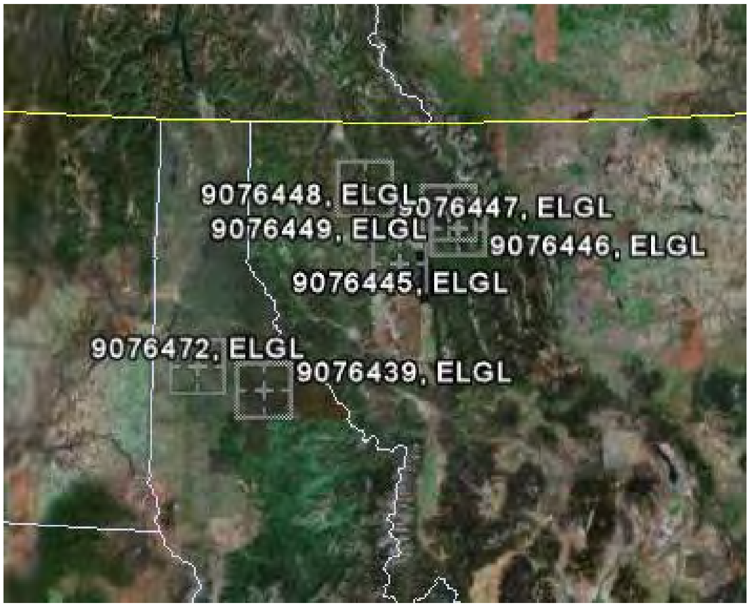
Appendix 1. Collection data and maps

Accession No.	Species	Date collected	Fresh wt. (lbs)	Cleaned wt. (lbs)	Forest	Location	Elevation (ft)
9076426	Bluebunch wheatgrass	7/17/2003	6	2.34	Lolo	N 46 51 38.6 W 114 10 18.4	4300
9076427	Idaho fescue	8/1/2003	1.5	0.22	Helena	N 46 28 20 W 111 54 42	5700
9076428	Bluebunch wheatgrass	8/1/2003	1.7	0.40	Helena	N 46 28 20 W 111 54 42	5700
9076429	Tufted hairgrass	8/6/2003	0.2	0.04	Lolo	N 46 42 31.3 W 114 35 31.6	4480
9076430	Tufted hairgrass	8/6/2003	0.6	0.12	Lolo	N 46 42 23.9 W 114 35 37.3	4480
9076431	Idaho fescue	7/22/2003	1.4	0.88	Beaver-Deer	N 45 51 15 W 112 22 08	7200
9076432	Idaho fescue	7/22/2003	1.3	1.02	Beaver-Deer	N45 51 27.3 W 112 28 48.2	6300
9076433	Bluebunch wheatgrass	8/6/2003	28	1.64	Beaver-Deer	N 45 42 47.7 W 112 35 10.3	7600
9076434	Bluebunch wheatgrass	8/12/2003	5.5	0.20	Beaver-Deer	N 45 42 47.7 W 112 35 10.3	7600
9076435	Tufted hairgrass	8/18/2003	4	0.60	Beaver-Deer	N 46 09 0.08 W 112 28 0.499	6400
9076436	Bluebunch wheatgrass	7/29/2003	7	1.00	Beaver-Deer	N45 2.247 46 W 111 56.904 08	6300
9076437	Idaho fescue	7/31/2003	9	2.40	Beaver-Deer	N45 7.332 36 W 111 51.832 43	8200
9076438	Idaho fescue	7/31/2003	3	0.94	Beaver-Deer	N 44 58.982 92 W 111 55.523 57	7500
9076439	Blue wildrye	8/20/2003	3.3	2.42	St. Joe Dist.	T43NR5E section 21	4600
9076440	Bluebunch wheatgrass	8/2/2003	0.8	0.12	Beaver-Deer	T7NR14W section 4 SW	5550
9076441	Bluebunch wheatgrass	7/25/2003	1.4	0.40	Beaver-Deer	T8NR14W section32-33 S	5850
9076442	Bluebunch wheatgrass	8/4/2003	1.1	0.44	Beaver-Deer	T5NR14W section 22 NW	6760
9076443	Idaho fescue	8/1/2003	1.3	0.40	Beaver-Deer	T4NR15W section 10	6460
9076444	Idaho fescue	7/29/2003	0.4	0.12	Beaver-Deer	T 7NR14W section 4	5890
9076445	Blue wildrye	8/21/2003	0.5	0.28	Flathead	T26NR22W section 26	5130
9076446	Blue wildrye	8/18/2003	2.1	0.78	Flathead	T29NR17W section 28,33,34	4500
9076447	Blue wildrye	8/19/2003	0.7	0.36	Flathead	T32NR25W section 22	5250
9076448	Blue wildrye	8/13/2003	1.4	0.46	Flathead	T30NR18W section 23	?
9076449	Blue wildrye	8/13/2003	1.9	0.95	Flathead	T29NR17W section 34	4600
9076450	Bluebunch wheatgrass	8/21/2003	0.4	0.22	Flathead	T26NR21W section 33	5000
9076451	Bluebunch wheatgrass	8/25/2003	0.1	0.03	Flathead	T26NR22W section 29	5700
9076452	Bluebunch wheatgrass	8/21/2003	0.3	0.08	Flathead	T26NR21W section 33	4980
9076453	Idaho fescue	8/25/2003	0.3	0.08	Flathead	T26NR22W section 29	5700
9076454	Common yarrow	8/21/2003	0.2	0.02	Flathead	T26NR22W section 15	4300
9076455	Common yarrow	8/13/2003	trace	trace	Flathead	T30NR18W section 23	3800
9076456	Common yarrow	8/21/2003	0.5	0.04	Flathead	T26NR21W section 33	4980
9076457	Common yarrow	9/4/2003	0.7	0.08	Flathead	T33NR21W section 26	4000

9076458	Common yarrow	8/20/2003	1.4	0.20	Flathead	T26NR21W section 29	?
9076459	Common yarrow	9/4/2003	2.5	0.86	Bitterroot	T2NR20W section 2,10,11	5600
9076460	Common yarrow	9/22/2003	0.5	0.38	Lolo	N46 42 14.7 W114 35 56.8	4500
9076461	Pearly everlasting	9/23/2003	1.8	0.03	Lolo	N46 41 48.5 W114 36 10.5	4600
9076462	Idaho fescue	7/24/2003	0.4	0.20	Bitterroot	T2NR20W section 11	5600
9076463	Bluebunch wheatgrass	7/24/2003	1.8	0.54	Bitterroot	T2NR20W section 2	5700
9076464	Bluebunch wheatgrass	7/14/2003	17.5	1.86	Gallatin	N45 40 08.32279 W1100026.177	5500
9076465	Sandberg bluegrass	7/15/2003	7	1.58	Gallatin	N45 58 43.57899 W1110012.792	6700
9076466	Bluebunch wheatgrass	7/30/2003	17	1.88	Gallatin	N452733.66724 W1104630.334	7200
9076467	Idaho fescue	7/30/2003	19	5.25	Gallatin	N452743.68577 W1104630.334	7400
9076468	Bluebunch wheatgrass	7/31/2003	9.5	0.00	Gallatin	N444430. W1110954	6570
9076469	Idaho fescue	8/4/2003	12.5	3.92	Gallatin	N454842. W1104642.	7200
9076470	Lupine	8/4/2003	9.5	1.08	Gallatin	N454842. W1104642.	7600
9076471	Idaho fescue	7/16/2003	17.5	3.00	Gallatin	N45 58 06. W110 57 24.	6400
9076472	Blue wildrye	8/1/2003	4.5	3.08	ID Panhandle	T45NR2W sec. 26	2800
9076473	Idaho fescue	7/25/2003	1	0.46	ID Panhandle	T48NR3W section 12	2400
9076474	Common yarrow	7/15/2003	15	0.98	Custer	T25NR46E section 19	4000
9076475	Common yarrow	9/5/2003	2.1	0.12	ID Panhandle	T19N R4E section 15	5200



Composite map of all collections



Blue wildrye

Idaho fescue

Tufted hairgrass

Bluebunch wheatgrass

Western yarrow

Appendix 2. Seed cleaning calibrations

Blue Wildrye (*Elymus glaucus*)

1. Thrashing
    - A. 3/8” screen followed by ¼” screen
2. Air screen cleaner
    - A. screens
        1. top-4.350
        2. middle-3.550
        3. bottom-6 X 32
    - B. valves
        1. 2.25
        2. 4.75
        3. 1.60
        4. intake-closed
    - C. adjustments
        1. blower speed-4.4
        2. sieve boat-10
3. Debearder
    - A. adjustments
        1. brush speed-10
        2. vacuum-on
4. Gravity table
    - A. adjustments
        1. sieve boat-10
        2. blower speed-5
            - i. valve-2.5
    - B. table angle
        1. slope-1.0
        2. pitch-0.5

Bluebunch Wheatgrass (*Pseudoroegneria spicata*)

1. Thrashing
    - A. #14 screen
    - B. 3/8” screen top and ¼” screen bottom
2. Clipper
    - A. screens
        - 1. 6-24
        - 2. #12
3. Air screen cleaner
    - A. screens
        - 1. top-3.95 round
        - 2. middle-3.150 round
        - 3. bottom-6 X 24 slit
    - B. valves
        - 1. 2.5
        - 2. 5.3
        - 3. 2.5
        - 4. intake-closed
    - C. adjustments
        - 1. blower speed-6
        - 2. sieve boat-10
4. Indent cleaner
    - A. spool-7.5
    - B. adjustments
        - 1. catchpan-4.0
        - 2, sieve speed-10
5. Debearder
    - A. adjustments
        - 1. brush speed-10
        - 2. gate-1.5
4. Gravity table
    - A. adjustments
        - 1. sieve boat-10
        - 2. blower speed-8
            - i. valve-3.0
    - B. table angle
        - 1. slope-1.0
        - 2. pitch-0.5

Idaho Fescue (*Festuca idahoensis*)

1. Thrashing
    A. 3/8" screen
2. Clipper
    A. screens
        1. #12 top
3. Air screen cleaner
    A. screens
        1. top-3.750 round
        2. middle-2.350 round
        3. bottom-solid blank
    B. valves
        1. 2.1
        2. 5.25
        3. 2.5
        4. intake-closed
    C. adjustments
        1. blower speed-4.5
        2. sieve boat-10

Sandberg Bluegrass (*Poa secunda*) and Tufted Hairgrass (*Deschampsia caespitosa*)

1. Thrashing
    A. 3/8" screen
2. Air screen cleaner
    A. screens
        1. top-3.150 round
        2. middle-2.10
        3. bottom-6 X 32
    B. valves
        1. .25
        2. 2.5
        3. 3.5
        4. intake-closed
    C. adjustments
        1. blower speed-3.5
        2. sieve boat-10

BASIN WILDRYE ADVANCED EVALUATION
FINAL REPORT - JANUARY 14, 2008
DEREK J. TILLEY, RANGE CONSERVATIONIST (PLANTS)

INTRODUCTION

The purpose of this study is to evaluate the "Gund" collection of basin wildrye (*Leymus cinereus*) from Nevada for pre-varietal release potential. Basin wildrye is a perennial cool-season bunchgrass native to many of the northern cold-desert ecosystems of the Intermountain West and western Great Plains. Basin wildrye is commonly used in seed mixtures for rangeland erosion control, forage and cover seedings, wildlife habitat improvement, as well as in mine spoil and critical area stabilization projects. Currently there are three industry releases available, 'Magnar', 'Trailhead', and Washoe Germplasm. Magnar and Trailhead were both selected for drought tolerance, while Washoe Germplasm was selected for high tolerance to acidic conditions encountered in mine reclamation situations (Ogle et al, 2002).

MATERIALS AND METHODS

This trial was conducted at the Aberdeen Plant Materials Center, Fish and Game farm located approximately 5 miles northeast of Aberdeen, Idaho. Experimental design was a randomized complete block with six replications. Individual plots were 20 feet long and contained one row with rows planted on three foot centers. Experimental design also contained plots of the three industry standards for comparison. Soil at the site is a Declo silt loam with pH of 7.4 to 8.4. Average annual precipitation is 8.75 inches. The test site was plowed in the fall of 2004 and subsequently disked and culti-packed in the spring prior to planting.

Plots were seeded on May 19, 2005 using a hand-pushed belt seeder calibrated to drill 30 pure live seeds (PLS) per foot of row. Seed was drilled to an approximate depth of one half inch. Border rows of 'Tegmar' intermediate wheatgrass (*Thinopyrum intermedium* [Host] Barkworth & D. Dewey) were planted on the outside of the blocks to eliminate edge effect. Plots were sprinkler irrigated and fertilized as needed during the growing season for maximum seed production. Natural precipitation was supplemented with irrigation to approximate 16 to 24 in total annual precipitation. Weeds were controlled with herbicide treatments and between row cultivation.

The first evaluation was conducted on June 15, 2005 (27 days after planting) when most of the plants had reached the one to two leaf stage. Plots were evaluated for percent stand, plant density and seedling vigor. Percent stand was measured using a twenty foot rope marked at one foot increments stretched the length of the plot and anchored at either end. Plants intercepting the one foot increments are summed and recorded as a percentage. Plant density was measured by counting seedlings found in the middle two feet of row and converted to average plants per foot of row. Seedling vigor was measured on an ordinal scale of one to nine (one being most healthy and nine being dead). Entire plots as well as individual plants within plots were viewed and given a rating based on overall apparent vigor.

The second evaluation occurred on September 15, 2005, prior to winter dormancy. Accessions were again evaluated for percent stand using the same method as discussed above. Additionally, it was planned at this point in the trial to evaluate treatments for plant height; however, due to weed pressure and weeds nearing the mature seed stage, the entire field was mowed to a height of approximately four inches. For this reason, individual plants in each plot were selected and measured for average width (in inches) to provide additional plant measurement data.

The evaluations conducted during 2006 occurred between July 22 and 28; in 2007 from July 18 to July 25. All plots were evaluated for above ground biomass, average plant height and seed yield. Plots were evaluated when the seeds within a plot were judged to be ready for harvest. Each plot was divided in half lengthwise, and the northern adjacent three feet were harvested for seed production, while the southern three feet were sampled for forage yield. Seed samples were cleaned to a visually estimated 90% purity. Forage samples were collected in paper sacks and allowed to air dry for two weeks prior to weighing.

All data from evaluations were subjected to an Analysis of Variance (ANOVA) and means were separated using a Tukey's multiple comparison test.

RESULTS

At the spring 2005 (establishment year) evaluation the highest percent stand was observed in the Trailhead plots (57.9 %) which did not differ significantly from the next highest rating of 52.6 % from Magnar (Table 1). The lowest stand came from Gund with 13.1 % which was significantly lower than the three standards of comparison. All three industry releases had significantly higher plant density than Gund (7.9, 7.6 and 5.8 plants/foot from Magnar, Trailhead and Washoe respectively versus 0.3 plants/foot from Gund). Gund also showed the poorest seedling vigor with a rating of 7.0 out of 9.0. The three other accessions differed significantly from Gund with vigor ratings from 2.7 to 1.3.

The fall evaluation similarly showed Gund performing significantly more poorly than the other three accessions being tested. Evaluation of percent stand showed the three industry releases rated highest to lowest as Washoe (65.0 %), Magnar (62.2 %) and Trailhead (57.8 %). Gund was rated at 16.7 %. Plant size, as measured in width, was greatest in the three releases. Average widths were 4.3, 4.2, and 4.0 inches for Washoe, Magnar and Trailhead respectively. Gund measured 2.3 inches.

The 2006 evaluation (first harvest year) included plant height, above ground biomass production and seed production. Magnar had the highest ratings in all three categories while Gund had the lowest. Due to poor stand establishment, Gund had zero seed produced in the harvested area, and very little forage production. Gund plants were significantly smaller than all other accessions tested.

In 2007 Gund had significantly lower forage production than all other accessions, producing 2300 lb/ac as compared to 8500 (Magnar) 7600 (Trailhead) and 5800 lb/ac (Washoe). Gund again had consistently lower seed production than the standards, 196 lb/ac versus 867 for Magnar, 667 for Trailhead and 533 for Washoe. Gund however did not show significant difference in height from the other accessions. All were between 63 and 73 inches tall.

Table 1. Basin wildrye evaluation

Accession	% PLS[3/]	% stand 6/15/05	Density[1/] 6/15/05	Vigor[2/] 6/15/05	% stand 9/16/05	Width (in) 9/16/05
Gund	89.2	13.1 c[4/]	0.3 b	7.0 a	16.7 b	2.3 b
Magnar	87.5	52.6 ab	7.9 a	1.7 b	62.2 a	4.2 a
Trailhead	89.6	57.9 a	7.6 a	1.3 b	57.8 a	4.0 a
Washoe	72.0	40.4 b	5.8 a	2.7 b	65.0 a	4.3 a
Critical value (0.05)				NA	11.9	0.7

[1/] Plants per foot of row
[2/] Rated 1-9 with 1best, 9 worst
[3/] Percent PLS based on estimated 95% purity
[4/] Means followed by the same letter are not significantly different

Table 1 (continued).

Accession	Biomass (lb/ac) 2006	Seed (lb/ac) 2006	Height (in) 2006	Biomass (lb/ac) 2007	Seed (lb/ac) 2007	Height (in) 2007
Gund	87 b	0 b	23 c	2345 b	196 b	68 ab
Magnar	8231 a	150 a	62 a	8496 a	867 a	73 a
Trailhead	4323 ab	39 ab	58 a	7639 a	667 a	72 a
Washoe	3972 ab	125 ab	43 b	5824 a	533 a	64 b
Critical value (0.05)	4931	138	10	3327	336	5

DISCUSSION

The three industry releases of basin wildrye (Magnar, Trailhead and Washoe) performed significantly better than the Gund collection in essentially all aspects evaluated. Gund established poorly, and the established plants were smaller at maturity, produce less seed and biomass. These differences could be attributed to the industry releases being better adapted to the conditions found at the Aberdeen PMC farm. Provenance tests at other sites are advisable to determine if Gund displays superior traits under other environmental conditions.

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Ogle, D. G., L. St. John, L. Holzworth, S. R. Winslow and T. A. Jones. 2002. Basin Wildrye. NRCS Plant Guide. USDA, NRCS, Idaho State Office & the National Plant Data Center. 6p.

Peachleaf Willow and Black Cottonwood IEP (1994 Planting)
Final Evaluation (2007)
Derek J. Tilley, Range Conservationist (Plants)
Loren St. John, Team Leader
May 15, 2007

INTRODUCTION

In June 1994, the Aberdeen PMC planted an initial evaluation planting of black cottonwood (*Populus balsamifera* ssp. *trichocarpa*) and peachleaf willow (*Salix amygdaloides*) to evaluate accessions for potential release. Since the time of planting this evaluation, data from riparian field plantings indicate that locally collected materials of willow and cottonwood species have established and persisted better than the accessions that were included in this evaluation. Based on the evaluations of the off-center field plantings, it was decided to abandon the release objective of this study and to use the planting strictly as a cutting nursery to provide hardwood cutting stock for use as standards of comparisons in field plantings.

In 2007 the plots were evaluated for survival. These data will guide decisions on which accessions will be maintained for cutting production.

MATERIALS AND METHODS

The trial was conducted at the PMC Fish and Game farm, 5 mi Northeast of Aberdeen. Soil at the site is a Delco silt loam with pH of 7.4 to 8.4. Mean annual precipitation is 9.39 inches. Experimental design was a completely randomized layout with four rows of 25 plots; each plot contained four trees. For each accession there were four, five or six replications (see table). Weed barrier fabric was installed after planting for weed control. Space between the plant rows were cleaned tilled to control weeds until a cover crop of ‘Hycrest’ and ‘Ephraim crested wheatgrass was planted in 1996. The planting was irrigated with solid-set handlines until 1997 when drip irrigation was installed. The drip system was functional for a few years but by 2001 it was removed due to pinching of the drip irrigation line by basal stems from the willows. Since that time, the planting has survived on natural precipitation and sub surface soil moisture.

Since about 2000 the planting has been managed as a cutting nursery to provide cutting stock for riparian field plantings in the PMC service area. Trees are cut to approximately 3 ft stumps and allowed to grow new stems which are harvested for cuttings in subsequent years. Some trees have been cut numerous times while others have grown without being cut for the duration of the trial.

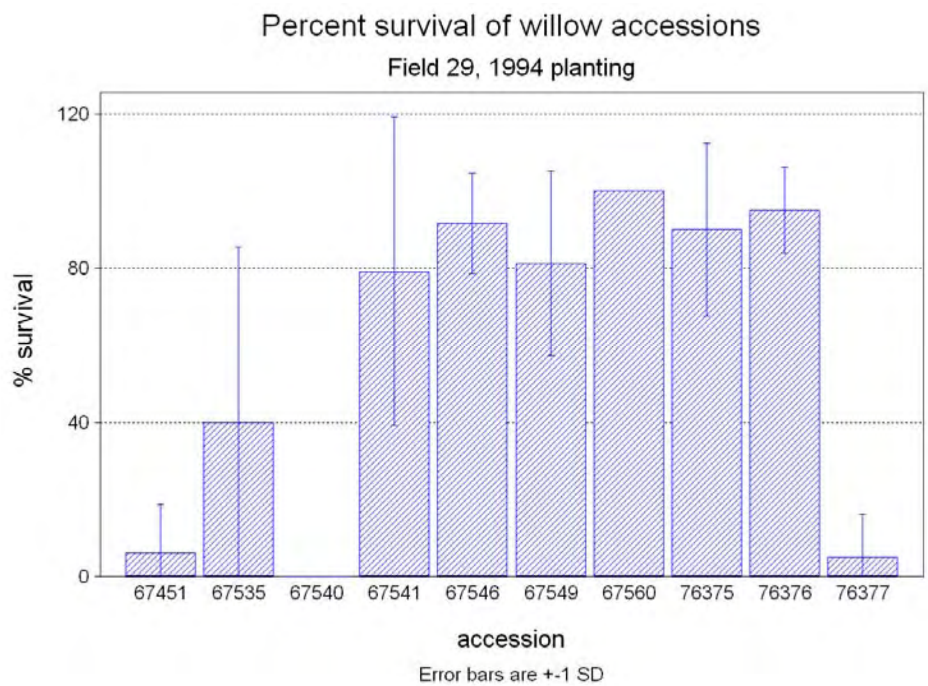
On May 9, 2007 all plots were evaluated for percent survival. Data were analyzed as a completely randomized design with varying numbers of replications using an analysis of variance (α=0.05). Means were separated with a Tukey’s all-pairwise comparison.

RESULTS

Peachleaf willow

Peachleaf willow survival means were more readily separated statistically (p=0.0000) (table 1). Four accessions had notably poor performance, 9067451 (6%), 9067535 (40%), 9067540 (0%), and 9076377 (5%). The remaining accessions all had reasonably good survival ranging from 79 to 100% survival.

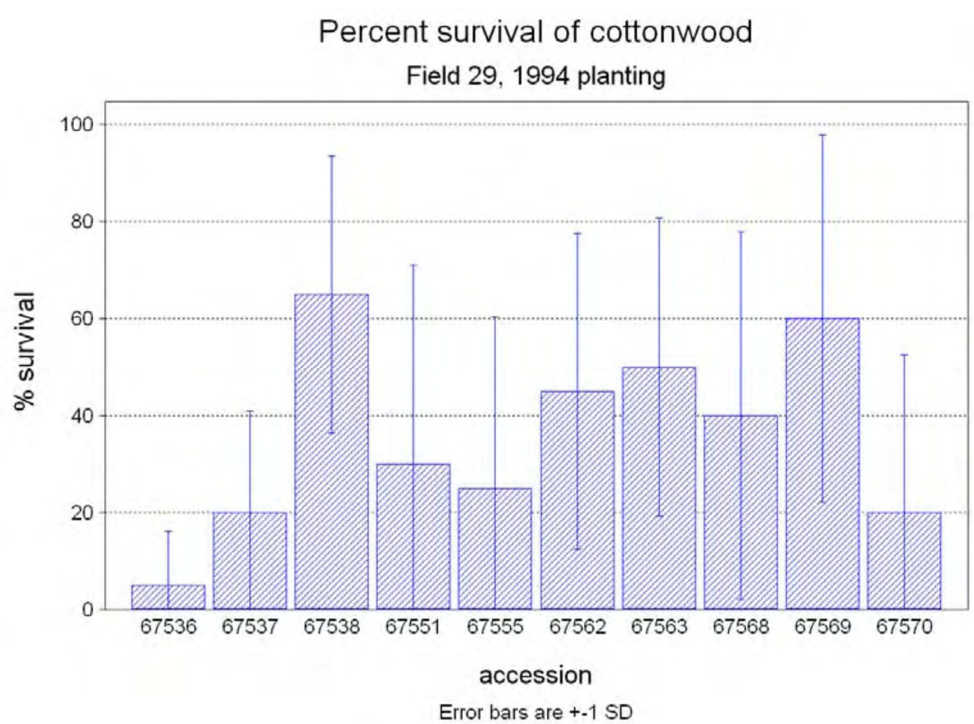
Table 1. Percent survival of peachleaf willow			
Accession	Source Location	Number of replications	% Survival
9067451	Baker City, OR	4	6 c
9067535	Hagerman, ID	5	40 bc
9067540	Aberdeen, ID	5	0 c
9067541	Baker City, OR	6	79 ab
9067546	Burns, OR	6	92 a
9067549	Prairie City, OR	4	81 ab
9067560	Deer Creek State Park,UT	5	100 a
9076375	Mink Creek, ID	5	90 a
9076376	Pocatello, ID	5	95 a
9076377	McTucker Island, ID	5	5 c
			P=0.0000



Black cottonwood

No significant differences were detected between survival means (p=0.0965) (table 2). Means ranged from 5% to 65%. The top performers in the trial were accessions 9067538 (65% survival) and 9067569 (60% survival).

Table 1. Percent survival of black cottonwood			
Accession	Source Location	Number of replications	% Survival
9067536	Idaho City, ID	5	5
9067537	Boise River, ID	5	20
9067538	Caribou NF, ID	5	65
9067551	Lakeview, OR	5	30
9067555	Sawtooth NF, ID	5	25
9067562	Humbolt NF, NV	5	45
9067563	Reno, NV	5	50
9067568	Challis NF, ID	5	40
9067569	Mackay, ID	5	60
9067570	Mackay Res., ID	5	20
			P=0.0965



DISCUSSION

PMC shipping records from 2002 through 2006 (minus 2003) and reports on peachleaf willow plantings from the IDPMC 2006 Annual Technical Report (ATR) show that in the past five years, only cuttings from accessions 9067541, 9067546, 9076549, 9067560, 9076375, and 9076376 have been used in field plantings. These correspond with the top six survival ratings in this trial. Shipping records of black cottonwood show cuttings from accessions 9067562, 9076568, and 9067569 are being utilized by field offices. Data from this study indicate that use of accessions 9067538 and 9067563 should also be recommended.

From the data collected in this trial and the usage data from the ATR, willow accessions 9067541, 9067546, 9067549, 9067560, 9076375, and 9076376 and cottonwood accessions 9067538, 9067562, 9067563, 9067568, 9067569 cottonwoods will continue to be maintained. An inventory of cutting quality material within the plots was completed to provide better estimates of cuttings that can be made available for field plantings. Based on an analysis of the data and arrangement of the plots, the PMC will concentrate on managing the plots in the 2 west rows. Plots will be permanently marked, and plants will be managed for production of cuttings to provide for field planting purposes. The 2 east rows will be managed for wildlife cover to help meet the objectives of the landowner.

Field 29, peachleaf willow and black cottonwood IEP (1994) Planting, 2007 map revision

25		9067451	9067546	
24			9067538	
23			9067563	9067549
22	9067555	9067569	9067546	9067538
21	9076376		9076375	9067551
20	9067546	9067546	9067560	9067568
19	9067551	9067560	9067568	
18			9067570	9067569
17	9067538		9067562	
16				
15		9067541		
14	9067560	9076377	9076375	9067538
13	9067569		9067560	
12	9067537	9067551		9067541
11	9067562	9067538	9067546	9067562
10	9067541	9067541		9076375
9	9067568		9067569	9067563
8	9067549	9067555	9067568	9067549
7	9067563		9067563	9067555
6	9076375	9067536	9076376	9067535
5	9076375	9067569		
4	9067562		9067537	9076376
3	9067535	9076376	9067562	9067560
2	9076376	9067535	9067541	9067546
1	9067549	9067537		

PL

BC

Main Line (North end)

Indian Valley Sedge Propagation
Progress Report
Derek J. Tilley, Range Conservationist (Plants)
November 26, 2007

Introduction

In 2006 the Aberdeen Plant Materials Center (PMC) accepted a request to propagate 300 plants of Indian Valley sedge (*Carex aboriginum* M.E. Jones) as part of a project to reestablish populations in its native habitat at the “Jewel Wetland” in southwestern Idaho. This unique species was first collected in the Weiser valley by Marcus E. Jones on July 12, 1899, at Indian Valley, ID and wasn’t seen again for 100 years. The species was thought to be extinct, until 1999, when a population was discovered south of Council, in Adams County, ID. As a result, Indian Valley sedge was moved from the Idaho Native Plant Society’s Taxa Believed to be Globally Extinct category to the Global Priority 1 category.

This project was coordinated by the NRCS Payette Field Office on a Wetland Reserve Program (WRP) site in cooperation with land owners Jon and Mary Trail, with support from the Land Trust of the Treasure Valley. The project involved several interested parties, including the U.S.D.A. Forest Service Rocky Mountain Research Station and Idaho Department of Fish and Game.

In May, 2007 the PMC delivered approximately 250 plants to Mike Raymond of the Payette Field Office who coordinated the planting at the site. Volunteers were used to transplant greenhouse grown materials (figure 1).

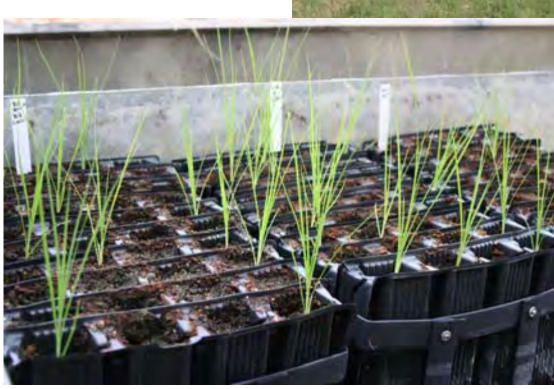


Figure 1. (Right) Volunteers planting Indian Valley sedge at Jewel wetland in western Idaho. (Below) flats of greenhouse grown sedges.

Stratification Trial

Because information regarding propagation of Indian Valley sedge was limited, the PMC initiated a seed germination trial investigating different methods of stratifying seed to develop a propagation protocol.

Seven treatments were compared (table 1). Prior to planting or treatment, peryginia were mechanically removed from all seed. Cold moist stratification in sphagnum moss was conducted at 4º C. Seed was placed into small cloth bags and inserted into 8 fl oz (237 ml) plastic ointment jars filled with 8.0 g green sphagnum moss and water. Cooler and outside treatments were seeded directly into flats with a 1:1:1 mixture of peat, vermiculite and sand. One set of flats was placed in the greenhouse cooler at 4º C, while the other set was placed outdoors from November through February for "natural" stratification as recommended by researchers in the Boise area. Outside temperatures at the PMC ranged from a high of over 70º F in November 2006 to -4 º F in January 2007. Following treatment, flats were moved into the PMC greenhouse where temperatures were maintained from 70 to 90 ºF and soil was kept moist for best germination conditions.

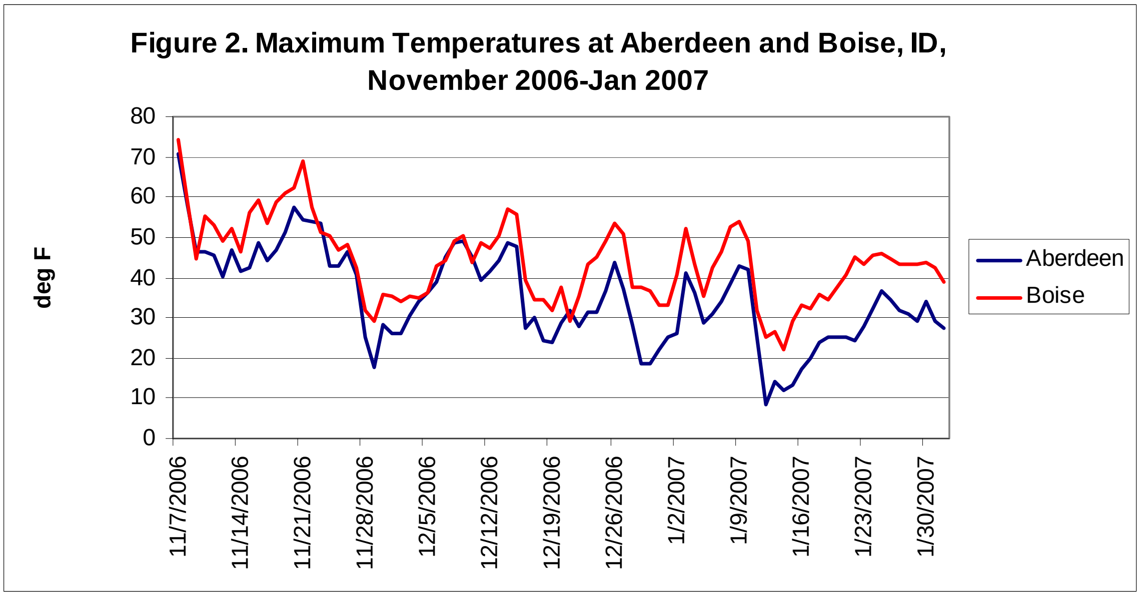
The trial was designed as a randomized complete block with four replications. Each rep consisted of a single flat of 20 cells, each cell planted with 1 seed. Data were analyzed with a one-way ANOVA and means separated with a Tukey's test.

Table 1. Treatments

Treatment	
1.	Seeded into flats and placed in cooler for 60 days
2.	30 day cold/moist stratification in moss
3.	60 day cold/moist stratification in moss
4.	30 days in moss followed by 30 days in cooler
5.	60 days in moss followed by 30 days in cooler
6.	Seeded into flats and left outside from Nov to Feb
7.	No treatment

Results

Although cooperators in the Boise, ID area have reported good germination rates from planting flats outside from November to February, outside stratification did not work in Aberdeen. This is most likely due to differences in temperatures between the two locations. Seed left outside in Boise would likely encounter temperatures above and below freezing on a regular basis subjecting the seed to freeze-thaw cycles, especially during the month of January (figure 2). With the cooler temperatures in Aberdeen, our seed was likely frozen for the duration of the trial and did not thaw until being brought into the greenhouse.



Best germination results (32.5 %) were obtained from the 60 day stratification in the PMC cooler (table 2). This treatment is likely the closest approximation to the conditions found in the sedge's natural habitat. The 30 day moss plus 30 day cooler treatment also had good results (25.0 %), but longer stratification in moss (60 d moss and 60 d + 30 d cool) decreased germination (0.0 and 5.0 % respectively). The non-stratified control treatment did not produce any germinants. From the results obtained here it seems that cold moist stratification is the best method for germinating seeds of Indian Valley sedge at Aberdeen.

Table 2. Mean germination from stratification treatments.

Treatment		**% germ**
60 day cool		32.5 a
30 d moss		5.0 bc
60 d moss		0.0 c
30 d moss + 30 d cool		25.0 ab
60 d moss + 30 d cool		5.0 bc
Outside		0.0 c
No treatment		0.0 c
Critical value (0.05)		23.5

Vegetative propagation

Despite poor germination numbers, the PMC was able to produce several more plants by vegetative division. Plants quickly produce offshoots via short rhizomes. These can be easily separated from the parent plant and transplanted to new cells. Separating plants is most easily done using Root Trainer cells that can be opened exposing the plant roots. Best results came from carefully splitting the plants so that roots remained on both the parent and the new plant. In many cases we were able to split numerous young plants from parents over time greatly increasing the total number of produced plants.

Forb Herbicide Tolerance Trial, 2005-2007
Study Number: IDPMC-T-0601-RA
Derek Tilley, Range Conservationist (Plants)
Natural Resources Conservation Service
Plant Materials Center
Aberdeen, Idaho

Introduction

Weed control is an important part of seed production. Competition from weeds decreases plant growth, health, and seed production. Many herbicide choices are available to control broadleaf weeds in grass fields and to control grasses among broadleaf plants; however, there are no known herbicides for controlling broadleaf weeds among our broadleaf forb releases. There is high demand for selective herbicides registered for use on seed production fields of rangeland forbs and half shrubs. A large amount of Plant Materials Center (PMC) resources are allocated annually to weed control in forb seed production fields by hand rouging and mechanical tillage. Selective weed control products for rangeland forbs and half shrubs are highly desirable and would reduce labor costs and potentially increase seed production. This study was designed as an initial screening of several herbicides with potential for weed control in forb and half shrub seed production fields. The goal of this project is to find herbicides that control broadleaf and grass weeds while not significantly reducing seed yields of forbs grown for seed production. *Trade names are used solely to provide information. Mention of trade names does not constitute a guarantee of the product by USDA-NRCS nor does it imply endorsement over comparable products that are not named.*

2005 Initial Herbicide Screening

Materials and methods

Appar blue flax (*Linum perenne*) and Maple Grove Lewis flax (*L. lewisii*) seeds were planted into flats of 10 cubic inch conetainers at the PMC greenhouse on December 9, 2005. Delar small burnet (*Sanguisorba minor*) was planted on January 5, 2006. When plants reached approximately 3 to 5 inches in height, they were delivered to UI Weed Scientist, Pam Hutchinson, for treatment with potential herbicides. Ten treatments including a non-treated check were evaluated (table 1). Herbicide treatments took place on February 2, 2006. Experimental design consisted of eight replications; each replicate consisted of one plant. All replicates were treated in a single spraying in a spray chamber. The herbicide application occurred 55 days after planting (DAP) for flax species and 28 DAP for small burnet. Plants were returned to the greenhouse following treatment and evaluated for phytotoxicity after 20 days.

Treatments included standard rates of the following herbicides: Buctril, Prowl H_20, MCPA, Chateau, Stinger, Poast, Plateau, Basagran, Sencor and a non-treated control. For a summary of the herbicides used in these trials, see the appendix at the end of the discussion.

Results

From the initial screening, Poast showed little damage to any of the three species and looks good for grass control. Plateau and Prowl both had very little phytotoxicity on the three species tested, and all appear to have good potential for broadleaf weed control on these forb crops. Basagran and Sencor had light phytotoxicity on Maple Grove plants (16.88 and 18.75% respectively).

Chateau also had light to moderate phytotoxicity on Appar and Delar (17.50 and 26.25% respectively).

Table 1. Initial herbicide tolerance screening.

		Appar	Maple Grove	Delar
Treatment	Trade Name	Phytotoxicity		
		-------------------%-------------------		
Check	No trtmnt	0.00 e	0.00 d	0.00 d
Sethoxydim+COC	Poast	0.00 e	0.00 d	8.75 cd
MCPA amine	MCPA	32.50 cd	72.50 a	73.75 ab
Clopyralid	Stinger	36.25 bc	60.00 a	60.00 b
Bromoxynil	Buctril	52.50 ab	36.25 bc	85.63 a
Bentazon+COC	Basagran	48.75 abc	16.88 cd	93.13 a
Metribuzin	Sencor	60.00 a	18.75 cd	90.00 a
Imazapic	Plateau	0.00 e	0.00 d	1.25 d
Pendimethalin	Prowl	0.00 e	0.00 d	5.00 d
Flumioxazin	Chateau	17.50 d	55.00 ab	26.25 c
cv (0.05)		16.46	20.93	21.02

2006 Maple Grove Field Trial

Materials and Methods

In 2005 a 3.2 acre seed production field of Maple Grove was established at the PMC home farm in Aberdeen. In 2006 it was discovered that the field had a significant contamination with Appar blue flax. It was decided to initiate an herbicide tolerance trial on this established field using a similar selection of herbicides as used in the initial screening trial.

The field was marked off into 24 X 75' plots. The plots were arranged in 3 blocks with 14 treatments per block. The only fall treatment (Plateau) was applied on December 8, 2006. The remaining spring treatments took place on May 20, 2007. All treatments were applied as a foliar broadcast using a backpack sprayer calibrated at 35 pounds per square inch (psi) and delivering 15 gallons/acre. Treatments were conducted by Pam Hutchinson, University of Idaho. On June 5, 2007 all plots were evaluated visually for percent phytotoxicity.

Because of weed presence in some plots and the risk of weed seed spreading to adjacent seed production fields, it was decided to mow the entire field except for a single row running through the center of the plots to be left for the seed production evaluation. Mowing occurred on June 21, 2007. Seed was harvested on 3 foot of row by hand from each plot on July 10, 2007. Weed control was not evaluated statistically; however a general idea of weed control was obtained from the plots at the time of evaluation.

All data were analyzed with a one-way ANOVA and means separated with a Tukey's test using Statistix 8 analytical software.

Results

The most prevalent broadleaf weeds in the plots were meadow salsify (*Tragopogon dubius*) and prickly lettuce (*Lactuca serriola*). At the time of evaluation Maple Grove appeared to have excellent tolerance to the spring application of Plateau (10.0%), the Plateau and Prowl treatment (13.3%) and the Basagran treatment (16.7%) (table 2). Moderate phytotoxicity came from the Targa+Stinger, MCPA, Targa, Stinger, and Prowl treatments. Treatments of Buctril, Bronate and fall applied Plateau caused severe damage to Maple Grove plants and essentially eliminated seed production. The Targa+Stinger treatment used a lower application rate of Stinger than the Stinger alone treatment (2 lb v. 3 lb/gal). Consequently the Stinger plots had a higher phytotoxicity and weed control rating and lower seed yields than the Targa+Stinger treatment.

Table 2. Phytotoxicity and seed production.

Treatment	Trade name	Rate	Unit	Phytotoxicity (6/5)	Seed/ac (7/10)	Weed control
				-----%-----	-----lb-----	
Bromoxynil	Buctril	2	Lb/gal	96.7 a	3 b	Moderate
Bromoxynil+MCPA	Bronate	4	Lb/gal	91.7 a	3 b	Excellent
Imazapic	Plateau (fall)	2	Lb/gal	86.7 a	31 b	Poor
Metribuzin	Sencor	75	5aw/w	56.7 b	168 ab	Moderate
Flumioxazin	Chateau	51	%	53.3 bc	111 ab	Good
Pendimethalin	Prowl	3.8	Lb/gal	36.7 cd	326 a	Moderate
Clopyralid	Stinger	3	Lb/gal	36.7 cd	197 ab	Excellent
Quizalafop	Targa	.88	Lb/gal	30.0 de	280 ab	Moderate
MCPA	MCPA	4	Lb/gal	26.7 def	289 ab	Good
Quiz + Clop	Targa + Stinger	.88+2	Lb/gal	23.3 def	294 ab	Good
Bentazon	Basagran	4	Lb/gal	16.7 efg	229 ab	Moderate
Imaz + Pendi	Plateau + Prowl	2+3.8	Lb/gal	13.3 efg	3 b	Poor
Imazapic	Plateau (spring)	2	Lb/gal	10.0 fg	3 b	Moderate
Check	No treatment	na	Na	0.00 g	245 ab	Poor
cv (0.05)				18.5	319	

Best seed production came from the Prowl treatment (326 lb/ac) despite having a moderately high phytotoxicity rating (36.7%) and a poor weed control rating (figure 1). Targa+Stinger, MCPA, Targa, the non-treated check and the Basagran treatments also had high seed yields (294, 289, 280, 245 and 229 lb/ac respectively). Contrary to the initial trial, MCPA treatments showed only moderate phytotoxicity and had excellent seed production.

Despite its low phytotoxicity rating, the spring applications involving Plateau had essentially no seed production. At the time of the evaluation, Maple Grove and salsify plants in the Plateau plots had produced very few flowers, and the flowers that formed had not opened (figure 2). The fall application of Plateau did severe damage to the plants in the plot, and many plants remained stunted throughout the following season (figure 3). Others however did flower, but seed production was minimal.

Targa used with the low rate of Stinger had high seed yields and relatively good herbicide tolerance with good weed control. Targa would have provided grass control, while Stinger is produced specifically to control weeds in the Asteraceae family which includes salsify and lettuce (figure 4). Using a low rate of Stinger appeared to provide sufficient broadleaf control with minimal damage to the Maple Grove plants.

Figure 1. Plot showing Prowl treatment. Prowl provided excellent seed yields despite poor weed control.

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Figure 2. Plot of spring applied Plateau (6/5). Plants appeared healthy, yet flowers never opened for pollination resulting in low seed production.

Figure 3. Fall applied Plateau. Many plants are stunted and never flowered. Flowering plants in the plot may have been the result of wind-skip at time of application.

Figure 4. Plots of Targa+Stinger had good seed yields and high weed control.

Appendix: Summary of tested herbicides (PNW Weed Management Handbook, 2003)

Basagran: A selective herbicide to control many broadleaf weeds and yellow nutsedge. Rain within 24 hours after application may reduce effectiveness. Basagran is a postemergence contact spray, so thorough coverage is essential.

Buctril: A selective, postemergence, contact herbicide. Controls some weeds resistant to 2,4-D. Can be safely applied to seedling grains and grasses. Has little soil activity.

Chateau: A long lasting residual broad spectrum herbicide that controls annual broadleaf and grass weeds.

MCPA: A postemergence, selective, translocated phenoxy herbicide. Material is less phytotoxic to some crops.

Plateau: A selective postemergence herbicide effective controlling broadleaf weeds and some grasses.

Poast: A selective, postemergence grass herbicide. It controls most annual and perennial grasses. Using a crop oil concentrate enhances activity.

Prowl: Depending on the crop, this is a selective, preplant, preemergence, and early postemergence herbicide that is used to control annual broadleaf and grass weeds.

Sencor: A selective pre-and postemergence herbicide to control grass and broadleaf weeds.

Stinger: A highly translocated, selective herbicide active primarily through foliage of broadleaf herbaceous weeds (mostly the Asteraceae, Fabaceae, and Polygonaceae families). This herbicide is known to accumulate and persist in crop residue and compost.

Targa: Same chemical as Poast, a grass herbicide.

JUNCUS DIRECT SEEDING METHOD EVALUATION, 2006-2008
STUDY NUMBER: IDPMC-T-0604-WE
2007 PROGRESS REPORT

Derek J. Tilley, Range Conservationist (Plants)

December 19, 2007

Introduction

Direct seeding of wetland species for wetland creation and restoration has certain inherent difficulties. Traditional broadcasting and drill seeding attempts are mostly unsuccessful. Small scale direct seeding experiments evaluating other techniques have indicated however, that there may be methods available that could produce much better establishment of wetland species.

Because seed from many wetland species are buoyant and also require light for germination, broadcast seeding has provided poor results because seed tends to wash away from the seeded area after flooding. Test results have shown that following a broadcast seeding with a packer or imprinter can improve the number of seeds held in place and allow for better onsite germination. However, it can be problematic trying to use small seeded species in conventional seeding equipment. Although seed from some wetland species are extremely small, over 90 million seeds/pound in the case of Baltic rush, inert carriers such as rice hulls can be used to increase the volume of seeded material and facilitate uniform distribution of seed from a drill or broadcast spreader (St. John and others 2005).

Hydroseed mulches can similarly act as an inert carrier in liquid form, much like rice hulls used for dryland plantings. The mulch keeps seed in suspension for more uniform dispersal and also provides structure allowing seed and tackifier to more readily attach to the soil surface. Greenhouse test results have shown that the tackifier used in hydroseeding can effectively glue the seed to the soil surface and prevents seed from washing off site (Tilley and Hoag 2006).

Another relatively new option for seeding wetlands is Submerseed™ from Aquablok Industries (Toledo, Ohio). This technology involves binding seeds with clay or clay-sized material and organic polymers to a dense aggregate core. These aggregates sink, preventing seed from floating to the surface and the clay absorbs water providing a suitable germination medium for the seed (Aquablok 2007).

Trade names are used solely to provide information. Mention of a trade name does not constitute a guarantee of the product by the U.S. Department of Agriculture nor does it imply endorsement by the Department or the Natural Resources Conservation Service over comparable products that are not named.

This project was designed in incremental steps for ease of evaluation and development of seeding rates. The first experiment (trial 1) was conducted in the Aberdeen PMC greenhouse during the summer of 2006. Trial 1 compared seedling establishment from four hydroseed mulches and four dry, inert carriers. The second trial took place in 2007 with the most promising performers from trial 1 and compared each against Submerseed pellets in a controlled outdoor seeding in 4’ X 8’ tanks. Each of these studies is a precursor to field testing the best methods of direct seeding into the PMC wetland ponds. Due to volunteer wetland seed contamination, the ponds were chemically treated in 2006 and in 2007 to ensure a clean, weed-free seed bed for use in seeding evaluations that will take place in 2008.

The goal of this project is to find the techniques that are most efficient, cost effective and successful for seeding common wetland species. Baltic rush (*Juncus balticus*) was chosen for this study because the seed exemplifies the problems faced in direct seeding wetlands, i.e. very small seed that float and seed that requires surface planting to allow adequate light for seed germination. The results obtained from theses studies will be used to develop seeding rates for use with those methods that will provide adequate establishment for wetland revegetation.

Trial 1: GH evaluation of hydroseed mulches and inert broadcast carriers

Materials and Methods
Because tackifier is designed to be used to hold grass, forb and shrub seed to dry soils and critical slopes it was unknown if the glues could withstand sustained flooding and if so, at what rate tackifier should be applied for use in wetland seedings. “Turbo Tack” tackifier from Turbo Technologies Inc. was tested at 1x, 5x and 10x the recommended rate of tackifier with 100 seeds on Petri dish blotters by mixing seeds and tackifier in water and pouring it out onto saturated blotters. Each treatment contained six replications. The blotters and tackifier were allowed to dry overnight, and the blotters were then put under slowly running water from a faucet to wash away any loose seed. Essentially no seed washout was observed, and no significant differences of seed washout were detected between treatments (data not shown). Because a larger amount of tackifier was easier to work with, a 5x rate of tackifier was used for trial 1.

Trial 1 was initiated on April 17, 2006 and was concluded on May 8, 2006. Eight seeding techniques were evaluated; four dry methods including no carrier, rice hulls, shop dry and sand, and four wet or hydroseeding methods including tackifier (tackifier alone with seed and water), Fertil Fibers™ Nutrimulch, straw mulch and wood mulch. Fertil Fibers is a seedmeal-based, protein-rich organic fiber nutrient source designed to deliver a long-term biological release of 6-4-1 N-P-K.

Three replications of each treatment were seeded in 12” X 18” (1.5 ft^2) greenhouse trays filled with a 1:1:1 mixture of peat, sand and perlite. Trays were placed randomly in a 4’ X 8’ X 1’ artificial wetland tank in the PMC greenhouse (figure 1). Mulch was applied at the recommended rate of 2000 lb/ac or 31.5g/tray (McClure, 2006). Tackifier was applied in all wet treatments at 5X the recommended rate (0.25g/tray) which equates to 16.25 lb/ac. The seed used for this trial was Sterling Selection of Baltic rush with a PLS of 89.1%. To more easily handle the very small amount of seed necessary, it was decided to use a very high seeding rate of 500 PLS/ft^2 (0.055g/tray). Hydroseeding applications were simulated by mixing seed, water, mulch and tackifier into a 2 liter kitchen measuring pitcher. The slurry was mixed and agitated for several minutes allowing tackifier crystals to dissolve and a uniform suspension to be made. The hydroseed slurry was then poured over the soil as evenly as possible. Any large clumps of mulch were smoothed out

Figure 1. Treatments in greenhouse trays prior to flooding.

with a spoon. Hydroseed treatments were applied on April 17 and allowed to dry overnight to allow the tackifier to set.

The dry treatments were initiated on April 18, so that all treatments could be flooded at the same time. Seed rates for the dry treatments were the same as those for the hydroseed treatments. Seed was mixed with approximately 1 tablespoon of inert carrier (2.0 g rice hulls, 10 g shop dry and 22 g sand). Inert carriers and seed were mixed in a small tray and spread as evenly as possible by hand over the soil. The no-carrier treatment was sprinkled by hand. Following broadcasting, the dry treatments were pressed into the soil with an imprinting jig designed to simulate a packer wheel.

The wetland tank was flooded on April 18 to a depth of approximately 2 inches above the top of the soil and water was allowed to spill over the edge of the wetland tank. The overflowing water caused any floating seed, mulch or inert material to be swept over the edge of the tank. This insured that no seed was spread to any other tray in the trial. All treatments were totally submerged for 15 minutes. After the first flooding, the water levels were dropped below the bottoms of the trays so the soil could dry slowly and optimum germination conditions could be met. Seventeen days after planting, on May 4, after the plants had a chance to establish and the soil was beginning to dry, the tanks were flooded again, this time for 24 hours, to test if established plants would wash out. Greenhouse temperatures ranged from 75 to 100º F for the length of the trial.

Seedling emergence was evaluated on May 1 (14 days after planting), and again on May 8 (21 days after planting) following the second flooding (figure 2). Four 2” X 12” strips running the 12” length of each tray were evaluated for seedling emergence. Germinants in each strip were totaled and added together to avoid pseudo replication. This total was then divided by 750 expected germinants based on 500 PLS/ft² or 750 PLS/tray.

Results

There were significant differences in establishment between treatments (table 1) There appeared to be a lot of seed washing out from the dry broadcast treatments, significantly more than from Fertil Fibers and tackifier treatments. Straw and wood mulch appear to be too thick and may be covering *Juncus* seeds and prohibiting germination. A lighter mixture of straw or wood may be as effective as Fertil Fibers or tackifier. It would be inaccurate to assume at this point that straw and wood mulches don’t work, only that they don’t work at the tested rates. Fertil Fibers appear to be a thin enough slurry to not cover seeds, and it also works as an effective inert carrier to disperse seed and hold it to the soil. Results from Fertile Fibers and tackifier alone seem promising enough to try these methods in the outdoor trial with a lower seeding rate as opposed to 500 PLS/ft. This would more closely be comparable seeding rate to be used with Submerseed pellets and is a more realistic rate for field applications.

Figure 2. Seedling emergence at time of evaluation.

Table 1. Seedling Germination

Treatment	5/1 (after 1 flood) Plants/ft²	5/8 (after 2 floods) Plants/ft²
No carrier	44 c	50 b
Rice hulls	67 c	71 b
Shop dry	52 c	55 b
Sand	45 c	48 b
Fertil Fibers	311 a	300 a
Straw	74 c	100 b
Wood	31 c	42 b
Tackifier	211 b	206 a

Results were similar after the second flood treatment except seedling emergence in the Fertil Fibers treatment was not significantly different from the tackifier treatment. No significant gains or losses in number of seedlings were detected between the first and second flooding treatments (data not shown). This indicates that once plants are up and have initiated some root growth into the soil they are very unlikely to be washed out by low energy flooding.

Trial 2- Outdoor trial of best performers (2007)

Trial 2 was designed to be a bridging step between greenhouse scale trials and large scale field experiments. The experimental design incorporates a high degree of water control and eliminates the concern of volunteer wetland plant germination. Conducting this trial outdoors also allowed natural drying and temperature conditions to occur, which may influence germination and survival. This experiment compares establishment abilities of the best hydroseed cariers (Fertil Fibers™ nutrimulch+ tackifier and Tackifier alone) and broadcast carriers (rice hulls) from trial 1 and Submerseed™ technology, which was evaluated in earlier trials at the PMC (Tilley and Hoag 2006).

Materials and Methods

Four treatments were planted in five 4' X 8' wetland tanks placed outside at the PMC farm. Each tank was divided into four 2' X 4' plots, one plot per treatment (figure 3). Each tank thus represented one of five blocks or replications. Because the plot size is small, seeding with a broadcaster or hydroseeder was unfeasible; therefore seeding was completed by hand in a manner similar to that described for trial 1. However, seeding rates were adjusted to rates much closer to those recommended for large area plantings, in this case 350 PLS/ft². Germination rates should, therefore, more accurately reflect those that might be observed in field plantings (table 2). Hydroseed mulch (Fertil Fibers) was applied at 2,000 lb/ac, with 600 gallons of water/60 lb mulch. Tackifier was applied at 5x the recommended rate (recommended=3lb/ac). An 8 ft soaker hose was placed on the long edge of each tank for irrigation. The wetland tanks were oriented to have a slight downward slope opposite the soaker hose to allow directional

Figure 3. Wetland tank divided into 2X4' plots for treatments.

water flow. All plots were planted on July 9, 2007. After planting, plots were allowed to dry for 2 hours for tackifier glues to set before flooding. Tanks were then flooded and allowed to spill over the shallow side for 15 minutes letting loose seed, rice hulls and other debris to wash over the edge and out of the tank. Excess water was then siphoned off to drop water levels to just cover the seed and soil. The tanks were irrigated regularly (approximately once per week) to maintain moist soil conditions for germination and establishment.

Table 2. Rates

	Rate/ft	Rate/ac
Submerseed	20 pellets (100-200 PLS)	2,000 lb
Fertil Fibers Mulch	20.8 g	2,000 lb
Tackifier	1.25 g	15 lb
Seed	350 PLS (0.0075g)	15,246,000 PLS (0.72lb)
Water (hydroseeding)	2.3 L	3,3000 gal
Rice hulls	1.35 g	130 lb

Plots were evaluated on Aug 20 (42 days after planting). Plant counts were made using a 100 cm X 25 cm" wire grid which was divided into five 25 cm X 20 cm cells. Plants were counted in the first, third and fifth cells and added together for a total number of plants per 1500 cm² and then converted to plants per ft². Because the broadcast and hydroseed treatments were seeded at a higher rate than Submerseed (350 PLS/ft versus 100 to 200 PLS/ft) data were also transformed to compare establishment based on a standard seeding rate (100 PLS/ft). Results were also compared to those data obtained from the 2006 greenhouse seeding study as well as the Submerseed establishment data from Tilley and Hoag (2006). Data were analyzed using Statistix 8 Analytical software and subjected to an analysis of variance with a significance level of $p<0.05$. Means were separated using a Tukey HSD all pairwise comparison.

Results

At planting, globs of tackifier were visible in the tackifier alone and Fertil Fibers plots, presumably due to inadequate mixing prior to planting. When the plots were flooded, rice hulls, Fertil Fiber mulch and some seed were observed washing off of the plots and out of the tank (figure 4).

Figure 4. Loose Fertil Fibers (l) and rice hulls (r) washing off of the plots.

Table 3. Establishment in 2007 outdoor trial.

	Plants/ft² @ seeded rate	Plants/ft² adjusted for 100 PLS/ft²	2006 GH means adjusted for 100 PLS/ft²
Fertil Fibers	42 a	18 a	60
Broadcast (rice hulls)	25 ab	10 ab	14
Tackifier alone	21 bc	9 ab	41
Submerseed	6 c	6 b	66 (Tilley & Hoag 2006)
Critical value (0.05)	18	10	na

Fertil Fibers had significantly better emergence than tackifier alone and Submerseed at the seeded rate ($p=0.001$). At the adjusted seeding rate of 100 PLS/ft, Fertil Fibers had significantly better establishment than the Submerseed treatment ($p=0.027$).

Figure 5. Establishment in 2007 outdoor trial.

Much lower emergence was achieved in outdoor conditions versus the greenhouse trial when compared at 100 PLS/ft² (table 3). Submerseed had 10 times better germination under greenhouse conditions than outdoors. Submerseed pellets appear to perform better in high moisture environments and may be better suited for use in broadcasting into shallow water instead of submitting it to numerous wet-dry cycles.

Discussion

Using data from these trials and industry costs, a price breakdown was created comparing five available methods of wetland planting: broadcast seeding with rice hulls as an inert dry carrier, hydroseeding with Fertil Fibers, hydroseeding using only tackifier, Submerseed pellets, and using greenhouse grown plugs (table 4). All costs are based on seeding 100 PLS/ft² (0.2 lb PLS/ac) or planting plugs at 18" spacing. A seeding rate of 0.2 to 1.0 lb PLS/ac would provide 100 to 430 PLS/ft². For broadcasting with rice hulls as an inert carrier, 9 lbs rice hulls per acre should be used with the drill or broadcaster set to 1 bushel of barley. Estimated seed costs ($150/lb) are an average price obtained from three regional seed suppliers: Ernst Conservation Seed, Pawnee Buttes Seed, and Western Native Seed (all 2006); man-hour costs for collecting seed from a local source could increase costs significantly. Tackifier costs are based on the manufacturer's recommended rate (3lb/ac). Hydroseeding equipment cost is based on a one day hydroseeder rental rate.

Broadcasting seed followed by an imprinter is by far the cheapest method and perhaps the least reliable. However, the trials discussed here show that some seed will stay in place if it is pressed firmly into the soil, but not covered. Broadcasting could be a low-cost option, however risky. Poor establishment of desired species could result in increased weeds or erosion.

Hydroseeding appears to be a viable option for a relatively small cost if the proper hydroseeding equipment is available. Hiring a contractor to perform the hydroseed application could dramatically increase costs. Hydroseeding using only tackifier provided fair establishment, but using mulch with nutrient amendments like Fertil Fibers nearly doubled establishment rates in our tests.

Submerseed pellets worked very well in greenhouse tests, but did not perform well in this outdoor trial. Better results may be obtained under wetter conditions such as broadcasting into standing shallow water. This factor may, ultimately, be extremely beneficial in situations where the hydrology of the wetland cannot be controlled, or where wetlands can not be sufficiently drained for large equipment use. Cost for Submerseed, however, is much higher than broadcasting or hydroseeding which may limit its use in more controlled environments.

Greenhouse grown plugs should be planted at 18” spacing or every 2.25 ft^2 using approximately 25 PLS per conetainer (Hoag 1995). For one acre that amounts to a minimum of 19,360 plants total from approximately 500,000 seeds. Estimated cost for greenhouse plug production including delivery and installation is $2.00 per plant or $38,720/ac (Hoag 2007). Using greenhouse grown plugs has several advantages over direct seeding methods; however contracting a greenhouse to produce plugs may be cost prohibitive. Nearly any species can be grown, including species where seeds require pre-stratification and expected establishment is much greater.

Table 4. Cost/ac @ 0.2lb/ac (100PLS/ft)

COST	Broadcast	Hydroseed (FF)	Hydroseed (tack alone)	SS	GH plugs (18” spacing)
Seed ($150/lb)	$30	$30	$30	$30	$10
shipping	na	$440	na	included	included
Carrier	Rice hulls $ negligible	Fertil fibers $670	na	SS	na
Tackifier	na	$60	$60	na	na
Equipment needed	Spreader Imprinter	Hydroseeder $200	Hydroseeder $200	Spreader, ATV	na
Man-hours@$20/hr	8=$160	8=$160	8=$160	8=$160	included
Total	**$200**	**$1,560**	**$520**	**$1,000-8,000**[a]	**$40,000** (includes installation) [b]

[a] Info from Aquablok 2007.
[b] Estimated cost from private companies.

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Effects of pre-plant soaking treatments on hardwood cuttings of peachleaf willow

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December 20, 2007
Study Number: IDPMC-T-0706-RI
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INTRODUCTION

Dormant hardwood cuttings of willow (*Salix*) and cottonwood (*Populus*) species are commonly used for riparian restoration and bioengineering efforts (Hoag 2007; Schaff et al. 2002). The greatest factors for successful restoration plantings are cutting placement in the soil profile, soil texture and moisture availability (Bentrup and Hoag 1998; Pezeshki and Shields 2006). Other factors, such as herbivory and competition for light, water and nutrients by other plants, are also important to the long-term survival of cuttings. Studies have indicated that one practice that can help increase initial survival rates is the soaking of dormant cuttings in water prior to planting. Several studies performed on black willow (*Salix nigra* Marsh.) showed that pre-soaked posts had increased root, shoot and leaf biomass as well as improved overall survival when compared with non-soaked posts (Schaff et al. 2002; Pezeshki et al. 2005; Pezeshki and Shields 2006). Other studies show similar results for nursery grown cottonwood and poplar clones (Krinard and Randall 1979; Phipps et al. 1983; Desrochers and Thomas 2003). Edwards and Kissock (1975) found increased root and shoot development resulting from soaking 2.75 m (9 ft) willow and poplar poles at water depths of 5 cm (2 in), 80 cm (31 in) or fully submerged versus unsoaked. They also noted different total water weight gain as well as different rates of water uptake for the different treatments.

It has been suggested that the increased survival and root and shoot production gained from pre-soaking is a result of improved stem water content coupled with early root and shoot initiation during soaking (Phipps et al. 1983; Schaff et al. 2002). In many cases cuttings used in riparian restoration efforts encounter water stress before developing a sufficient root system (Edwards and Kissock 1975). The increased water content provided from pre-soaking is believed to allow cuttings to more readily cope with the often stressful conditions associated with planting by delaying desiccation and loss of cell turgor (Schaff et al. 2002). Quicker initiation of roots and shoots also aid the cuttings in droughty environments and can help cuttings compete with other vegetation found at the site. Phipps et al. (1983) summarized that pre-soaking in water is beneficial under hot, dry conditions that induce high moisture stress, but may also be beneficial under ideal conditions.

Within the common practice of pre-soaking dormant cuttings, there is a great deal of variation on how exactly this is done. Many soaking practitioners allow cuttings to soak in the stream where the restoration is taking place. Others soak cuttings in buckets, troughs and garbage cans. These different methods add other factors. Shallow, still waters generally have higher temperatures than deeper, flowing streams. Additionally, some cuttings may be fully submerged under the water's surface, while some have portions exposed to the air. Recommended soaking durations range from 24 hrs (Hoag 1991), to as long as 14 days (Briggs and Munda 1992). Cutting diameter is also believed to be an important factor in increasing cutting survival. In streambank restoration and bioengineering practices, cuttings less than 1.0 cm (0.38 in) are generally not recommended for use because of limited energy reserves in the stem (Hoag 2007). Nursery protocols differ with some using 0.48 cm (0.19 in) diameter cuttings for bareroot stock propagation (Zeidler and Justin 2003), and others using 1.5 to 2.5 cm cuttings (Mathers 2003).

In this study we addressed the following questions: 1) is pre-soaking beneficial, and if so, 2) what temperatures are optimum for soaking, 3) to what depths should cuttings be soaked, fully or partially submerged, 4) how long should cuttings be soaked, and 5) what is the best diameter cutting to plant? To this end we looked at multiple pre-soaking depths, temperatures and durations to determine the most effective strategy for successful cutting establishment. We also examined cutting water weight gain in response to the different soaking treatments, and we looked at cutting survival as a factor of cutting size regardless of pre-treatment to determine the ideal size cutting for planting. For this study, we chose to use peachleaf willow, a tree-type willow, native to riparian zones in low to mid-elevation plant communities in the United States. The species is commonly utilized in riparian restoration and streambank bioengineering projects throughout its native range and is known to have good to excellent rooting capabilities.

MATERIALS AND METHODS

The trial was designed as a randomized complete block with 4 replications. Each replicate consisted of five cuttings. Cuttings were harvested from multiple accessions on March 5 and 6, 2007 at the Aberdeen Plant Materials Center (PMC) from trees established in 1994. The base of the cuttings ranged in diameter from 0.8 to 2.2 cm (0.3 to 0.9 in) and measured 45 cm (18 in) long. All secondary branches were trimmed off in the field.

Cuttings were then subjected to increasing durations of four soaking treatments plus a non-treated control (no treatment, partially submerged in warm or cold water, and fully submerged in warm or cold water). The partial soak treatments were placed vertically in five gallon buckets with a maintained water depth of 29 to 35 cm (11.5 to 14 in). Full soak treatments were placed horizontally in styrofoam coolers and weighted down with metal frames so that the water was between 5 and 10 cm (2 to 4 in) over the top of the cuttings. Cold soaking treatments occurred in dark conditions in the PMC storage cooler, while the warm treatments occurred under natural light schedules in the PMC greenhouse. Temperatures for the cold treatments were maintained around 1.7º C (35º F) and warm soaking treatments ranged from 16 to 20º C (60 to 68º F). Soaking initiation was staggered so all cuttings would be ready for planting on the same date. Cuttings not soaking were kept in cold dry storage at 1.7º C (35 º F) to maintain dormancy. Cuttings were allowed to soak for 1, 2, 6, 14 or 21 days and were then planted into 40 cubic inch "contetainers" filled with a mixture of 80% vermiculite and 20% perlite and placed on a greenhouse mist table. All roots and shoots that had formed prior to planting were removed by hand to approximate root and shoot damage occurring at field plantings. All cuttings received approximately 2 cm (0.8 in) of water every 7 days from overhead misters. This low water rate, compared to 2.5 to 5 cm of water every 7 to 10 days used by nurseries (Mathers 2003), caused water stress and allowed only the most vigorous cuttings to survive. Greenhouse temperatures were maintained between 20 and 30º C (68 to 86 º F). 28 days after planting, cutting survival, and air dried root and shoot biomass production were evaluated. Because the survival data did not meet assumption of normality, data were analyzed using the Friedman non-parametric two-way analysis of variance.

Cuttings survival was also evaluated against cutting diameter without regard to pre-soaking treatment. This was done by analyzing survival of all cuttings as a completely randomized design and plotting a linear regression for the data. To be sure there was a totally random assignment of cuttings of different diameters to each of the 21 treatments, an analysis of variance was conducted on cutting diameter per treatment. No significant differences were detected (P=0.1738).

A second set of cuttings was used to evaluate water weight gain caused by different soaking treatments, and to determine at what duration maximum weight gain from water occurred. Six cuttings were pre-weighed prior to soaking either partially or fully submerged in cold or warm water. Weights were then taken at 1, 7, 14, 21, 28 and 35 days after initiation. Development of any epidermal lesions (ruptures in the bark where roots will emerge), roots or shoots was documented. Roots and shoots were trimmed before weighing to measure only water weight gain within the cutting. In those cases where root and shoot growth had occurred, growth was evaluated by measuring the length of the longest root or shoot. The same cuttings were evaluated repeatedly for the cold treatments where there was no root or shoot growth; however, different batches of cuttings were used for each soaking duration in the warm treatments where root and shoot removal may have affected later measurements.

To test if long-term soaking treatments had an effect of the overall health of cuttings, the cuttings used in the weight gain test were planted into five gallon buckets filled with water following the 35 day evaluation. The cuttings thus had ample water and ideal conditions in which to grow. Cuttings survival and root and shoot growth were evaluated after 28 days and these data compared to data obtained from the survival study to ascertain if long-term soaking treatments had any detrimental effects. These results were strictly observational and were not analyzed statistically.

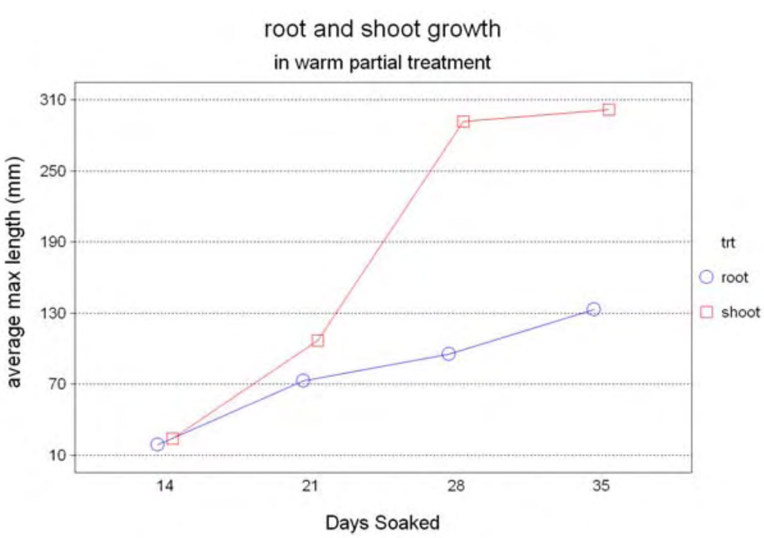


Figure 1. Root and shoot growth in average maximum length while soaking partially submerged in warm water.

RESULTS

Survival and growth

When portions of the cuttings were exposed to air (partial soak treatments), root lesions and buds began to form after about 7 days of soaking in warm water. Root and shoot elongation was first visible between 7 and 14 days. Cuttings fully submerged in warm water showed epidermal lesions after 14 days, and by 35 days all cuttings in the warm full treatment had epidermal lesions present. However no fully soaked cuttings ever initiated root or shoot growth, even after 35 days. Additionally, no cuttings in either of the cold treatments ever showed any indications of breaking dormancy.

Significant differences were detected in survival response to pre-plant soaking treatments (P<0.0001). Survival generally increased with longer durations of soaking (figure 2). One hundred percent survival was achieved by pre-soaking partially submerged cuttings in cold water for 14 days. Other pre-soaking treatments had varying levels of success. Nearly all pre-soaking treatments had better survival rates than the non-soaked control treatment. Only the 1 day cold water partial soak had zero percent survival. Survival of the cold partial treatments increased until reaching 100% at 14 days and then dropped to 80% after 21 days. The highest survival for the fully submerged cold treatment came at 21 days (80%); however the trend for the cold full treatment was still increasing. Longer soaking periods under fully submerged cold conditions may produce even better survival rates.

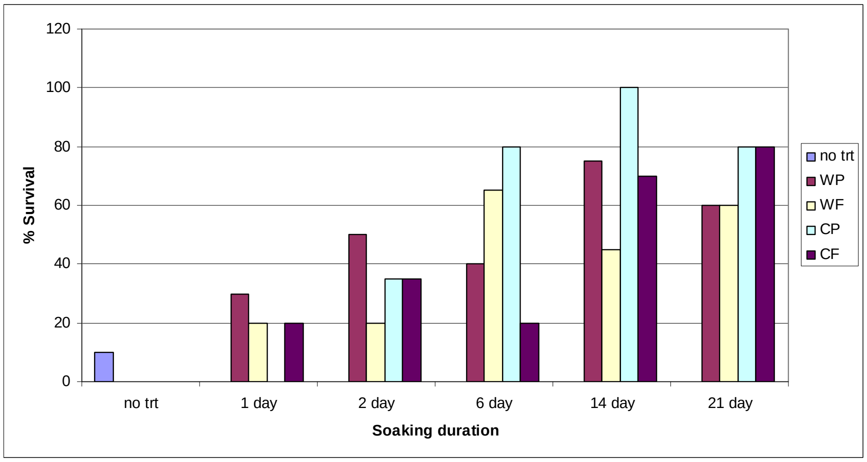


Figure 2. Survival of dormant hardwood peachleaf willows following different presoaking treatments. WP=warm partially submerged, WF=warm fully submerged, CP=cold partial, CF=cold full. Survival cutting increased as soaking duration lengthened. P<0.0001.

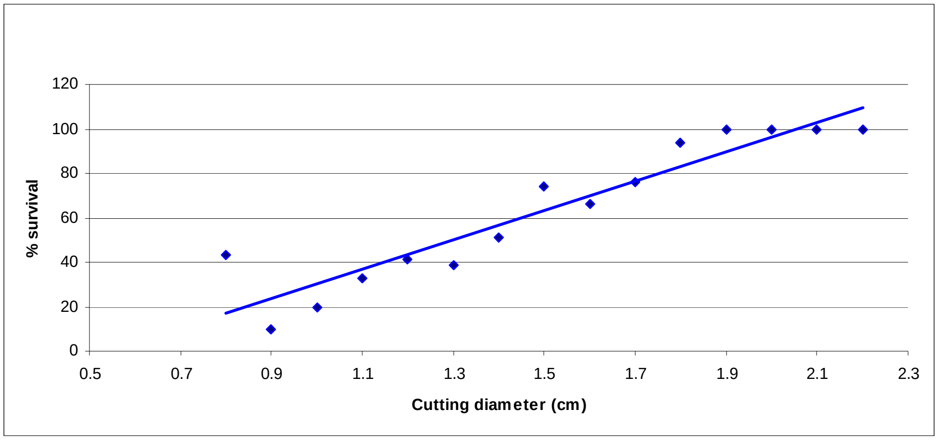
Plants that did survive produced varying amounts of roots and shoots which were not readily separable statistically (P=0.38 and P=0.21 respectively). Shoot growth averaged from 0.75g per cutting to 0.008 g per cutting. Root growth ranged from 0.31 g to 0.003 g per cutting. The 14 day and 21 day warm partial treatments both had root and shoot growth prior to planting. Removal of the roots and shoots appeared to set back new root and shoot initiation and, in the case of the 21 day warm partial treatment, kill the above ground portion of the cutting (figure 3). Sites where roots and shoots had been removed never recovered and resprouted; all growth came from new growing points.

Figure 3. Cuttings 28 days after planting that had been pre-soaked for 21 days, partially submerged in warm water. Roots and shoots that had been removed prior to planting failed to recover. Above ground portions of the cuttings were dead, and all growth initiated below the soil surface.

Cutting size

We discovered a very clear positive relationship between cutting diameter and survival (figure 4). Cuttings having diameters of 1.9 cm (0.75 in) or greater all had 100% survival regardless of what pre-plant soaking treatment they were in. According to the regression trend, the recommended size cutting for bareroot nursery stock (0.48 cm) would have had essentially zero percent survival (y= -4.4) under high water stress conditions.

Figure 4. Linear regression graph of cutting diameter versus percent survival. $y=66.25x-36.242$. $R^2=0.8843$.



Weight gain

Soaking completely submerged cuttings in warm and cold water resulted in steady weight gain. Both treatments had reached approximately 45 percent weight gain at 35 days and the trend was still increasing, so no optimum duration for peak weight gain was discovered (figure 5). Soaking cuttings partially submerged in cold water also had steady gains but leveled at below 20%. Cuttings soaked partially submerged in warm water produced small weight gains after seven days but lost weight after root and shoot initiation as water stored in the cutting was translocated to new shoots and roots. After about 28 days the cuttings resumed gaining weight, presumably as cells began actively growing and dividing in the vascular cambium. When compared to the survival data, it becomes apparent that higher levels of water in the stem cannot wholly account for improved survival. The highest survival rate was achieved by the 14 day cold partially submerged treatment which would have had approximately 16 percent weight gain. All of the fully submerged soaking treatments from cold and warm water had higher weight gains, yet lower rates of survival.

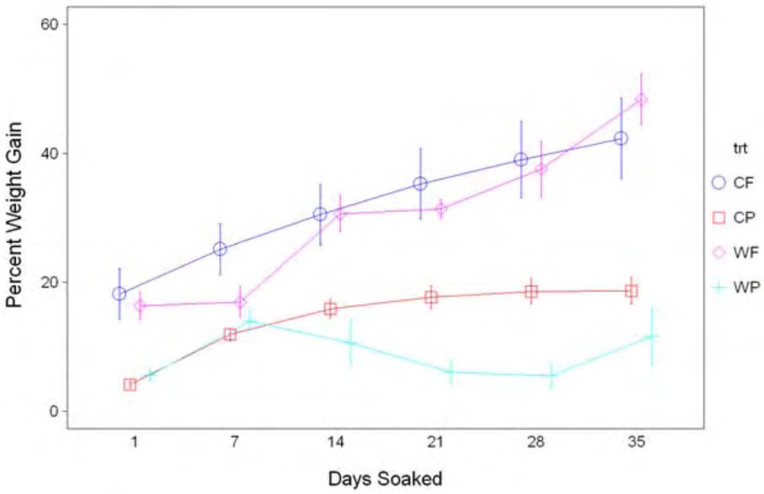


Figure 5. Cutting weight gain as a result of soaking. Fully submerged treatments had far greater weight gain than those of partially submerged treatments.

Cutting health after long-term soaking

No apparent damage occurred to cuttings in the cold soaking treatments after 35 days. Water in the warm full soaking treatment turned cloudy after several days, while the water used for other treatments remained clear. After soaking for 35 days, all cuttings were planted into five gallon buckets filled with water. Survival was, 100% for the cold full soak, 100% for the cold partial soak, and 33% for warm full soak treatment. All cuttings from the cold soaking treatments had excellent vigor and root and shoot growth. Cuttings from the warm full soak treatment were covered in a slimy film and were slow to produce roots and shoots. Only two of six cuttings from the warm full soak treatment produced roots or shoots, and these were much smaller and less vigorous than those from the other treatments. Root and shoot growth after 28 days averaged 3.18g (shoot) and 0.36g (root) for the cold partial treatment and 2.06 g (shoot) and 0.25 g (root) for the cold full treatment. Growth from cuttings in the warm full treatment averaged much lower, 0.39 g (shoot) and 0.06 g (root). It is unclear what affected the cuttings in the warm full soak treatment. Possibilities include, but are not limited to, fungal or bacterial infection, or the cuttings simply drowned without oxygen being supplied to the cells once dormancy was broken due to warm temperatures.

SUMMARY

Pre-plant soaking of dormant peachleaf willow cuttings can increase cutting survival under stressful conditions. All soaking treatments tested had better survival than the non-soaked control treatment, with the exception of a single day soaking partially submerged in cold water. Cuttings soaked for 14 days partially submerged in cold water had 100 percent survival. The survival of cuttings in the fully submerged cold soaked treatments was greatest (80%) with a 21 day soak, the longest duration tested. It is unknown whether or not longer soaking periods of this treatment would have resulted in even better survival. Soaking for extended durations in warm water with portions of the cuttings exposed to oxygen can initiate root and shoot growth which can be easily damaged and affect the vigor of the cutting.

Water weight gain does not appear to be the only factor determining increased survival from pre-soaking. Fully submerged cuttings in cold and warm water had much greater weight gain than those from partially submerged cuttings of the same duration, but there appeared to be no corresponding increases in survival.

Increasing cutting diameters resulted in higher rates of survival. Cuttings 1.9 cm in diameter and larger had 100 percent survival. Using cuttings of this diameter may not be feasible for nursery stock propagation, and the increased vigor may not be necessary under the ideal moisture conditions provided in typical greenhouse situations; however, these data suggest that for streambank restoration and other “natural” site applications, use of larger diameter cuttings would be beneficial.

From the data gathered in this study, we recommend soaking peachleaf willows for one to three weeks in cold water. This should be achievable in most cases by using streams, ponds or backwaters at or near the planting or collection site, especially in early spring when streams are full with snowmelt water. Temperatures should be watched carefully. As daily air temperatures increase, the cuttings should be monitored for any signs of growth, especially if the cuttings are not kept fully submerged. Best results will come from planting cuttings before buds form and epidermal lesions appear on the cutting. By doing this, water content should be high, and the roots and shoots are ready to emerge but are not yet susceptible to damage of the primary meristems.

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FINAL TECHNICAL REPORT

INTEGRATED RESTORATION STRATEGIES TOWARDS WEED CONTROL ON WESTERN RANGELANDS

Chapter 2 – Plant materials selections and seeding equipment modifications

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SPECIES SELECTION AND SEED PROCUREMENT

The cooperators of the IFAFS "Integrated Restoration Strategies Towards Weed Control on Western Rangelands" Project selected test species for studies based on seed availability of the most common species found in Wyoming big sagebrush plant communities throughout the Great Basin and Snake River Regions.

Experiment 1 – Plant Screening Trials involved replicated plot plantings using the Truax Rough Rider Rangeland Drill in fall of 2003 and 2004 at two locations in each of the states of Idaho, Nevada, Oregon and Utah (**Table 2.1**) to evaluate different releases for their competitive ability with cheatgrass. This experiment involved eight separate plantings each of the two years this experiment was planted. Seed for Experiment 1 was purchased from seed companies or supplied by NRCS, ARS, or the FS. At each location, 3 of 6 replications were treated with Roundup in late spring prior to planting and the other 3 replications were left untreated. Plots were 10 feet wide (one drill width) x 20 feet long. Species and accessions utilized in Experiment 1 are listed in **Table 2.2**. Additional details on the plot treatments and experimental design can be found in Chapter 5.

Table 2.1. Seeding dates for Experiment 1 at each study site.

State	Study site	2003 seeding dates	2004 seeding dates
Idaho	Canyon Creek	October 20-21	October 20-21
	Cinder Cone Butte	October 21-22	October 21-22
Nevada	Eden Valley	November 10-11	October 27-28
	Izzenhood Ranch	November 12-13	October 29-30
Oregon	Lincoln Bench	October 27-28	October 24-25
	Succor Creek	October 29-30	October 25-26
Utah	Simpson Springs	November 3-4	October 18-19
	Vernon Hills	November 5-6	October 17-18

Table 2.2. Species and accessions of plant materials used in Experiment 1 seedings.

Plant type	Latin name	Common name	Accession name	Sites seeded	Seed source	Seeding rate	
						number PLS ft^{-1}	lbs PLS $acre^{-1}$
(1) Native perennial species	*Achillea millefolium*	Western yarrow	Eagle	All except: (1) NV-Izzenhood Ranch; (2) all ID & OR sites in 2004	Geertson Seed	50	0.5
	Achillea millefolium	Western yarrow	Great Northern	All except NV-Izzenhood Ranch	Bridger, MT PMC	50	0.5
	Achnatherum hymenoides	Indian ricegrass	Rimrock	Only NV-Izzenhood Ranch	Commercial	25	4.6
	Atriplex canescens	Fourwing saltbush	N/A	Only NV-Izzenhood Ranch	Local collection	25	21.0
	Atriplex confertifolia	Shadscale	N/A	Only NV-Izzenhood Ranch	Local collection	25	18.0
	Elymus multisetus	Big squirreltail	Sand Hollow	All	L&H Seed	25	5.7
	Elymus elymoides brevifolius	Bottlebrush squirreltail	Shaniko Plateau	All	L&H Seed	25	5.7
	Elymus lanceolatus lanceolatus	Thickspike wheatgrass	Bannock	All	Aberdeen, ID PMC	25	8.1
	Elymus lanceolatus lanceolatus	Thickspike wheatgrass	Critana	All	Bridger, MT PMC	25	8.1
	Elymus wawawaiensis	Snake River wheatgrass	Secar	All	L&H Seed	25	7.8
	Elymus wawawaiensis	Snake River wheatgrass	SERDP (KBJ)	All	ARS, Logan, UT	25	7.8
	Krascheninnikovia lanata	Winterfat	N/A	Only NV-Izzenhood Ranch	Local collection	25	8.9

Plant type	**Latin name**	**Common name**	**Accession name**	**Sites seeded**	**Seed source**	**Seeding rate**	
						number PLS ft^{-1}	**lbs PLS $acre^{-1}$**
	Leymus cinereus	Basin wildrye	Magnar	All except NV-Izzenhood Ranch	Aberdeen, ID PMC	25	8.4
	Leymus cinereus	Basin wildrye	Trailhead	All except NV-Izzenhood Ranch	Bridger, MT PMC	25	8.4
	Poa secunda secunda	Sandberg bluegrass	Hanford	All	L&H Seed	50	2.4
	Poa secunda secunda	Sandberg bluegrass	High Plains	All	Bridger, MT PMC	50	2.4
	Poa secunda secunda	Sandberg bluegrass	Mountain Home	All	Rainier Seed	50	2.4
	Poa secunda ampla	Sandberg bluegrass	Sherman	All	Pullman, WA PMC	50	2.4
	Pseudoroegneria spicata	Bluebunch wheatgrass	Anatone	All	SW Seed	25	7.8
	Pseudoroegneria spicata	Bluebunch wheatgrass	Columbia	All	Logan, UT ARS	25	7.8
	Pseudoroegneria spicata	Bluebunch wheatgrass	Goldar	All	Aberdeen, ID PMC	25	7.8
	Pseudoroegneria spicata	Bluebunch wheatgrass	P-7	All	Landmark Seed	25	7.8
	Sphaeralcea coccinea	Scarlet globemallow	UTDWR Source	All	UTDWR, Ephraim, UT	25	2.9
	Achnatherum thurberianum	Thurber's needlegrass	Orchard	Only Idaho and Oregon sites in 2004	USFS Shrub Lab, Boise, ID	25	4.8
(2) Comparison Standards	*Agropyron cristatum X desertorum*	Crested wheatgrass	CD-II	All	Aberdeen, ID PMC	25	6.6
	Agropyron fragile	Siberian wheatgrass	Vavilov	All	Aberdeen, ID PMC	25	6.8

Plant type	Latin name	Common name	Accession name	Sites seeded	Seed source	Seeding rate	
						number PLS ft^{-1}	lbs PLS $acre^{-1}$
(3) Hybrid Small Grains	*Triticum X Elytrigia*	Hybrid wheat	Regreen	All	Rainier Seed	25	91
	Triticum X Secale	Triticale	Pioneer	All	Granite Seed	25	91
		Triticale	Stani	All	Granite Seed	25	91
	Secale montanum	Mountain rye	Common	All	Stevenson Seed	25	60.5

Experiment 2 – Competitive Interactions Trials involved small replicated plots (1.5 x 2.5 meter) which were broadcast-seeded by hand in the fall of 2003 and of 2004 (**Table 2.3**). Seed for this Experiment was purchased from seed companies or supplied by NRCS, ARS, or the FS. Species and accessions utilized in Experiment 2 are listed in **Table 2.4**. Additional details on plot treatments, experimental design, seeding rates, and seed mixtures for Experiment 2 are discussed in Chapters 6 and 7.

Table 2.3. Seeding dates for Experiment 2 at each study site.

State	Study site	2003 seeding dates	2004 seeding dates
Idaho	Canyon Creek	November 18-20	November 17-19
	Cinder Cone Butte	November 18-20	November 17-19
Nevada	Eden Valley	October 26-27	November 1-2
	Izzenhood Ranch	October 28-29	November 3-4
Oregon	Lincoln Bench	November 20-22	November 15-17
	Succor Creek	November 20-22	November 15-17
Utah	Simpson Springs	November 1-15	November 1-15
	Vernon Hills	November 1-15	November 1-15

Table 2.4. Species and accessions of plant materials used in Experiment 2 seedings.

Plant type	Latin name	Common name	Accession name	Seed source	Site seeded
Native perennial species	*Achillea millefolium*	Western yarrow	Great Northern	Bridger, MT PMC	All
	Artemesia tridentata ssp. *wyomingensis*	Wyoming big sagebrush	N/A	Local collections for each site	All
	Elymus multisetus	Big squirreltail	Sand Hollow	L&H Seed	All
	Poa secunda secunda	Sandberg bluegrass	High Plains	Bridger, MT PMC	All
	Pseudoroegneria spicata	Bluebunch wheatgrass	Anatone	SW Seed	All
	Sphaeralcea coccinea	Scarlet globemallow	UTDWR Source	UTDWR, Ephraim, UT	All
	Agropyron fragile	Siberian wheatgrass	Vavilov	Aberdeen, ID PMC	All
Primary weed	*Bromus tectorum*	Cheatgrass	N/A	Local collections for each site	All
Secondary weed	*Centaurea virgata*	Squarrose knapweed	N/A	Local collections for each site	UT-Simpson Spring
	Lygodesmia juncea	Skeletonweed	N/A	Local collections for each site	ID-Cinder Cone Butte
	Taeniatherum caput-medusae	Medusahead	N/A	Local collections for each site	ID-Canyon Creek OR-Lincoln

					Bench

Experiment 3 – Restoration Strategies Trials involved the seeding of mixtures on large scale plots (approximately 10 acres each). Because of limited available funding, this experiment was conducted at only one site: Bedell Flats, located northeast of Reno NV. The site receives 8-10 inches mean annual precipitation and has sandy loam to loamy sand soils, 100-110 frost free days, and elevation of 4,500 – 5,500 feet. Approximately 150 acres were seeded. It was intended that the species that were most successful in Experiment 1 would be selected for use in Experiment 3. Three plots were seeded with a cover crop of winter triticale on October 30-31, 2004. The perennial seed mixes were planted November 3-8, 2005. Seed for this experiment were purchased from seed companies except as noted. Indian ricegrass was added to the mixture because Indian ricegrass was a natural species on the area being planted. Two seeding mixes were planted. Species and accessions for each mix utilized in Experiment 3 are listed in **Table 2.5**.

Table 2.5. Species and accessions of plant materials used in Experiment 3 seedings.

Seed mix	Latin name	Common name	Accession name	Seed source	Seeding rate (lbs PLS acre^{-1})
1	*Achnatherum hymenoides*	Indian ricegrass	Nezpar	Aberdeen, ID PMC	1.5
	Elymus elymoides brevifolius	Bottlebrush squirreltail	Shaniko Plateau	L&H Seed	0.6
	Elymus lanceolatus lanceolatus	Thickspike wheatgrass	Bannock	Cedera Seed	1.26
	Leymus cinereus	Basin wildrye	Magnar	Wind River Seed	1.05
	Poa secunda ssp. *ampla*	Sandberg bluegrass	Sherman	Wind River Seed	0.4
	Pseudoroegneria spicata	Bluebunch wheatgrass	Anatone	Wind River Seed	1.4
2	* *Achillea millefolium*	Western yarrow	Eagle	Geertson Seed	0.02
	* *Artemesia tridentata* ssp *wyomingensis*	Wyoming big sagebrush	N/A	Local collection	0.02
	Elymus multisetus	Big squirreltail	Sand Hollow	Cedera Seed	1.2
	Poa secunda secunda	Sandberg bluegrass	High Plains	Bridger, MT PMC	0.4
	Pseudoroegneria spicata	Bluebunch wheatgrass	Anatone	Wind River Seed	3.5
	Sphaeralcea coccinea	Scarlet globemallow	UTDWR Source	UTDWR, Ephraim, UT	0.1

NOTE: * Yarrow and sagebrush were broadcast seeded in alternate rows with Seed Mix #2

TRUAX DRILL MODIFICATIONS

The cooperators of the IFAFS "Integrating Weed Control and Restoration on Great Basin Rangelands" Project chose to use the Truax Rough Rider Rangeland Drill to seed Experiment 1 and Experiment 3 because the drill was considered the best available technology for rangeland seedings.

Personnel from the USDA-NRCS Aberdeen Plant Materials Center (PMC) were responsible for completing modifications to ensure both small (10 x 20 foot) plots in Experiment 1 and large (acreage size) plots in Experiment 3 would be planted accurately.

The Truax drill was delivered to the PMC in July 2003 so modifications to the drill could be completed. Due to safety issues identified by the manufacturer, the drill was recalled to the factory in mid-August. The drill was returned to the PMC in late September 2003. The following modifications were made prior to the first seeding project:

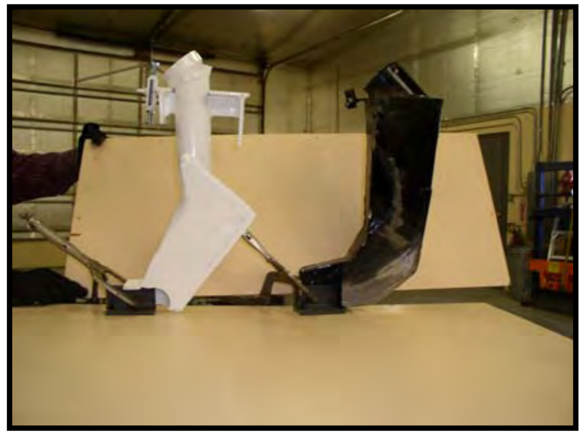


Photo 2.1. Re-designed seed drop tubes and boots (white boot) for a smoother flow of seed from the seed box to the soil.

- Replaced accordion style drop tubes with smooth, clear tubes to facilitate seed flow from the seed box (**Photo 2.1**)
- Fabrication of V-shaped trough over individual seed cups to facilitate changing seed for each plot and cleanout between plots
- Mounted generator, vacuum cleaner and bag holder for changing seed between plots
- Mounted a handle on drive wheel for calibration and drill priming
- Modifications to facilitate calibration
- Removed agitator in cool season box to facilitate cleaning between plots
- Installed seats on drill platform
- Adjustment of press wheels to ensure accurate tracking behind openers

Photo 2.2. Wider disc opening in the soil for seed to drop into and press wheel adjustment to better cover seeds with soil behind disc openers.

On October 19, 2003 PMC personnel transported the drill to the Canyon Creek site in Idaho to begin seeding Experiment 1. Due to the time constraints imposed by the recall of the drill in August, PMC personnel did not have a chance to fully field test the drill under field conditions to determine how well the drill placed seed into the soil. It was assumed that the manufacturer had tested seed placement under rangeland conditions. Seeding began after delays in procuring the proper hitch and hydraulic connections between the drill and the tractor supplied by ARS.

Once seeding commenced, PMC personnel found seed bridging in the seed drop boot, drastically impeding seed flow to the soil. It was determined that the disk openers were not cutting a slot in the soil wide enough for seed to enter slot. The location where the seed left the boot was altered to direct more seed into the slot formed by the disk. Modifications to the drill while in the field were extremely limited due to lack of appropriate tools and materials. The Idaho sites (Canyon Creek and Cinder Cone Butte) were seeded under less than ideal conditions and much of the seed was not adequately covered with soil by the drill.

The following week the Oregon sites were seeded. PMC personnel were able to make additional modifications prior to seeding. Seed tubes were extended past the boot re-directing where the seed dropped, which improved seed placement. Drag chains were also installed behind the press wheels to improve seed coverage. The Nevada and Utah sites were seeded following completion of the Oregon sites.

Prior to the seeding in the fall of 2004, the following additional modifications were completed:

- Wedges (from the manufacturer) were installed to adjust toe-in (7°) on disk openers (this widened the slot that the seed falls into) (**Photo 2.2**)
- Added flute adjustment crank wheel to improve adjustment of calibration (**Photo 2.3**)
- Constructed side load trailer ramps on 35 foot PMC trailer in order to haul both the drill and tractor (now supplied by PMC) with one truck
- Constructed hitch pin sleeve to use with clevis-type tractor drawbar to reduce the amount of play in pintle eye on drill
- Fabricated pintle hitch for tractor loader in order to side load drill with tractor

The second year seeding of Experiment 1 plots were completed in late October and early November 2004. The ability to transport both the tractor and drill from site to site with one truck

Photo 2.3. Addition of a crank wheel to improve accuracy and ease of calibration.

Photo 2.4. Addition of windshields to reduce seed loss during windy conditions.

Photo 2.5. Addition of broadcast seeders to alternate rows of drilled and broadcast seeds to facilitate planting shallow-seeded species and deep-seeded species in a single operation.

improved the efficiency of the project. A cover crop (triticale) was seeded on the Experiment 3 site in early November. The additional drill modifications significantly improved the seed placement and soil cover of the seed. The drill performed very well in maintaining seeding depth which was set at ½ to ¾ inch depth for the small grain cover crop.

In 2005, a new drill was used to seed Experiment 3. Many of the modifications that were made to the drill used the prior 2 years were installed on the new drill. Additional modifications included:

- Windshields added around seed cup drops to reduce seed loss during windy conditions (**Photo 2.4**)
- Broadcast seeders added to alternate rows to facilitate planting shallow seeded species as well as deeper seeded species in a single operation (**Photo 2.5**)
- Repositioned mounting brackets for broadcast seeders

This drill was used for the Crested Wheatgrass Diversification Project (Great Basin Native Plant Selection and Increase Project) and Experiment 3.

Mr. Jim Truax visited the seeding sites for the Crested Wheatgrass Diversification Projects in Utah and Oregon and was able to see how the drill performed with the modifications that had been made. After the first seeding project was completed in Utah, Mr. Truax manufactured new seed drop boots that were steeper, to improve seed drop. The new boots were installed on the drill and were used in Oregon (Crested Wheatgrass Diversification Project) and the seeding of Experiment 3 in Nevada.

Since completion of the seedings in 2005, Mr. Truax has manufactured a new seed drop boot that should further improve seed placement. The new boot will be installed and used in upcoming seeding projects. All of the modifications that have been made have incrementally improved the performance of the Truax Rough Rider Rangeland Drill. The Truax drill is a significant improvement over the older rangeland drills which had very poor control of seeding depth.

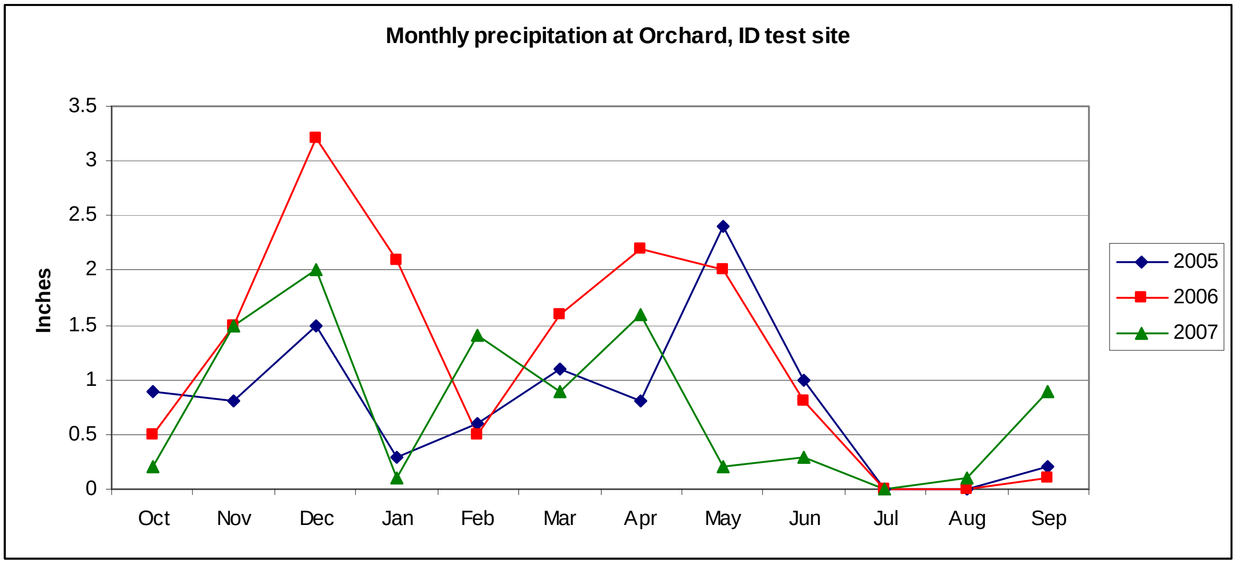
The cooperators of the IFAFS project thank Mr. Jim Truax for providing the drill for the project and his willingness to work with the project to make improvements to the drill. The excellent cooperation will undoubtedly pay great dividends in future rangeland seeding projects throughout the western United States.

Orchard Display Nursery
Evaluation Summary (2005-2007)
Derek J. Tilley, Range Conservationist (Plants)
Loren St. John, Team Leader Aberdeen Plant Materials Center

Introduction

The Orchard Display Nursery was planted on November 16, 2004 in cooperation with the Great Basin Native Plant Selection and Increase Project. The nursery includes 82 accessions of 27 native and introduced grass, forb and shrub species. Each accession was planted in 7 X 60 foot plots. See Tilley et al (2005) for descriptions of the species and accessions planted. The remaining area was planted to a cover crop mix of 50% Anatone bluebunch wheatgrass, 20% Bannock thickspike wheatgrass, 20% Magnar basin wildrye and 10% Snake River Plains fourwing saltbush. The test site is located on a loamy 10-12 inch precipitation ecological site that historically supported a Wyoming big sagebrush - bluebunch wheatgrass – Thurber's needlegrass plant community. Total precipitation at the Orchard Test Site for water year 2005 was 9.6 inches, 2006 was 14.4 inches and total accumulated precipitation for 2007 was (USDA 2007).

Orchard test site on May 16, 2007.



Materials and Methods

Orchard display site in September 2004 prior to final mechanical seedbed preparation

The Bureau of Land Management (BLM) burned the site in the fall of 2002. The site was later sprayed by PMC staff in May 2003 and May 2004 with a Roundup/2, 4-D herbicide mix to create a weed free seedbed. Due to limited breakdown of dead grass clumps that would inhibit proper seed placement with a drill and to ensure a clean seedbed, the decision was made to cultivate the site with a culti-packer just prior to seeding. During the first evaluation most plots contained high numbers of Russian thistle (*Salsola* sp.) and moderate amounts of bur buttercup (*Ranunculus testiculatus* Crantz) plants. Russian thistle plants were approximately two to three inches tall and the buttercup plants had already flowered. At the time of the second evaluation, there was a heavy infestation of tumble mustard (*Sisymbrium altissimum* L.). Plots were consequently sprayed again on June 9, 2005 with 16 oz. 2, 4-D and 8 oz. Clarity per acre to control the mustard.

The first evaluation of the plots for initial establishment was conducted on April 27, 2005 using a frequency grid based on that described by Vogel and Masters (2001). The grid measured approximately 40X41 inches, having four ten inch columns (to incorporate 1 drill row per column) and five rows, totaling 20 cells. The first grid was laid on the rows approximately two grid lengths (80 inches) into the plot. Counts were made of the cells that contained at least one plant. Grids were subsequently flipped and evaluated three more times giving a total of 80 evaluated cells. Total area for one grid is approximately 1m^2. Total area evaluated is therefore approximately 4m^2. A conservative estimate of plant density (plants/m^2) is the total number of cells containing at least one plant divided by four. The second evaluation occurred on May 25, 2005. The 2006 evaluation was conducted on May 31, and the 2007 evaluation took place on May 16. The methods followed in 2006 and 2007 were the same as described above; however, the frame was evaluated five times for a total of 100 cells or 5m^2. Total counts were then divided by five for approximate plants/m^2. Numbers for approximate plants/m^2 were then divided by 10.8 to calculate approximate plants/ft^2. It is important to note that because cells with plants were counted and not number of plants per cell, the best possible score is 100 hits per five frames which converts to 20 plants/m^2 or 1.85 plants/ft^2. Actual plant density may be higher than the numbers indicated below. All tables have been arranged with accessions ranked from highest plant density to the lowest at the time of the second evaluation in 2005. Data were not analyzed for significance.

Native Grasses

There were forty-seven accessions of native grasses planted. Overall the native grasses established well considering the limited amount of precipitation received over the winter and early spring of 2005. Especially good stands were seen in the bluebunch wheatgrass and Snake River wheatgrass plots during 2005. There was a marked decrease in plant density between the first and second evaluations with some notable exceptions. Seven of nine bluebunch wheatgrass accessions and three of four Snake River wheatgrass accessions increased in density from the first evaluation to the second. This is possibly due to receiving 2.5 inches of precipitation during that period and/or from a lack of pressure by black grass bugs (*Labops* sp.). Most of the native grasses decreased steadily in density from 2005 to 2007.

In 2005 the best performing Indian ricegrass accession was White River, having a plant density of 0.56 plants/ft^2 during the first evaluation and 0.17 plants/ft^2 during the second evaluation. In 2006 and continuing to 2007 there were no plants of any Indian ricegrass accessions observed in the evaluation grids and very few seen within their respective plots.

In 2005 the squirreltail plots had as high as 0.54 plants/ft^2 with Fish Creek. In 2006 all squirreltail accessions had decreased. Fish Creek maintained the best plant density with 0.26 plants/ft^2. Densities remained essentially the same in 2007.

Bannock thickspike wheatgrass had a density of 1.04 plants/ft^2 and stayed essentially the same at the second evaluation of 2005. In 2006 Bannock had dropped to nearly half of the original density to 0.58 plants/ft^2. The 2007 evaluations showed small declines from established plots.

Revenue and San Luis slender wheatgrass both showed zero plants/ft^2 in 2006. Pryor slender wheatgrass similarly dropped in density but had 0.02 plants/ft^2. In 2007 no slender wheatgrass plants could be found in any of the evaluated grids.

The western wheatgrass accessions had less dramatic declines in density from 2005 to 2006, but still showed poor stands with Rodan having the highest density of 0.13 plants/ft^2. In 2007 all accessions had zero plants surviving.

The bluebunch wheatgrass accessions had the highest average densities of all the native grasses. All decreased slightly in density from 2005 to 2006, but still maintained good stands. P-12, Wahluke and Jim Creek all had densities over 1.00 plants/ft^2. Columbia, Anatone, P-7 and P-15 had densities between 0.50 and 1.00 plants/ft^2 while P-5 and Goldar both shared low densities. In 2007 densities were generally slightly lower, but still higher than all other species as a whole. The highest density recorded in 2007 was Jim Creek at 1.07 plants/ft^2.

Jim Creek bluebunch wheatgrass, 2007.

Snake River wheatgrass accessions had good densities the establishment year with three accessions having densities greater than 1.00 plants/ft^2. Numbers declined slightly yet steadily over the next two years. In 2007 the best density was from SERDP with 0.70 plants/ft^2.

The basin wildrye accessions densities also decreased from 2005 to 2006; U108-02 and Trailhead retained the highest densities at 0.24 and 0.26 plants/ft^2 respectively. By 2007 the best density was achieved by Trailhead with 0.17 plants/ft^2. U108-02 and U100-01 had similar densities with 0.11 and 0.13 plants/ft^2 respectively.

Sheep fescue stands remained poor from 2005 to 2006 with Covar slightly increasing from 0.00 to 0.07 plants/ft^2. In 2007 Covar still had 0.07 plants/ft^2, and Initial Point had decreased to 0.00 plants/ft^2.

Thurber's needlegrass had no plants in the evaluated grids for any year.

All five of the Sandberg bluegrass accessions increased in density from 2005 to 2006. The best stands were observed in the High Plains and Mountain Home plots with respective stands of 0.54 and 0.35 plants/ft^2. In 2007 all stands had been reduced to 0.0 plants/ft$^{2.}$

Species	**Name or accession**	**4/27/05**	**5/25/05**	**5/30/06**	**5/16/07**
		Plants/ft²			
Indian ricegrass	Rimrock	0.37	0.20	0.00	0.00
	White River	0.56	0.17	0.00	0.00
	Nezpar	0.42	0.17	0.00	0.00
	Ribstone	0.14	0.09	0.00	0.00
	Paloma	0.05	0.00	0.00	0.00
Squirreltail	Fish Creek	0.97	0.54	0.26	0.22
	Sand Hollow	0.37	0.20	0.19	0.20
	Shaniko Plateau	0.81	0.52	0.06	0.09
	Toe Jam Creek	0.58	0.17	0.00	0.00
	9019219	0.02	0.02	0.00	0.00
Thickspike wheatgrass	Bannock	1.04	1.07	0.58	0.43
	Schwendimar	0.69	0.52	0.39	0.24
	Critana	0.90	0.56	0.24	0.17
	Sodar	0.37	0.30	0.15	0.07
Slender wheatgrass	Revenue	1.00	0.93	0.00	0.00
	San Luis	0.60	0.69	0.00	0.00
	Pryor	0.30	0.30	0.02	0.00
Western wheatgrass	Rodan	0.28	0.35	0.13	0.00
	Rosana	0.05	0.20	0.04	0.00
	Arriba	0.16	0.15	0.06	0.00
Bluebunch wheatgrass	Jim Creek	0.83	1.02	1.02	1.07
	Wahluke	0.97	1.26	1.02	0.98
	P-12	1.34	1.59	1.04	0.89
	Columbia	1.30	1.23	0.84	0.83
	Anatone	0.81	1.15	0.80	0.69
	P-7	0.93	1.15	0.67	0.57
	P-15	0.60	0.93	0.54	0.50
	Goldar	0.51	0.37	0.33	0.19
	P-5	0.42	0.61	0.22	0.13
Snake River wheatgrass	SERDP	1.02	0.94	0.67	0.70
	Secar	1.00	1.11	0.76	0.56
	Expedition	1.27	1.44	0.54	0.41
	E-26	0.21	0.23	0.22	0.13
Basin wildrye	Trailhead	0.60	0.52	0.26	0.17
	U100-01	0.53	0.41	0.11	0.13
	U108-02	0.56	0.57	0.24	0.11
	Washoe	0.21	0.09	0.09	0.06
	Magnar	0.28	0.22	0.04	0.04
	U70-01	0.30	0.22	0.02	0.02
Sheep fescue	Covar	0.16	0.00	0.07	0.07
	Initial Point	0.21	0.04	0.02	0.00

Thurber's needlegrass	Thurber's	0.00	0.00	0.00	0.00
Sandberg bluegrass	High Plains	0.25	0.00	0.54	0.00
	Sherman	0.00	0.00	0.02	0.00
	Mountain Home	0.00	0.00	0.35	0.00
	Toole County, MT	0.00	0.00	0.04	0.00
	Hanford Source	0.00	0.00	0.19	0.00

Introduced Grasses

Although many of the introduced grass accessions had fair emergence, an outbreak of black grass bugs at the time of the first evaluation in 2005 was noted. The infestation appeared limited to the introduced grass section of the nursery. Plants were covered with yellow spots making the plants appear yellow-green overall. Although most of the stands of the introduced grasses decreased from the first to the second evaluation, many stands had recovered and increased by 2006 indicating that many plants thought to be dead during the second evaluation in 2005 were still alive. However, the plants of crested wheatgrass were very small when compared to the other wheatgrasses in the nursery and still appear to be recovering from black grass bug pressure. The 2007 evaluation showed all established plots with reduced densities, many accessions dropping out completely.

In 2006 all of the crested wheatgrass accessions increased in density or remained approximately where they were in 2005. Ephraim rose from 0.28 to 1.23 plants/ft^2; however, many of the plants were small in size due to the black grass bug infestation during the spring of 2005. In 2007 the best density was obtained from Nordan with 0.67 plants/ft^2. Ephraim had dropped from 1.23 to 0.02 plants/ft^2.

Both Siberian wheatgrass accessions similarly increased from 2005 to 2006, but decreased in 2007. In 2007 Vavilov was down to 0.26 plants/ft^2 and P-27 had 0.00 plants/ft^2.

The three pubescent wheatgrass accessions decreased from 2005 to 2006 with the highest density in 2006 coming from Manska at 0.28 plants/ft^2. Manska continued to have the best density in 2007 with 0.13 plants/ft^2.

Rush intermediate wheatgrass, had 0.00 plants/ft^2 in 2006 and 2007.

Prairieland and Eejay Altai wildrye had zero plants in 2006. Pearl Altai wildrye had 0.02 plants/ft^2. In 2007 Prairieland and Eejay again had 0.00 plants/ft^2 and Pearl increased slightly to 0.04 plants/ft^2.

The Russian wildrye accessions all increased in density with the exception of Tetracan which decreased slightly. The best stand was recorded in the Bozoisky Select plot with 0.58 plants/ft^2. Bozoisky select had the best stand in 2007 with 0.35 plants/ft^2. Bozoisky II had the next best rating with 0.26 plants/ft^2.

		4/27/05	**5/25/05**	**5/30/06**	**5/16/07**
Species	**Name or accession**	-----------------------	**Plants/ft²**		-------------------------
Crested wheatgrass	Nordan	1.30	1.19	1.10	0.67
	Roadcrest	1.30	0.07	0.52	0.19

	Hycrest	0.39	0.24	0.15	0.07
	Ephraim	0.65	0.28	1.23	0.02
	CD-II	0.56	0.24	0.20	0.00
	Douglas	0.28	0.04	0.09	0.00
Siberian wheatgrass	Vavilov	0.65	0.20	0.61	0.26
	P-27	0.09	0.02	0.33	0.00
Pubescent wheatgrass	Manska	0.69	0.65	0.28	0.13
	Greenleaf	0.60	0.59	0.15	0.09
	Luna	0.79	0.54	0.13	0.00
Intermediate wheatgrass	Rush	0.60	0.56	0.00	0.00
	Pearl	0.35	0.15	0.02	0.04
Altai wildrye	Prairieland	0.56	0.39	0.00	0.00
	Eejay	0.16	0.28	0.00	0.00
Russian wildrye	Bozoisky Select	0.72	0.54	0.58	0.35
	Syn-A (Bozoisky II)	0.21	0.13	0.24	0.26
	Mankota	0.46	0.28	0.32	0.19
	Tetracan	0.42	0.20	0.17	0.07

Forbs and Shrubs


Stand of Eagle yarrow, May 2007.

Despite some good stands in 2005, all of the forb and shrub accessions except for Eagle yarrow had zero plants during the 2006 evaluation. Eagle had 0.07 plants/ft^2 in the frequency grids along with a small stand of plants at one end of the seeded plot. In 2007 more plants of Eagle had either germinated from the original seeding, or seed had spread from established plants. Plant density for Eagle in 2007 equaled 0.24 plants/ft^2. Snake River Plains fourwing saltbush also had a single plant found in the plots, increasing its density from 0.00 to 0.02 plants/ft^2.

Species	Name or accession	4/27/05	5/25/05	5/30/06	5/16/07
		----------------------------Plants/ft²			------------------------
Western yarrow	Eagle	0.51	0.50	0.07	0.24
	Great Northern	0.19	0.09	0.00	0.00
Utah sweetvetch	Timp	0.14	0.02	0.00	0.00
Firecracker penstemon	Richfield Selection	0.02	0.02	0.00	0.00
Scarlet globemallow		0.00	0.00	0.00	0.00
Lewis flax	Maple Grove	0.42	0.15	0.00	0.00
Blue flax	Appar	0.90	0.26	0.00	0.00
Wyoming big sagebrush		0.02	0.02	0.00	0.00
Fourwing saltbush	Snake River Plains	0.00	0.00	0.00	0.02
	Wytana	0.00	0.00	0.00	0.00
	Rincon	0.00	0.00	0.00	0.00

Gardner's saltbush	9016134	0.00	0.00	0.00	0.00
Winterfat	Hatch	0.28	0.17	0.00	0.00
	Northern Cold Desert	0.00	0.00	0.00	0.00
	Open Range	0.00	0.00	0.00	0.00
Forage kochia	Immigrant	0.00	0.00	0.00	0.00

Cover Crop

The cover crop consisted of a four species mix which contained: 50% Anatone bluebunch wheatgrass, 20% Bannock thickspike wheatgrass, 20% Magnar basin wildrye and 10% Snake River Plains fourwing saltbush. Four grids were examined during the first evaluation in 2005, one on each side of the nursery, and five grids were evaluated at the time of the second evaluation in 2005 and the 2006 evaluation. Total plant density was estimated at 0.37 plants/ft^2 at the first evaluation and 0.57plants/ft^2 at the second evaluation. In 2006 the cover crop density was 0.13 plants/ft^2. Cover crop densities increased in 2007 up to 0.20 plants/ft^2.

Discussion

Despite large amounts of Russian thistle, native and introduced grasses had fair to good emergence and plant density during the establishment year. Germination and emergence might have been increased with more precipitation during March and April, 2005 but emergence was good with the rain that was received. The majority of the plots showed decreased stands from 2005 to 2006 and again into 2007. The low precipitation at the site, especially the lack of moisture in July and August every year seems to have eliminated many of the less drought tolerant accessions. One concern is the effect of black grass bugs on the introduced grasses. Plants subjected to black grass bug are normally affected by decreased seed yield and a reduction in palatability. Infestations rarely result in the death of established plants, but in low water years establishing plants may be under enough stress to kill the establishing seedlings (Hammon and Peairs 2001). The second evaluation in 2005 indicated a loss in plant densities; however it appears that many of the plants survived, although stunted, through 2006. In 2007 many more plants had died out leaving poor or no stands in many plots. Snake River and blue bunch wheatgrass had consistently good stands from essentially all accessions. Introduced species like crested wheatgrass and Russian wildrye also had good performers such as Nordan and Bozoisky select.

Future evaluations will provide more information on plant establishment, persistence and longevity. The PMC staff will continue to evaluate plant performance at the site.

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Coffee Point Off-Center Evaluation (2006 planting)
2007 Progress Report
Derek J. Tilley
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INTRODUCTION

In the fall of 2006, the Aberdeen Plant Materials Center (PMC) installed a multi-species off-center planting at the Coffee Point test site 25 miles northwest of Aberdeen. Seed collections were assembled with the assistance of ARS Logan, UT; Bridger, MT PMC; Benson Seed Farm; University Nevada, Reno; Department of Defense; Geertson Seed Farm and Los Lunas, NM PMC. The trial contains 58 accessions of 23 species of native and introduced grasses, forbs and shrubs (table 1). Figure 1 shows a plot map of the planting. The goal of this trial is to evaluate the adaptability of numerous new conservation releases in a low precipitation environment and compare their establishment, production and longevity against older traditionally used released plant materials.

The Coffee Point test site is located in Major Land Resource Area (MLRA) 11B, Snake River Plains of the Northwestern Wheat and Range region of the Intermountain West in what historically supported a Wyoming big sagebrush/bluebunch wheatgrass plant community. Climatic conditions are very dry with mean annual precipitation from 8 to 12 inches, average air temperature is 43º F, and the frost free period is approximately 90 days. Soils at the site are a Splittop-Atomic complex with 2 to 8% slope and effective rooting depth of 20 to 40 inches. The pH of the soil complex is 7.4 to 8.4. The elevation is 4,850 ft.

MATERIALS AND METHODS

Prior to site preparation we determined the pre-existing cover frequencies by running four 30 meter transects across randomly chosen portions of the test site on April 15, 2006. Intercept determinations were made at each meter. Pre-existing cover consisted of 38.3% litter; 28.3 % bare ground; 15.8% P-27 Siberian wheatgrass; 14.2% Hycrest crested wheatgrass and 3.3% Immigrant forage kochia.

The seed bed was prepared with chemical treatments of 16 oz 2,4-D and 64 oz Roundup per acre applied on May 2, 2005, August 1, 2005 and May 17, 2006. The site was disked on August 3, 2006. The trial was planted on November 20, 2006 with a modified Tye Drill with a width of 80 inches (8 spouts at 10” spacing). Experimental design was a randomized complete block with 4 replications. Each plot was one drill width wide (80 in) and 20 ft long. Species were arranged into blocks with the exception of introduced grasses, forbs and shrubs making up one block each. Seeding depths were dependent on species and were planted according to Ogle et al (2006). Species were seeded at a target rate of 20 to 30 pure live seeds (PLS) per ft² for large seeded species (<500,000 seeds per pound) and 40 to 50 PLS/ft² for smaller seeded species (>500,000 seeds/lb). PLS was determined by seed lab results or, when lab results were not available, PLS was estimated visually or the PLS from other accessions were averaged. All seed was mixed with rice hulls as an inert carrier for better seed flow according to St. John et al (2005) with the exception of fourwing and Gardener’s saltbush. A cover crop of 50% Anatone bluebunch wheatgrass, 20% Bannock thickspike wheatgrass, 20% Magnar basin wildrye and 10% Snake River Plains fourwing saltbush was planted in the prepared areas surrounding the trial.

Plot evaluations were conducted on April 30 and May 1, 2007 and again on September 7, 2007 using a frequency grid based on that described by Vogel and Masters (2001). The grid measured approximately 40X41 inches, having four ten inch columns (to incorporate 1 drill row per column) and five rows, totaling 20 cells. The first grid was laid on the rows approximately 1 ft into the plot. Counts were made of the cells that contained at least one plant. Grids were subsequently advanced one grid length in the plot and evaluated four more times giving a total of 100 evaluated cells. All tables have been arranged with accessions ranked from highest plant density to the lowest at the time of the first evaluation. Data were analyzed using the Statistix 8 Analytical software and subjected to an analysis of variance with a significance level of $p<0.05$. If significance was detected, means were separated using a Tukey HSD all pairwise comparison.

ZEBA

Also included in the planting are single observational plots of Appar blue flax, Goldar bluebunch wheatgrass, Magnar basin wildrye and Nezpar Indian ricegrass treated with ZEBA coating. ZEBA is a super-absorbent cornstarch based polymer. When saturated, the ZEBA molecules form a hydrogel that is able to absorb up to 400 times its original weight and holds and releases water for use by plants as needed. The reported result is faster germination, quicker emergence, consistent growth and higher, better-quality yields using less water. ZEBA plots will not be included in any statistical analysis but is only for observational purposes.

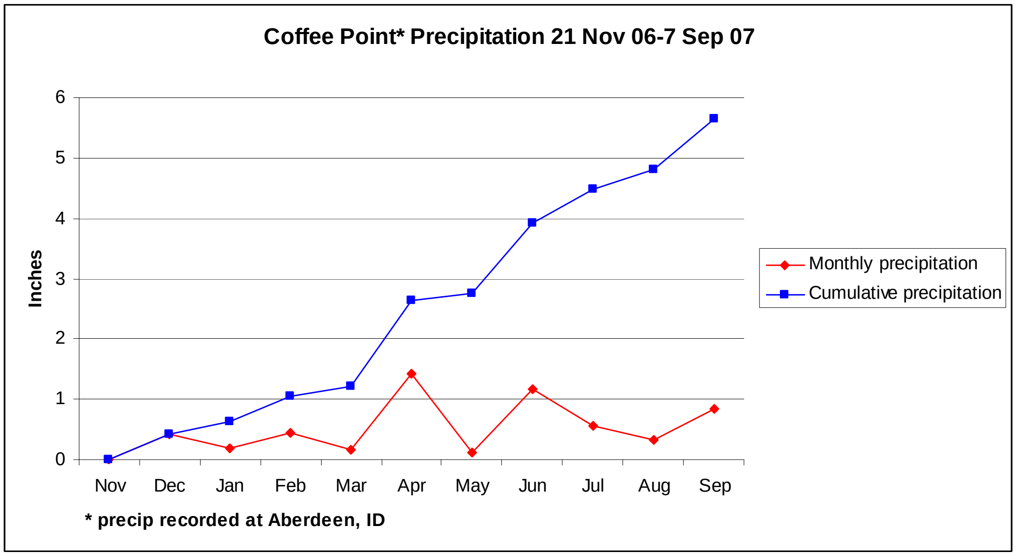
Table 1

Species	**Accession**	**Seed source**
Basin wildrye	Trailhead	MTPMC
	Washoe	MTPMC
	Topinish	Benson Seed Farm
	Jim Creek	Benson Seed Farm
	Gund	UNR
	Magnar	IDPMC
	L-45	ARS
	L-46	ARS
Sandberg bluegrass	High Plains	MTPMC
	Mountain Home	FS
	Duffy Creek	Benson Seed Farm
	Wallowa	Benson Seed Farm
	9081633	MTPMC
Bluebunch wheatgrass	P-7	ARS
	P-32	ARS
	Wahluke	Benson Seed Farm
	9081636	MTPMC
	Anatone	IDPMC
	Goldar	IDPMC
	P-19	ARS
	P-24	ARS
	P-22	ARS
	P-27	ARS

Snake River wheatgrass	SERDP	ARS
	E-45	ARS
	E-46	ARS
	E-51	ARS
Thickspike wheatgrass	Critana	MTPMC
	Bannock	IDPMC
	Sodar	IDPMC
Western wheatgrass	Rosana	MTPMC
	9081630	MTPMC
	9076517	DOD/ARS
Slender wheatgrass	Pryor	MTPMC
	9076516	DOD/ARS
	Copperhead	MTPMC
Bottlebrush squirreltail	9019219	MTPMC
	Toe Jam Creek	ARS
Shrubs	Wytana fourwing saltbush	MTPMC
	SRP fourwing saltbush	IDPMC
	9016134 Gardner saltbush	MTPMC
	N. Cold Desert winterfat	IDPMC
	Open Range winterfat	MTPMC
	Wyoming big sagebrush	BLM
Forbs	Great Northern w. yarrow	MTPMC
	Eagle w. yarrow	Geertson
	Antelope P. clover	MTPMC
	Stillwater coneflower	MTPMC
	9081632 Phacleia	MTPMC
	Old works penstemon	MTPMC
	Cedar penstemon	NMPMC
	Maple Grove flax	IDPMC
	Richfield penstemon	IDPMC
Intro. Grasses	Bozoisky Russian wildrye	ARS
	Bozoisky II	ARS
	Vavilov Siberian wheatgrass	ARS
	Vavilov II	ARS
	Mustang Altai wildrye	ARS
ZEBA	Nezpar Indian ricegrass	IDPMC
	Magnar	IDPMC
	Goldar	IDPMC
	Appar blue flax	IDPMC

RESULTS

At the time of the first evaluation in the spring of 2007, there was major crusting of the soil surface to about 0.5 in depth. Soil moisture conditions below the soil crust were good and most species had managed to break through the crust or had germinated inside the cracks in the soil. Most species had reached 1 to 4 true leaves by the first evaluation. Weed control from the chemical and mechanical treatments was excellent. Young plants of prickly lettuce (*Lactuca serriola*), white-stem blazing star (*Mentzelia albicaulus),* flixweed (*Descurainia sophia*), lupine (*Lupinus* sp.), tumble mustard (*Sisymbrium altissimum*) and Russian thistle (*Salsola* kali) were common throughout the test site, but were not in such numbers as would present a problem with competition.



Rainfall during the establishment year was lower than normal. In the 2007 water year, less than 6 inches of precipitation accumulated at Aberdeen. Spring rains in April helped establishment, but sparse summer rains caused many germinants to die by September.

SPECIES DISCUSSION

In the spring evaluation basin wildrye densities ranged from 0.06 plants/ft² (Topinish and Jim Creek) to 0.24 plants/ft ² (Trailhead). Densities dropped to 0.00 to 0.06 plants/ft ² at the time of the fall evaluation.

Basin wildrye

Accession	% PLS	Density (plants/ft ²) 5/07	9/07
Trailhead	86.6	0.24[a]	0.06 [a]
L-46	74.4	0.22	0.03
L-45	81.7	0.21	0.01
Magnar	89.6	0.15	0.01
Washoe	83.9	0.08	0.02
Gund	89.9	0.08	0.01
Jim Creek	83.6	0.06	0.01
Topinish	85.8	0.06	0.00

[a]Not significant at $p<0.05$

Although no significant differences were detected between the Sandberg bluegrass accessions, at the spring evaluation, 9081633, an accession being investigated by the Bridger, MT PMC had better overall establishment than all other accessions. 9081633 continued to have the highest density in the fall evaluation, 0.06 plants/ft ^{2}, which was significantly higher than all other accessions.

Sandberg bluegrass

Accession	% PLS	Density (plants/ft ^{2}) 5/07	9/07
9081633	86.0	0.13 [a]	0.06 a
High Plains	95.0	0.07	0.00 b
Wallowa	83.2	0.02	0.05 b
Duffy	79.0	0.05	0.00 b
Mt. Home	85.0	0.05	0.00 b
Critical value (0.05)			0.05

[a]Not significant at p<0.05

In the bluebunch wheatgrass trial no significance was detected between density means for the spring or fall evaluation. Plant densities in the spring ranged from 0.1 plant/ ft^2 to 0.37 plants/ft^2. The top performer was P-19, a test accession from the ARS (0.37 plants/ft ^{2}). Plant densities generally stayed the same between the spring and fall evaluations indicating good adaptability of the species to the site conditions.

Bluebunch wheatgrass

Accession	% PLS	Density (plants/ft ^{2}) 5/07	9/07
P-19	92.9	0.37[a]	0.37 [a]
Anatone	88.1	0.33	0.29
P-24	91.2	0.28	0.28
9081636	92.0	0.27	0.17
P-22	85.3	0.24	0.28
Wahluke	87.3	0.24	0.25
Goldar	90.6	0.13	0.13
P-27	87.4	0.11	0.09
P-7	89.4	0.11	0.12
P-32	86.5	0.01	0.12

[a]Not significant at p<0.05

Snake River wheatgrass densities were generally higher than those of bluebunch wheatgrass indicating, at least in this trial, greater adaptation to low precipitation conditions. The highest establishment density was 0.50 plants/ft ^{2} achieved by SERDP, and the lowest was 0.32 from E-46. Densities decreased between the spring and fall evaluations. SERDP continued to have the highest density (0.35 plants/ft ^{2}).

Snake River wheatgrass

Accession	% PLS	Density (plants/ft²) 5/07	9/07
SERDP	90.0	0.50[a]	0.35[a]
E-51	91.1	0.39	0.29
E-45	94.5	0.33	0.18
E-46	96.3	0.32	0.27

[a]Not significant at $p<0.05$

Thickspike and streambank wheatgrass exhibited good drought tolerance and seedling vigor with spring plant densities between 0.84 and 0.98 plants/ft². No significant differences were detected between means. Densities remained high through the fall evaluation, with all accessions having densities between 0.66 and 0.78 plants/ft².

Thickspike and streambank wheatgrass

Accession	% PLS	Density (plants/ft²) 5/07	9/07
Sodar	96.5	0.98[a]	0.78[a]
Critana	90.0	0.86	0.67
Bannock	94.3	0.84	0.66

[a]Not significant at $p<0.05$

Western wheatgrass is typically recommended for use in sites receiving 12 inches or more annual precipitation and is not well adapted to the conditions faced at Coffee Point. Although some plants did germinate from each of the accessions tested. Densities were very low, 0.03 to 0.05 plants/m² in the spring and slightly lower in the fall.

Western wheatgrass

Accession	% PLS	Density (plants/ft²) 5/07	9/07
Rosanna	90.0	0.05[a]	0.02[a]
9076517	90.0	0.03	0.03
9081630	85.0	0.03	0.03

[a]Not significant at $p<0.05$

Among the slender wheatgrass accessions, 9076516 slender wheatgrass from the Department of Defense and ARS had significantly greater plant densities than Copperhead from the MT PMC. 9076516 was developed for superior traits in germination and establishment for use on Army training grounds. The other tested accession, Pryor did not differ significantly in establishment from of the other accessions. At the fall evaluation, the ranking remained constant, although densities decreased for all accessions.

Slender wheatgrass

Accession	% PLS	Density (plants/ft²) 5/07	9/07
9076516	90.0	0.53 a	0.37 a
Pryor	95.9	0.46 ab	0.30 ab
Copperhead	85.0	0.23 b	0.08 b
Critical value (0.05)		0.28	0.28

In the bottlebrush squirreltail trial, accession 9019219, test material from the MT PMC had a density of 0.65 plants/ft² and was significantly greater than the plant density of Toe Jam Creek (0.20 plants/ft²). Fall densities remained essentially the same as spring. Accession 9019219 is likely the subspecies *elymoides* and is currently being tested by the Bridger PMC in Montana, while Toe Jam Creek is subspecies c*alifornicus* and was collected in a higher precipitation area near Elko, Nevada.

Bottlebrush squirreltail

Accession	% PLS	Density (plants/ft²) 5/07	9/07
9019219	85.0	0.65 a	0.57 a
Toe Jam Creek	92.2	0.20 b	0.15 b
Critical value (0.05)		0.32	0.37

Shrub densities were low and were not separable statistically in the spring evaluation. Most accessions had meager amounts of germinants; however Snake River Plains fourwing saltbush and the accession of Gardner's saltbush from the MT PMC both had fair establishment with 0.17 and 0.15 plants/ft² respectively. In the fall evaluation the saltbush accessions continued to have relatively good densities (0.19 for Gardner's and 0.13 for Snake River Plains). Other accessions had negligible establishment.

Shrubs

Accession	% PLS	Density (plants/ft²) 5/07	9/07
Snake River Plains 4-wing	44.5	0.17[a]	0.13 ab
Gardener's saltbush, 9016134	30.0	0.15	0.19 a
Open Range winterfat	80.8	0.02	0.04 bc
Wytana 4-wing	45.0	0.01	0.00 c
Northern Cold Desert winterfat	85.2	0.00	0.00 c
Wyoming big sagebrush	21.3	0.00	0.01 bc
[a]Not significant at p<0.05			0.13

In the forb trial, only Maple Grove Lewis flax and the test accession of Phacelia, 9081632, from the MT PMC had fair establishment. Maple Grove had a plant density of 0.45 plants/ft² and was significantly greater than all other accessions with the exception of Phacelia which had a density of 0.28 plants/m². All other accessions had essentially zero plants emerge. In the fall, Maple Grove continued to have the best density (0.20 plants/ft²). Most of the Phacelia plants had died by the fall evaluation, and Cedar penstemon had an increase in density, from 0.00 to 0.06 plants/ft².

Forbs

Accession	% PLS	Density (plants/ft²) 5/07	9/07
Maple Grove flax	93.0	0.45 a	0.20 a
Phacelia	81.8	0.28 ab	0.00 b
Great Northern yarrow	90.0	0.01 b	0.00 b
Cedar penstemon	95.0	0.00 b	0.06 ab
Eagle yarrow	90.0	0.00 b	0.01 b
Richfield penstemon	92.2	0.00 b	0.00 b
Antelope prairie clover	98.0	0.00 b	0.00 b
Old Works penstemon	95.0	0.00 b	0.00 b
Stillwater prairie coneflower	94.5	0.00 b	0.00 b
Critical value (0.05)		0.34	0.18

As a group, the introduced grasses outperformed all others with regard to establishment densities. All performed well with the lowest density coming from Bozoisky II Russian wildrye with a density of 0.54 plants/ft². The best density was achieved by Vavilov II, a new release of Siberian wheatgrass from the ARS, DOD and NRCS which had 1.48 plants/ft². Fall densities were generally slightly lower than in the spring, but all accessions maintained good plant densities. Vavilov II again had a significantly higher density than all other accessions (1.46 plants/ft²).

Introduced grasses

Accession	% PLS	Density (plants/ft²) 5/07	9/07
Vavilov II Siberian	90.0	1.48 a	1.46 a
Vavilov Siberian	90.0	0.74 b	0.68 b
Mustang Altai wildrye	90.0	0.75 b	0.58 b
Bozoisky Select Russian	90.7	0.70 b	0.65 b
Bozoisky II	90.0	0.54 b	0.59 b
Critical value (0.05)		3.70	0.42

Zeba Initial Evaluation

We also included one plot each of Magnar, Goldar, Appar and Nezpar which were treated with Zeba® moisture retention seed coating. Because there was only one plot of each these could not be analyzed statistically and only general observations can be made. The treated Magnar seed had a mean density of 0.71 plants/ft² as compared with 0.15 plants/ft² achieved in the untreated plots. Likewise, the treated goldar plot had an average plant density of 0.43 plants/ft² while the untreated plots averaged only 0.13 plants/ft². Appar and Nezpar were not included in the main trial, so a comparison cannot be made, however, the results achieved with Magnar and Goldar are favorable. Further examinations could determine more accurately the benefits and costs of using the Zeba® product. In the fall evaluation, all densities had decreased with the exception of Nezpar which increased from 0.90 to 0.15 plants/ft².

Zeba®

Accession	% PLS	Density (plants/ft²) 5/07	9/07
Magnar	87.3	0.71[a]	0.24[a]
Goldar	92.0	0.43	0.32
Appar	91.3	0.33	0.26
Nezpar	79.3	0.09	0.15

[a] Means not separated

The plots will continue to be evaluated in future years. In 2008, the grass plots will be sampled for air-dry forage yield in addition to evaluation of plant density.

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Figure 1. Plot map; Coffee Point, 2006

NE ↑

34’	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	
	Rosanna	9076517	9081630	Copper	Pryor	9076516	Toe jam	9019219	Open range	NCD	WY sage	Gardner’s	Wytana	SRP	Stillwater	Old works	Antelope	Great northern	M. grove	Richfield	Cedar	Eagle	Phacelia	Vavilov	Mustang	Bozoisky	Vav II	Boz II	ZEBA Annar	blank	
	9081630	Rosanna	9076517	9076516	Copper	Pryor	9019219	Toe jam	Gardner’s	WY sage	NCD	Open range	SRP	Wytana	Old works	m. grove	Richfield	Phacelia	Stillwater	Antelope	Great northern	Cedar	Eagle	Mustang	Vavilov	Vav II	Boz II	Bozoisky	ZEBA Goldar	blank	
	9076517	Rosanna	9081630	Pryor	Copper	9076516	Toe jam	9019219	SRP	Gardner’s	Open range	Wytana	WY sage	NCD	Eagle	Phacelia	Great northern	Cedar	M. grove	Stillwater	Antelope	Richfield	Old works	Vav II	Bozoisky	Mustang	Vavilov	Boz II	ZEBA Magnar	blank	
	Rosanna	9081630	9076517	Pryor	9076516	Copper	9019219	Toe jam	Wytana	SRP	Gardner’s	NCD	Open range	WY sage	Great northern	Eagle	Antelope	Stillwater	Phacelia	Old works	Cedar	Maple grove	Richfield	Bozoisky	Boz II	Vavilov	Vav II	Mustang	ZEBA Neznar	blank	
14’	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	
	Magnar	L-45	Washoe	Topinish	L-46	Jim crk	Gund	Trailhead	Duffy	High plains	9081633	Mt home	Wallowa	Anatone	Goldar	p-32	p-22	p-19	Wahluke	p-7	p-27	p-24	9081636	e-46	e-51	e-45	SERDP	Sodar	Critana	bannock	
	Jim crk	Topinish	Trailhead	L-46	Washoe	Gund	L-45	Magnar	Wallowa	Duffy	High plains	9081633	Mt home	Goldar	p-27	9081636	p-19	p-32	p-24	Anatone	p-22	p-7	Wahluke	e-51	Serdp	e-45	e-46	Bannock	Sodar	critana	
	Washoe	Jim crk	Gund	L-45	Magnar	Trailhead	L-46	Topinish	Mt home	Wallowa	9081633	Duffy	High plains	p-32	9081636	p-7	p-27	p-24	p-22	Goldar	Wahluke	p-19	Anatone	e-45	e-46	Serdp	e-51	Bannock	Critana	sodar	
20’	Trailhead	Washoe	Topinish	Jim crk	Gund	Maganr	L-45	L-46	High plains	Mt home	Duffy	Wallowa	9081633	p-7	p-32	Wahluke	9081636	Anatone	Goldar	p-19	p-24	p-22	p-27	SERDP	E-45	E-46	E-51	Critana	Bannock	Sodar	20’
34’	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	

PLANT MATERIALS

2007

IDAHO EVALUATION SUMMARIES

FIELD, SEED INCREASE 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. **FY06** The field is still in production. It has been an excellent hay crop averaging 4 tons/ac dryland over the 10 year period with one year producing 5.5 tons/ac. Landowner applies 300 pounds/ac of Nitrogen each spring. This grass needs to be managed for harvesting - cut and windrow at 50% cured. 80% cured results in loss of leaves because it is too brittle because of fine leaves. Cooperator also reports Regar also does well when planted with alfalfa, is easy to manage and he is very happy with it. **Next evaluation FY09.**

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. FY04 prescribed burned fall 2004 (15 acres) to rejuvenate existing stand – resulted in excellent response in plant vigor. Stand is primarily Latar, Alkar, Greenar, and alfalfa – general overall stand is predominately wheatgrasses and orchardgrass. Providing excellent wildlife nesting and escape cover. **Next evaluation FY08.**

ID04002 Dave Wattenburger Field Planting. Delar small burnet ordered August 19, 2003. Planting seeded fall 2004. No evaluation FY05 - FY07.

ID06007 Idaho Fish and Game – Field planting for wildlife winter nesting habitat. Blackwell switchgrass and 905439 switchgrass seed ordered March 9, 2006. Site characteristics: Farnhampton silt loam soil, 0-2 percent slopes, south aspect, elevation 1760 feet, 24 inch precipitation, non-irrigated, T65N R2W Sections 23 and 25. FY06 Idaho Fish and Game field planting of native grasses is slow establishing. The field was mowed in 2006 for wild oats weed control. FY07 no evaluation.

ID06008 Bernie Heinemann – Riparian Field Planting. Coyote willow (50); 9067541 Peachleaf willow (20); 9067546 Peachleaf willow (20); 9067549 Peachleaf willow (20); 9067375 Peachleaf willow (20); 9067376 Peachleaf willow (20); and 9067560 Peachleaf willow (20) cuttings ordered February 2006. Site characteristics: Porthill silt loam soil, 5 percent slopes, 2000 feet elevation, 24 inch precipitation, non-irrigated, T65N R1W, Section 10. FY06 and FY07 no evaluation.

FIELD OFFICE: COUER D'ALENE
None

FIELD OFFICE: PLUMMER
None

FIELD OFFICE: SANDPOINT
None

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. File was cancelled at end of 2003. **FY06** field determination indicated the Yakima ecotype failed to establish, but the Lind ecotype is still alive. Lind ecotype has not grown much, but there is good survival of this ecotype during field evaluation in July 2006. **Next evaluation FY08.**

ID04009 Carl Skyrman demonstration planting. Anatone bluebunch wheatgrass and Secar Snake River wheatgrass. Seed ordered March 8, 2004. Site characteristics: Chard sandy loam soil, northwest aspect, 1820 feet elevation, 16-22 inch precipitation, non-irrigated, T26N R1E NW1/4 Section 13. FY04 – Secar and Anatone were planted side by side in the spring of 2004. Good stands for each with > 5 plants per square foot establishing and it is hard to differentiate between plantings. Anatone plants were a bit more robust than Secar plants during evaluation 7/22/04. FY05 no evaluation. **FY06** (4/25/06) good established stand, Carl will spray with Sencore for cheatgrass and ventenata control. **Next evaluation FY09.**

ID05003 Steve Hunter – starthistle control project. Rush intermediate wheatgrass, Tegmar intermediate wheatgrass and Newhy hybrid wheatgrass were ordered February 4, 2005. Site characteristics: 3 acres, MLRA B9, Bluesprin skeletal loam soil, 20 percent slopes, southwest aspect, elevation 2700 feet, 18 inch precipitation zone, non-irrigated, T30, R3, NW ¼ section 36. FY05 not planted. **FY06** planted May 22, 2006 into poorly prepared seedbed. Fair stand establishing with about 0.25 plants/ft2 and fair vigor. **FY07** no evaluation.

ID05004 Tony Carson (combined with ID04004) – field planting. Anatone bluebunch wheatgrass, Magnar basin wildrye, Nezpar Indian ricegrass, High Plains Sandberg bluegrass, Rosana western wheatgrass, Sherman big bluegrass, Snake River Plains fourwing saltbush and Northern Cold Desert winterfat were ordered February 4, 2005. Site characteristics: 1 acre, Lickskillett – Tannahill silt loam soil complex, 45 percent slopes, south aspect, elevation 1960 feet, 16 inch precipitation, T28N, R1E, NE ¼ section 12. FY05 seeding was completed in early spring 2005. Half of the seeded area was treated with a straw pellet mulch. Above average spring rainfall resulted in very encouraging initial stand establishment with positively identified plants of Northern Cold Desert winterfat, Rosana western wheatgrass, Nezpar Indian ricegrass, Anatone bluebunch wheatgrass and many small seedlings present on July 13, 2005. **FY06** April 25, 2006 excellent stand establishing, primarily seedlings, but also includes a few established grasses and fourwing saltbush. Good soil moisture during evaluation and cooperator will irrigate in 2-3 weeks if no additional rains occur. **FY07** Snake River Plains fourwing saltbush fair stand with good vigor and about 35 inches tall. Northern Cold Desert winterfat fair stand with good vigor and about 6 inches tall. Nezpar Indian ricegrass, Sherman big bluegrass and Rosana western wheatgrass poor stands with fair vigor and about 3- 4 inches tall. Too sooner to conduct a complete evaluation of stand.

ID05006 Gary Crea (combined with ID04008) – Feedlot species adaptation trial. (1st planting P27 Siberian wheatgrass, Sodar streambank wheatgrass, Topar pubescent wheatgrass, Vavilov Siberian wheatgrass, Rush intermediate wheatgrass, Rosana western wheatgrass, Durar hard fescue and Alkar tall wheatgrass) (2nd planting Newhy hybrid wheatgrass, Critana thickspike wheatgrass, and Rosana western wheatgrass) Seed was ordered on February 4, 2005. Site characteristics: 0.5 acres, MLRA B9, Ferdinand-Flybow-Riggins soil complex, 2-8 percent slopes, west to southwest aspect, 20-24 inch precipitation, non-irrigated, T31N, R1E, SW of SW ¼ of section 27. FY04 overall the stand establishment is excellent due to good rainfall this year. Stand establishment exceeds 2 plants per square foot for all species except Alkar. The grasses are suppressing weeds in the feedlot. FY05 stand is spotty possibly due to excessive weed competition during establishment. **FY06 and FY07** no evaluation.

ID05007 Les Killgore – field planting. Covar sheep fescue, Durar hard fescue, Bannock thickspike wheatgrass and Rosana western wheatgrass seed was ordered on February 4, 2005. Site characteristics: 1.5 acres, MLRA E43a, loamy skeletal soil, 10 percent slopes, east aspect, elevation 2200 feet, 18 inch precipitation, non-irrigated, T28N, R1E NE ¼ section 33. FY05 and FY06 not planted. **FY07** no evaluation.

ID06005 Tony Carlson – Field planting of Rush intermediate wheatgrass, Bozoisky Russian wildrye, Magnar basin wildrye, Nezpar Indian ricegrass, and Sherman big bluegrass. Seed ordered February 21, 2006. Site characteristics: silt loam soil, 2 percent slopes, east aspect, 2100 feet elevation, 14-15 inch precipitation, non-irrigated, T28N R1E NE 1//4 Section 12. **FY06** seeded spring of 2006 (4/25/06) excellent stand establishing and seeding will be sprayed for broadleaf weed control. **FY07** no evaluation.

ID07009 Darrel ______ Ventenata Study. Demonstration planting seed ordered February 14, 2007. Site was prepared for planting in fall of 2006 and spring of 2007. Site was planted on May 8, 2007. **FY07** Mark Stannard visited the plots on 7/27/07. The weeds were not bad but he mowed the plots to keep the weeds from going to seed. The grasses were doing fairly well. Vavilov was the best performing grass and alfalfa, cicer milkvetch, and small burnet were also doing very well. The ground was very hard and very dry. A lot of the plants were totally dormant.

ID07010 Debbie Hatter – Butcher Creek woody field planting. 15 cuttings each of coyote willow and Laurel willow were ordered March 1, 2007. Shipping is scheduled for April 2 for delivery on approximately April 6th. Site characteristics MLRA B9, DeMasters-Riggins silt loam soil, 10 percent slopes, north aspect, 3200 feet elevation, 24 inch precipitation, T30N R3E SW Quarter Section 15. **FY07** cuttings shipped in early April.

FIELD OFFICE: LEWISTON

ID82001 Pat Richardson 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. FY04 excellent stand of Covar with excellent vigor, 7 inch height and light infestation of yellow starthistle. FY06 plots were heavily grazed by horses – some plants appear to be uprooted by hoof action. **FY07** good stand with fair vigor – stand is being very heavily grazed to ½ inch stubble height. Stand continues to exclude yellow starthistle with only 3- 4 plants observed within the plots. The edges of the plot are infested with Japanese brome, cheatgrass and medusahead. Plot was measured with GPS unit to determine actual size (203 ft x 80 ft = 0.37 acres). **Next evaluation will be in 2010.**

ID95028 Dau Bannock thickspike wheatgrass and Rush intermediate wheatgrass field planting. Seed ordered 4/3/95. FY95 - 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. FY04 good stand with good vigor. This stand is suppressing yellow starthistle fairly well and also providing excellent erosion control. FY05 and FY06 no evaluation. **FY07** very poor stand with very poor vigor – site is dominated by yellow starthistle and annual grasses – competition from weeds and perhaps poor grazing management may have affected stand life. **Cancel**

FIELD OFFICE: MOSCOW

ID06001A Lee and Roxanne Carrick riparian field planting. Cuttings ordered August 9, 2005. Cuttings to be shipped mid-late October 2005. Site characteristics: MLRA B9, Hampson silt loam soil, 0-3% slopes, NW aspect, 2600 feet elevation, 24 inch precipitation, non-irrigated, T41N R3W NW ¼ Section 3. 85 each of Rivar Mackenzie willow, Curlew Drummond willow, and Silvar coyote willow will be dormant fall planted 2005. **FY06** planted November 4, 2006. **FY07** no evaluation.

ID06001B Lee and Roxanne Carrick riparian field planting. Plants to be shipped early-mid April 2006. Site characteristics: MLRA B9, Hampson silt loam soil, 0-3% slopes, NW aspect, 2600 feet elevation, 24 inch precipitation, non-irrigated, T41N R3W NW ¼ Section 3. 60 each of Blanchard blue elderberry, Okanogan snowberry, St Maries mockorange and 125 Cheney redosier dogwood will be spring planted in 2006. **FY06** planted May 25, 2006. **FY07** no evaluation.

FIELD OFFICE: NEZPERCE

ID05009 William Stillman – Weed control project. Rush intermediate wheatgrass, Topar pubescent wheatgrass, Bannock thickspike wheatgrass, Paiute orchardgrass, Delar small burnet and Sherman big bluegrass seed was ordered on February 4, 2005. Site characteristics: 12 acres, MLRA B9, Jacket-Larkin silt loam soil, 20 percent slopes, south aspect, elevation 2900 feet, 23 inch precipitation, non-irrigated, T36N R1E SW ¼ section 19. **FY06** plots were broadcast seeded March 12, 2005 and trampled by cattle and sprayed with Roundup. All plots contain intermediate wheatgrass from prior planting making identification of planted wheatgrass species difficult. Scattered patches Paiute were observed. Small burnet was observed across all plots. No Sherman was observed. There is heavy competition from weeds such as yellow starthistle, medusahead and ventenata. **FY07** Delar small burnet fair stand with fair vigor; Topar pubescent wheatgrass and Paiute orchardgrass poor stand with poor vigor; Rush intermediate wheatgrass, Bannock thickspike wheatgrass and Sherman big bluegrass very poor stand with very poor vigor. Severe competition from weeds - medusahead, cheatgrass, yellow starthistle and ventenata.

ID07015 David Mosman – Nezpar Indian ricegrass seed increase. Seed shipped March 1, 2007. **FY07** no report.

ID07020 David Mosman – Anatone bluebunch wheatgrass. Seed shipped August 31, 2006. **FY07** no report.

FIELD OFFICE: OROFINO

ID04011 Clearwater County Riparian Project. 9067541 peachleaf willow, 9067546 peachleaf willow, 9067 549 peachleaf willow, 9067568 black cottonwood, 9067569 black cottonwood, 9023 733 redosier dogwood, 9023739 redosier dogwood, 9023740 redosier dogwood and Okanogan snowberry. Cuttings ordered March 5, 2004. Site characteristics: Cobbly soil, flat aspect, 1100 feet elevation, 26 inch precipitation, non-irrigated. FY04 – FY06 no evaluations. **FY07** 9067541 peachleaf willow -30% survival with good vigor, 9067546 peachleaf willow -30% survival with good vigor, 9067549 peachleaf willow -20% survival with good vigor, 9067568 black cottonwood - failed, 9067569 black cottonwood - failed, 9023 733 redosier dogwood - failed, 9023739 redosier dogwood - failed, 9023740 redosier dogwood - failed and Okanogan snowberry - failed.

ID04012 Ray Geidl Project. 9067541 peachleaf willow, 9067546 peachleaf willow, 9067549 peachleaf willow, 9023733 redosier dogwood, 9023739 redosier dogwood, 9023740 redosier dogwood and Okanogan snowberry. Cuttings ordered March 5, 2004. Site characteristics: fine loamy soil, flat aspect, 3000 feet elevation, 35 inch precipitation, non-irrigated (naturally sub-irrigated). FY04 – FY06 no evaluations. **FY07** 9067541 peachleaf willow – 10% survival with good vigor, 9067546 peachleaf willow – 10% survival with good vigor, 9067549 peachleaf willow - failed, 9023733 redosier dogwood - failed, 9023739 redosier dogwood - failed, 9023740 redosier dogwood - failed and Okanogan snowberry - failed. **Cancel**

ID04013 Paul Schroder Project. 9067541 peachleaf willow, 9067546 peachleaf willow, 9067549 peachleaf willow, 9023733 redosier dogwood, 9023739 redosier dogwood, 9023740 redosier dogwood and Okanogan snowberry. Cuttings ordered March 5, 2004. Site characteristics: Fine loamy soil, flat aspect, 3000 feet elevation, 35 inch precipitation, non-irrigated (naturally sub-irrigated). FY04 – FY06 no evaluations. **FY07** 9067541 peachleaf willow – failed, 9067546 peachleaf willow – failed, 9067549 peachleaf willow - failed, 9023733 redosier dogwood - failed, 9023739 redosier dogwood - failed, 9023740 redosier dogwood - failed and Okanogan snowberry - failed. **Cancel**

IDAHO DIVISION III
PLANT MATERIALS PLANTINGS

FIELD OFFICE: CALDWELL (see Meridian FO for additional field plantings)
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, 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 - FY04 no evaluations. **FY05** all plants are under some type of supplemental irrigation. Both the basin wildrye accessions are doing fine and are good landscape plants. The Secar bluebunch wheatgrass is doing well and is a good landscape plant. Covar sheep fescue has done well near the edges of walks and driveways where a little additional moisture is available and the soils are deep. It did poorly in an area that had topsoil removed and the soil may be somewhat compacted and is a good xeriscape plant. The accessions of Indian ricegrass that germinated and survived are doing well. There was poor germination and survival in general. They are good xeriscape plants. Appar Lewis flax is doing well with partial irrigation and is a good xeriscape plant. Scarlet globemallow seed was collected by cooperator and seeded. It did well for a couple of years, but died after 3-4 years. A good looking xeriscape plant. All accessions of penstemon, mostly Eaton or firecracker have done well under partial irrigation and are good xeriscape plants. The curlleaf mountain mahogany has done well and is a good landscaping plant. It receives some extra water. Serviceberry is doing well and is near full irrigation. Utah sweetvetch came up well, but received heavy use from rabbits and only one plant has survived. It is doing well. Golden current came into our yard through birds. Where it has volunteered, it is doing well and is a good xeriscape shrub. It needs to be pruned to make it denser since it is pretty leggy without pruning. It receives some additional water. I planted 3 or 4 silver buffaloberry shrubs and they have been slow in developing and are still quite small. They may do ok. The Maybell bitterbrush is doing fine. It receives some additional water and is a good xeriscape plant. Western yarrow was planted. It receives some additional run-on water where it was planted. It has spread readily to other areas with partial irrigation and some areas of full irrigation. In many ways this is a weed at my house. Rocky mountain iris has done fair in a place that I can fully irrigate and with no competition. Woods rose has done well and is a good landscaping plant. It is under full irrigation and should be pruned, similar to other roses to keep it under control. Western clematis started very slowly. This was from seed and not from Pullman PMC. Once it got going, after about 3 years, it has grown quite
well and in fact needs to be controlled for spread. The almond we harvested near Brownlee reservoir has done very well under full irrigation. It has very good vigor, has good shape and in favorable springs has produced good seed crops. It is a medium sized tree, about 20 ft. high now. Herbaceous sagewort or Louisiana sage was planted from seed

and receives partial irrigation. It does very well where it was planted and if the water was spread to a larger area, it would expand from rhizomes into that area. Mulberry trees volunteered through the help of birds to our yard. They do very well here and are good looking medium sized trees. They get partial to full irrigation and are not producing seed yet at 3 years old and 18 ft. tall. The ones down near the river do produce seed. **Next evaluation 2009.**

ID05010 Jacy Gibbs – shrub test plots. Prospector common snowberry, Trapper western snowberry, St Marie's mockorange (plants) and Colfax mockorange (plants) were ordered February 4, 2005. Site characteristics: MLRA 11, silt loam to loam soil, 1 percent slope, elevation 2250 feet, 8 inch precipitation, irrigated. **Cooperator will complete evaluations. FY05** Mockorange received in April in good condition. The accessions were not marked. NOTE: this was indicated on receipt that was sent back to Pullman PMC. Wayne Crowder called shortly after this and no resolution on how to identify was made. No way to evaluate them separately. They were planted shortly after they arrived. Four mockorange received partial irrigation and had moderate competition from grass. Six mockorange received full irrigation and had little or no grass competition. Most of the partially irrigated plants died. The others have low vigor and have grown little for full irrigation. There should be better first year growth with full irrigation to be a good landscape plant. They are planted in partial shade and may come on in 2006. Seed of the snowberry accessions were received in April. Warm-cold stratification occurred per instructions. The seed was planted 1/03/06. **FY06** snowberry failed. Mockorange was not sent with separate identification so accessions can not be determined. Mockorange is still alive, but growth rates are very slow. **Next evaluation 2009.**

ID06002 CB River Ranch WRP upland planting. Seeding mixture includes Bozoisky Russian wildrye, Pryor slender wheatgrass, Vavilov Siberian wheatgrass, Magnar basin wildrye, Nezpar Indian ricegrass and Snake River Plain fourwing saltbush. Seed was ordered September 26, 2005 and planting date is scheduled for May 2006. Site Characteristics: Feltham loamy fine sand soil, 3-12 percent slope, NE aspect, 11 inch precipitation and site will be irrigated for establishment. FY06 no evaluation. **FY07** Previous seedings in this field have failed due to lack of moisture, sandy soils and weed competition. We discussed an irrigation system with handlines in order to get plants established, however it proved to be cost prohibitive, so operator will be trying a dryland seeding again. Manure has been added and disced in to increase organic matter and hopefully retain soil moisture. Seeding will occur around the 1st of November.

FIELD OFFICE: EMMETT
ID04016 Richard Zamzow WRP upland field planting. Vavilov Siberian wheatgrass, Sodar streambank wheatgrass, Bannock thickspike wheatgrass and Magnar basin wildrye. Seed ordered July 2003. Site characteristics: fine sandy loam soil, 2100 feet elevation, 10-12 inch precipitation, aspect-flat. Planting planned for fall 2003. FY04 – FY05 no evaluations. FY04- FY07 no evaluation.

ID07007 V Dot Ranch – Jim Little field planting. Seed ordered 1/10/07. Seed mix 1: Anatone bluebunch wheatgrass, Bannock thickspike wheatgrass, Magnar basin wildrye, Sherman big bluegrass, Snake River Plains fourwing saltbush; Seed mix 2: Goldar bluebunch wheatgrass, Bannock thickspike wheatgrass, Washoe basin wildrye, High plains Sandberg bluegrass, Wytana fourwing saltbush. Site characteristics: wildfire burn 2006, stony clay loam soil, 3000 feet elevation, 12-16 inch precipitation, ESD – Stony Loam 12-16 bluebunch wheatgrass, basin big sagebrush, bitterbrush, Sandberg bluegrass. Mixtures (one acre each) will be broadcast planted in mid to late winter and where possible using ATV dragged-raked to incorporate seed. FY07 no evaluation.

ID07008 ____________ - _________ field planting. Peachleaf willow (accessions 9067541 and 9067546) and black cottonwood (accessions 9067537 and 9067569) extra long cuttings were delivered to Field Office on February 13, 2007. Planting to be completed using backhoe to dig holes to perennial water table – 2-3 cuttings will be placed in each hole. FY07 no evaluation.

ID08002 Randy Heffner field planting. Bozoisky Russian wildrye and Syn – A Russian wildrye fall and winter forage trial. Seed ordered October 12, 2007. Site Characteristics: Boise County, MLRA B10, 6 acres, dormant fall planting, Brownlee sandy clay loam, 5-10 percent slope, south aspect, 2800 feet elevation, 14-16 inch rainfall, irrigated, T7N R2E NE1/4 Section 2

FIELD OFFICE: MARSING/GRANDVIEW
None

FIELD OFFICE: MERIDIAN (Caldwell FO staff)
ID07001 Wayne Newbill field planting. Regar meadow brome and Cache meadow brome irrigated forages trial. Seed ordered August 10, 2006. Seed will be planted in late summer – early fall and surface irrigated (furrows) for establishment. Seed was delivered on 8/18/06. **FY06** weed control using 2 pints Roundup per acre was applied on 8/30/06 followed by discing, corrugating, pre-irrigation, harrowing, seeding with drill – 7 inch spacing on 9/9/06 and final corrugation. Regar is located in west field and Cache is located in east field. Fields were irrigated following planting. Initial evaluation in later fall 2006 indicated best stand establishment was Regar accession. **FY07** Regar - excellent stand, excellent vigor, 18 inch height and 3 plus plants per foot squared. Cache - excellent stand, excellent vigor, 12 inch height and 3 plus plants per foot squared. Cooperators rates Regar good to excellent and Cache good during establishment year.

ID07002 Doug Austin field planting. Regar meadow brome, orchardgrass and alfalfa field planting. Seed ordered August 28, 2006. Seed was planted in late summer – early fall and irrigated for establishment. Site characteristics: silt loam soil, 0-2 percent slope, 2800 feet elevation and irrigated. Seed was planted in early September 2006 and irrigated for establishment. **FY07** stand 75% Potomac orchardgrass, 10% Regar meadow brome and 15% alfalfa – cooperator took 3 cuttings of hay (1st 0.6 ton/ac; 2nd 0.9 ton/ac and 3rd 1.5 ton/ac = 3 ton/ac for first year).

OTHER PLANTINGS MANAGED BY PMS
ID06003 Rebecca Laramie Field Planting. Roadcrest crested wheatgrass and Ephraim crested wheatgrass low moisture lawn trial. Seed shipped March 2005. Seedbed preparation included roto-tilling and hand raking. Lawn was seeded on September 1, 2005. Seed was broadcast at about 600 seeds per square foot, lightly raked and the entire area was mulched with dry grass clippings and then watered. Irrigation the first month was 3 times per week. On September 7, 2005 seedlings could be seen coming through the mulch. On September 25, 2005, no noticeable difference could be seen between Roadcrest and Ephraim establishment. **FY06** - the grass seeding is looking good, did spot seeding in a few spots where stand wasn't too thick.

FIELD OFFICE: MOUNTAIN HOME
None

FIELD OFFICE: PAYETTE
University of Idaho low maintenance turf plot(s) studies. Seed ordered March 1, 2007. Species include: Vavilov Siberian wheatgrass, Sodar streambank wheatgrass, Hycrest crested wheatgrass, Ephraim crested wheatgrass, Roadcrest crested wheatgrass, Rosana western wheatgrass, Covar sheep fescue and Manchar smooth brome. Plots will be established at 4 locations:

ID07016 Lower Payette Ditch Plots - Site preparation and seeding: <u>Seeded 3/22/07.</u> Plots were cultivated with a front tine garden cultivator, raked, hand seeded, light raked, and rolled with a water-filled drum (estimate 30-40 pounds pressure) immedi after seeding. Some emergence, but plots essentially failed due to lack of soil moisture, extreme heat during summer and weeds (kochia and thistle). **Reseeded: 11/8/07**. Site prep included hand-raking before seeding (no cultivation), seeding, and rolling v water filled drum.

ID07017 Clay Peak Landfill Plots - Site preparation and seeding: <u>Seeded 3/22/07</u>**.** Plots were prepared with a "groundhog" cultivator, hand seeded, light raked, and rolled with a water-filled drum (estimate 30-40 pounds pressure) and immediately after seeding a tanker truck watered the plots. Some emergence, but essentially the plots failed due to lack of soil moisture and extre heat. **Reseeded: 11/9/07**: hand-seeded and rolled with water-filled drum.

ID07018 Oregon Trail Rest Area plots - three sets of plots. **Site preparation and seeding**: <u>Seeded: 4/11/07.</u> Plots were pre-sprayed with glyphosate 3/23/07 to kill existing weeds and grass; rototilled, hand raked, hand-seeded, light raked, rolled with water filled drum. These are irrigated plots. Two sets of plots were very successful, although infested with broad leaf weeds, saltgrass, and bristlegrass. The third set of plots was heavily infested with kochia, was not watered as frequently, and did not get cultivated as deeply due to malfunction of cultivator during site prep. Cooperator was treating successful plots with "Quicksilver," a broadleaf herbicide for new grass seedings. Plots were mowed in fall.

ID07019 Four Rivers Cultural Center plots – Plots were terminated 6/1/07 due to maintenance and watering problems, and problems with vandalism.

FIELD OFFICE: WEISER

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. FY04 – Cattle preference (cows were moved into filed 4 days prior to evaluation on 10/5/04). Most preferred species during this period was Bozoisky-Select Russian wildrye which was grazed very close. Second most preferred species was Goldar bluebunch wheatgrass which was grazed to a uniform 2 inch stubble height. Secar Snake River wheatgrass and Rush intermediate wheatgrass were not utilized. FY05 no evaluation. FY06 – observations in late June, grazing preference was Goldar bluebunch as first choice, Bozoisky-Select Russian wildrye as second choice, Rush intermediate as third and Secar as least desirable. Continue with this evaluation in 2007. **FY07 no evaluation - keep this as a viable planting and evaluate in 2008.**

ID96024 Howard 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. FY04 – good stands with good vigor for all species.

Production was approximately 0.7 AUMs per acre. FY05 - **FY07 no evaluation - keep this as a viable planting and evaluate in 2008.**

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. FY04 no evaluation. FY05 end of 4th growing season - peachleaf willow 90% survival with excellent vigor, 15 feet plant height, 10 feet crown width, 3 inch DBH. Golden willow 90% survival with very good vigor, 10 feet plant height, 6 feet crown width and 2 inch DBH. Peachleaf plants are more vigorous than golden willow, but in a slightly better site based on soil and moisture availability. Plants are protected from grazing by domestic livestock. FY06 evaluation – peachleaf willow 90 percent survival, excellent vigor, 22-25 feet tall, 15 feet crown width; golden willow 90 percent survival, good vigor, 11-12 feet tall, 8 feet crown widths. Evaluate again in 2007 to document a good record of the success of planting and growth rates. **FY07 no evaluation - keep this as a viable planting and evaluate in 2008.**

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 - FY05 - **FY07 - no evaluation - keep this as a viable planting and evaluate in 2008.**

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 - FY04 no evaluation. FY05 Mankota good stand and vigor with 24 inch plant height; Bozoisky good stand and vigor with 36 inch plant height; Goldar good stand and vigor with 26 inch plant height; Magnar poor stand with good vigor and 60 inch plant heights; Trailhead poor stand with good vigor and 60 inch plant heights. Cooperator states that Goldar is the first plant grazed each season and then Bozoisky and Mankota are utilized. Magnar and Trailhead are the last grasses utilized each season, but calves do utilized the basin wildrye stands for thermal cover. Both basin wildrye accessions are spreading into other plots. **Next evaluation FY08.**

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 - FY04 no evaluation. FY05 cooperator indicated that yields are up over previous years due to better rainfall this spring with 24-30 inch vegetative heights and seedheads up to 48 inches in height. The wetter areas of the field are primarily Garrison even in areas where it was not originally planted. The original planting was irrigated, but is no longer irrigated today and Garrison is going out of this area. Cooperator like Garrison as a forage species and would like to have in more of his pastures. Note: Garrison creeping foxtail requires full moisture either through irrigation and/or sub moisture conditions. It is very productive and a very high quality forage species if fully irrigated and if fertilized. You might consider recommending a fertility program to Mike if he wants to increase production. This planting is providing good information and should be maintained. **Next evaluation FY08.**

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 - FY04 no evaluation. FY05 Garrison is probably about 50% of the stand throughout field. Cooperator likes Garrison and said it is an excellent hay and grazable forage. Note: Garrison creeping foxtail requires full moisture either through irrigation and/or sub moisture conditions. It is very productive and a very high quality forage species if fully irrigated and if fertilized. You might consider recommending a fertility program to Gary if he wants to increase production. This planting is providing good information and should be maintained. **Next evaluation FY08.**

FIELD OFFICE: GOODING/FAIRFIELD
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 good stand and vigor – field produced 43 pounds per acre probably due to spring frost (May 19 - 16^0, May 20 – 21^0, June 23 – 26^0), low precipitation, and very hot summer. FY04 - good stand and vigor with field producing 90 pounds of clean seed per acre. Producer feels too much vegetative growth was produced this year due to spring rains hurt seed production. Producer plans to maintain stand for seed production one more year. FY05 Wet spring, dry summer and fall. Bill said about 150 pounds per acres clean seed on this field, up from 90 pounds last year. Sprayed with 2 pints/ac 2,4-D in mid June. No fertilizer. Bannock is first seed harvested on the Camas Prairie, about August 1. FY05 wet spring – harvested about 150 lb/ac clean seed on August 1. Field was sprayed with 2 pints/ac 2,4-D in mid June, field was not fertilized. FY06 no evaluation. **FY07** Bill Simon said the Bannock stand did not produce seed heads this year. Early dry spring and early freezes may have hurt seed production. Stand is also getting old and interspace rows are filled in due to rhizomatous spreading. Bill cut this 41 stand for hay about July 20 (unknown production). Recommend planting be **cancelled**.

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 - FY04 seed not planted due to extreme drought. Cooperator plans to plant fall 2004. FY05 Planting Site 1: Seed again not planted. Dan said he still wants to drill the Magnar next spring (2006) in the planned site (Planting Site 1). Said site in 2005 was too dry. As of 1/10/06 site is under flood waters. Moisture should be good for spring 2006 planting. He said he will drill seed in spring 2006. **FY07** Dan has not planted the Magnar yet on account of other farming activities, but still wants to keep the seed and says he will try to get it planted this fall (2007).

D02015 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 - FY04 seed not planted due to drought and field change. Seeding planned for spring 2005. FY05 905439 and Blackwell switchgrass seeded on different halves of same field via Brillion drill on July 4, 2006. Late drilling was to favor establishment of warm season switchgrass over the cool season grasses which dominate the mix. Due to round smooth small seeds both switchgrass varieties added by hand into small seed box on Brillion as field was being drilled. Large seed box contained mixture of Bannock thickspike wheatgrass, Alkar tall wheatgrass, Rush intermediate wheatgrass, Eski sainfoin, and Delar small burnet. Site was smooth and firm prior to drilling. Much seed after drilling was not adequately covered by Brillion press wheels. Field was therefore harrowed after drilling, all seed thereafter covered. Irrigated immediately and for remainder of season. Young redroot pigweeds dominating by end of July, killed with 0.5 pint/ac LV-4 (2,4-D). Some sainfoin germinated by then but not affected by LV-4. Sainfoin well respresented by end of season. Bannock germinated within 7 days of seeding, was main planned grass at end of season. Other species in mix including switchgrass appeared to remain dormant this first season. Site dominated by bristlegrass this first year (Setaria), should diminish or disappear in 2006. Evaluate in 2006 growing season. Site was seeded for permanent nesting habitat. **FY07** switchgrass planting failed - **Cancel.**

ID07006 Hugh Koonce field planting. Sodar streambank wheatgrass was ordered November 13, 2006 for critical area planting seeding. Seed will be dormant broadcast planted between November and January and harrowed to incorporate seed. Site characteristics: clay loam to silt loam soil, 5,000 feet elevation 2-6 percent slopes, 12 – 16 inch precipitation. **FY07** no evaluation.

FIELD OFFICE: JEROME
None

FIELD OFFICE: RUPERT
None

FIELD OFFICE: SHOSHONE/HAILEY
None

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. FY04 stands were mowed in June and inadequate moisture was available for regrowth. Wytana fourwing saltbush and Snake River Plains fourwing saltbush are becoming more evident with scattered plants throughout plantings 3 and 4. Mowing is keeping the fourwing saltbush short, but does not appear to be killing the shrubs. FY05 this is the first year of above normal spring moist since plantings were installed. Planting 1: good stand of Vavilov (2-3 plants/ft^2), Bozoisky (2 plants/ft^2) and alfalfa (< 1 plant/ft^2) and good vigor for grasses and poor vigor for alfalfa. Planting 2: good stand of Hycrest (3 plants/ft^2) and thickspike (2 plants/ft^2). Wytana fourwing saltbush and Snake River Plains fourwing saltbush are becoming more evident and plants are larger than last year throughout the older plantings 3 and 4. FY06 and FY07 no evaluation.

ID02009 Shoshone Creek Riparian Planting – Rob Rogerson. 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. FY04 9067549 peachleaf willow failed, 9067541 peachleaf willow 24 percent survival with fair vigor, 9067560 peachleaf willow not evaluated, native willows 100 percent survival with good vigor. FY05 9067541 28% survival with good vigor and 18 inch height; 9067549 10% survival with good vigor and 24 inch height; 9067560 failed; native Planeleaf willow 100% survival with good vigor and 24 inch height. FY06 and FY07 no evaluation.

ID03001 Walt Coiner Field Planting. Purpose: Field Planting - windbreak interspace perennial cover/weed control study - irrigated-semi irrigated-dryland trials. Seed was ordered on September 17, 2002. 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; and Quatro sheep fescue. **Dryland species:** Vavilov Siberian wheatgrass; Rosana western wheatgrass and Bozoisky Russian wildrye. FY03 initial evaluation August 20, 2003. FY04 evaluation September 13, 2004. FY05evaluation August 11, 2005 following well above average spring moisture. FY07 no evaluation.

	Stand				Vigor			
Species	2003	2004	2005	2006	2003	2004	2005	2006
Irrigated Perennial Cover								
Sherman big bluegrass	good	fair	fair	fair	exc.	fair	exc.	exc.
Talon Canada bluegrass	good	exc.	exc.	exc.	exc.	exc.	exc.	exc.
Foothills C. bluegrass	exc.	exc.	exc.	exc.	exc.	exc.	exc.	exc.
Durar hard fescue	fair	exc.	fair	good	exc.	exc.	fair	good
Semi-Irrigated Perennial Cover								
Covar sheep fescue	poor	fair	good	good	fair	good	exc.	exc.
Quatro sheep fescue	poor	good	exc.	good	fair	good	exc.	exc.
Newhy hybrid wheatgrass	poor	failed	fair	fair	fair	v. poor	good	good
Roadcrest c. wheatgrass	good	fair	poor	poor	good	good	good	fair
Ephraim c. wheatgrass	exc.	fair	exc.	exc.	good	fair.	exc.	exc.
Sodar s. wheatgrass	good	poor	poor	poor	fair	poor	poor	poor
Paiute orchardgrass	fair	fair	fair	fair	fair	fair	fair	fair
Dryland Perennial Cover								
Vavilov S. wheatgrass	good	exc.	exc.	good	good	exc.	exc.	good
Bozoisky R. wildrye	poor	v. poor	good	good	fair	poor	good	good
Sherman big bluegrass	v. poor	v. poor	good	good	poor	v. poor	good	good
Rosana w. wheatgrass	fair	good	exc.	exc.	good	good	exc.	exc.

Recommendations based on four evaluation years

Irrigated – Talon Canada bluegrass and Foothills Canada bluegrass are best fully irrigated choices.

Semi-irrigated – Ephraim crested wheatgrass and the good dryland species Vavilov, Rosana, Bozoisky.

Dryland – Vavilov Siberian wheatgrass mixed with Rosana western wheatgrass or Bozoisky.

ID04003 Steve Schuyler field planting – windbreak. Siouxland poplar, Carolina poplar, Golden willow and Laurel willow cuttings. Cuttings ordered January 12, 2004. Site characteristics: 0-1 percent slope, north aspect, 8-10 inch precipitation zone, irrigated-gravity, Portneuf silt loam soil. Planted April 10, 2004 – weed barrier fabric was installed – planting protected with snow fence along west edge. FY04 survival and height - 91 percent – 35 inches Laurel willow, 42 percent – 6 inches Carolina poplar, 82 percent – 42 inches Golden willow, 0 percent Siouxland poplar. FY05 replacements ordered February 22nd 10 golden willow, 25 Carolina poplar, and 5 Laurel willow. Evaluation August 11, 2005- Laurel willow 94% survival with excellent vigor, 8 feet height and 5 feet crown width; Carolina poplar 58% survival with excellent vigor, 9.3 feet height and 7.5 feet crown width; Golden willow 82% survival with excellent vigor, 9.5 feet height and 11 feet crown width.; Siouxland poplar failed. FY06 and FY07 no evaluation.

ID04006 Dickenson 319 riparian woody planting. Laurel willow, golden current, Wood's Rose, redosier dogwood, Siberian peashrub, coyote willow, golden willow, chokecherry, blue spruce, and Austrian pine. Plantings are protected from grazing and grass is mowed around pines, spruce, juniper and sumac.
FY04 planted in May 2004. Plantings are protected from grazing with a fence and arranged in clumps (copses) for natural appearance. Laurel willow 92 percent survival, excellent vigor, 24-36 inch height. Golden current 100 percent survival, excellent vigor, and 18-24 inch height. Wood's rose 100 percent survival, excellent vigor, and 18-24 inch height. Redosier dogwood 60 percent survival, fair vigor, and 18-24 inch height. Siberian peashrub 100 percent survival, excellent vigor, and 18-24 inch height. Coyote willow 80 percent survival, good vigor and 12-48 inch height. Golden willow 100 percent survival, excellent vigor and 72 inch height. Chokecherry 23 percent survival, poor vigor and 36 inch height. Blue spruce 73 percent survival, good vigor and 36 inch height. Austrian pine 100 percent survival,

excellent vigor and 36 inch height. FY05 evaluation August 11, 2005- Laurel willow 100% survival, excellent vigor, 4-8 feet height and 2 feet crown width; Golden current 92% survival, excellent vigor, 4 feet height and 2.5 feet crown with; Wood's rose 100% survival, excellent vigor, 2.5 feet height and 3 feet crown width; Redosier dogwood 83% survival, excellent vigor, 4 feet height and 2 feet crown width; Siberian peashrub 12% survival, very poor vigor; Coyote willow 33% survival, good vigor, 5 feet height and 0.5 feet crown width; Golden willow 90% survival, excellent vigor, and 6 feet height; chokecherry 27% survival, fair vigor and 4.4 feet height; blue spruce 73% survival, fair vigor and 4.5 feet height; Austrian pine 100% survival, excellent vigor and 4.6 feet height; Rocky Mountain juniper 100% survival, excellent vigor and 14 inch height; Skunkbush sumac 80% survival, good vigor and 2 feet height. FY06 and FY07 no evaluation.

ID05002 Perinne Coulee 319 Project riparian planting. Redosier dogwood (accessions 9023733, 9023739 and 9023740), Laurel willow and Peachleaf willow (accessions (9067375, 9067376, 9067541, 9067546, 9067549 and 9067560) cuttings were ordered February 4, 2005. Planted spring 2005. Survival and identification difficult in 2005. FY06 and FY07 no evaluation.

ID05011 Twin Falls County – Rock Creek Park critical area field planting. Regar meadow brome, Topar pubescent wheatgrass, Bannock thickspike wheatgrass, Snake River Plains fourwing saltbush, Rosana western wheatgrass, pryor slender wheatgrass and Garrison creeping foxtail were ordered March 14, 2005. Site characteristics: silt loam soil, 2 percent slopes, NW aspect, 3600 feet elevation, 12 in rainfall zone, non-irrigated (riparian – sub irrigated), T10S R17E SW ¼ Section 8. Twin Falls county coordinator said only a small amount of seed was planted in 2005. FY06 and FY07 no evaluation.

ID06006 Twin Falls Co. Riparian Projects. Woody field planting. Simon poplar (30), Peachleaf willow – Caribou Source (20), Peachleaf willow – Pocatello Source (20), Coyote willow (120), Golden willow (20), Laurel willow (20), White willow (20), Redosier dogwood – Harrington Source (50), Redosier Dogwood – Cheney Source (50) and Redosier dogwood – Wallowa Source (50). Cuttings ordered February 2, 2006. FY06 and FY07 no evaluation.

ID07021 Twin Falls Centennial Park field planting. Regar meadow brome, Sodar streambank wheatgrass, Bannock thickspike wheatgrass, Garrison creeping foxtail, Jose tall wheatgrass and Largo tall wheatgrass seed was ordered April 20, 2007. April 23 was informed Jose is not available. FY06 and FY07 no evaluation.

IDAHO DIVISION V
PLANT MATERIALS PLANTINGS

FIELD OFFICE: AMERICAN FALLS/ABERDEEN
ID07022 Wynn Farms Magnar basin wildrye demonstration planting. Seed ordered April 12, 2007. Seed shipped April 13, 2007. FY07 no evaluation.

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. FY03 evaluated 12/9/03. FY04 evaluated and clipped 6/23/04. FY05 - FY07 no evaluations. See attached tables at end of this section.

FIELD OFFICE: FORT HALL
ID03002 Shoshone-Bannock Tribe Demonstration Planting. Nezpar Indian ricegrass, Goldar bluebunch wheatgrass, Magnar basin wildrye, Sodar streambank wheatgrass, High Plains Sandberg bluegrass, and Sherman big bluegrass seed was ordered September 30, 2002. Planting completed early November 2002. FY03 no evaluation. FY04 Nezpar Indian ricegrass excellent stand and vigor with 24 inch height. Goldar bluebunch wheatgrass excellent stand and vigor with 24 inch height. Magnar basin wildrye excellent stand with good vigor and 36 inch height. Sodar streambank wheatgrass excellent stand and vigor with 30 inch height. Sherman big bluegrass good stand with good vigor and 30 inch height. Very poor stand and vigor with 8 inch height (only 3 plants came up – seed may have been buried too deep). FY05 evaluation June 15, 2005. Magnar excellent stand, 98% survival, excellent vigor and 48 inch height; Nezpar good stand, 90% survival, good vigor and 36 inch height; Goldar good stand, 95% survival, good vigor and 42 inch height; Sodar excellent stand, 98% survival, excellent vigor and 42 inch height; Sherman excellent stand, 98% survival, excellent vigor and 38 inch height; High Plains failed and will be replanted next year and irrigated for establishment. **FY06** excellent stands of Goldar bluebunch wheatgrass and Magnar basin wildrye, good stands of Sodar streambank wheatgrass, and Sherman big bluegrass, fair stand of Nezpar Indian ricegrass and High Plains Sandberg bluegrass failed. **FY07** no evaluation.

ID06010 Shoshone Bannock Tribe – ShoBan High School common camas field planting. FY06 Tribal members collected bulbs from the Camas Prairie near Fairfield in Camas County. The bulbs were planted about 4 inches deep in the native garden behind the field office and also near the constructed wetland at the ShoBan Jr./Sr. High School. Plantings are being heavily watered. FO– 1 plant/ft2; School– 1 plant/hole approximately 10-15 feet apart. **FY07** Planted 36 bulbs in the garden and all but 3 came up - 4 or 5 flowered and form seed pods. We are currently waiting for the seed to ripen so we can gather them and hopefully get some growing from seed.

FIELD OFFICE: MALAD
None

FIELD OFFICE: MONTPELIER
None

FIELD OFFICE: POCATELLO
None

FIELD OFFICE: PRESTON
None

FIELD OFFICE: SODA SPRINGS
ID05001 Michael Tingey – Irrigated forages Demonstration Plots. Latar orchardgrass, Regar meadow brome, Cache meadow brome, Paiute orchardgrass, Garrison creeping foxtail, Rush intermediate wheatgrass, Bozoisky Russian wildrye, 905439 switchgrass, Blackwell switchgrass and Lutana cicer milkvetch seed was ordered February 4, 2005. SCD/Cooperator Supplies the following: Paddock meadow brome, Forager alfalfa, Kemal festolium, Potomic

orchardgrass, Rebound meadow brome, Fuego tall fescue, Tekapo orchardgrass, Mara perennial ryegrass, Barliza timothy, Pradel meadow fescue, Barloex tall fescue, Bariane tall, fescue, Barcell tall fescue, Baridana orchardgrass, Hakari Alaska brome, Birdsfoot trefoil, Sainfoin, Sorgam, Grazing corn, Lakota prairie brome and Alice white clover. Site characteristics: 0.8 acres, MLRA B13, Rexburg-Ririe silit loam soil complex, 1-4 percent slopes, north aspect, elevation 5140 feet, 12-14 inch precipitation, irrigated, T11S R41E SW ¼ section 19. Planted in late spring 2005 due to persistent rainfall that did not allow earlier final land preparation and planting. No evaluation FY06 and FY07.

Species	**Percent Stand**			**Vigor**			**Height**		
	2005	**2006**	**2007**	**2005**	**2006**	**2007**	**2005**	**2006**	**2007**
Kura Clover	0			0			0		
Forager alfalfa	exc.			good			24”		
Lutana cicer milkvetch	good			good			6”		
Alice white clover	poor			fair			4-6”		
Birdsfoot trefoil	fair			good			3”		
Eski sainfoin	good			good			12”		
Baridana orchardgrass	poor			good			16”		
Tekapo orchardgrass	fair			good			12”		
Paiute orchardgrass	poor			fair			12”		
Latar orchardgrass	poor			fair			12”		
Potomic orchardgrass	fair			good			12”		
Satin orchardgrass	poor			good			8”		
Renagade orchardgrass	fair			good			18”		
Rebound meadow brome	good			good			24”		
Cache meadow brome	fair			good			30”		
Regar meadow brome	fair			good			12”		
Lakota prairie brome	good			exc.			36”		
Hakari Alaska brome	85			exc.			12”		
Seine tall fescue	30			good			24”		
Johnstone tall fescue	20			good			18”		
Bronson tall fescue	50			good			24”		
Bariane tall fescue	35			good			12”		
Dovy tall fescue	50			good			18”		
Pradel tall fescue	50			good			12”		
Garrison creeping foxtail	10			fair			12”		
Rush intermediate whtgrs	40			fair			6”		
Bozoisky Russian wildrye	35			poor			4”		
Kemal festolium	90			exc.			24”		
Mara perennial ryegrass	85			good			8”		
Barliza timothy	5			poor			4”		
Outlaw timothy	5			poor			8”		
Blackwell switchgrass	15			fair			18”		
9005439(MT) switchgrass	5			fair			8”		
Garrison sorgum-sudan	90			good			54”		

ID05012 Don Ayers – herbaceous windbreak field planting. Magnar basin wildrye seed ordered March 15, 2005. Site Characteristics: Lantonia-Chinahat silt loam soil, 1-4 percent slopes, 5983 feet elevation, 14-16 inch precipitation, non-irrigated, T8S R41E NW ¼ Section 24. FY05 Two of the four rows had good emergence and two rows had very poor emergence. Ground preparation was much better in rows that the best emergence. Plants that emerged have grown well and look very healthy - fair stand with 4 plants/ft^2, good vigor and 4 inch height. Several more plants emerged in the fall. **FY06** planting was accidentally tilled and destroyed – cooperator plans to replant.

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. FY04- FY06 no evaluations. **FY07** Vavilov Siberian wheatgrass good stand with good vigor - 2 plants per feet squared; Bannock thickspike wheatgrass good stand with good vigor - 2 plants per feet squared; Bozoisky Russian wildrye poor stand with fair vigor - trace plants per feet squared; Snake River Plains fourwing saltbush failed; Bighorn skunkbush sumac – failed.

FIELD OFFICE: DRIGGS
None

FIELD OFFICE: IDAHO FALLS
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. FY04 – excellent stand and vigor for each accession. No seed production reported. FY05 Venus penstemon – good stand and good vigor – no seed production reported. Firecracker penstemon stand was plowed out. FY06 excellent stand and vigor. FY07 Richfield firecracker penstemon - fair stand with fair vigor – no seed production; Clearwater Venus penstemon – excellent stand with excellent vigor – 75 pounds per acre cleaned.

ID03007 Winterfeld San Juan fuzzytongue penstemon - Demonstration planting. Seed ordered February 10, 2003. Seed shipped February 18, 2003. FY03 not planted. FY04 planted with poor stand establishing. FY05 replanted October 26, 2005. FY06 fair stand establishing with 2 plants/ft2. FY07 fair stand with fair vigor – still establishing with primarily rosettes this year - no seed production.

ID04015 Winterfeld Maple Grove Lewis flax for seed increase. Seed shipped April 19, 2004. FY04 excellent stand with excellent vigor establishing. Plants are about 5 inches tall. FY05 good stand, good vigor and plants are about 24 inches tall. Lighter in color than Appar and not as good a competitor with severe weed competition in stand. No seed production reported. FY06 good stand with good vigor – seed production was not reported. FY07 Fair stand with fair vigor – little to no seed production.

ID05015 Winterfeld Pryor slender wheatgrass for seed increase. Seed shipped May 2, 2005. FY05 no evaluation. FY06 excellent stand with excellent vigor - seed production not reported. FY07 excellent stand with excellent vigor – 320 pounds per acre cleaned seed production.

ID07003 Winterfeld Appar blue flax for seed increase. Seed shipped September 26, 2006. FY07 excellent stand with excellent vigor – establishment year – no seed production – clipped weed 3 times this season.

ID07004 Winterfeld Sodar streambank wheatgrass for Foundation seed increase. FY07 planting failed. **Cancel**

ID07011 Winterfeld Bannock thickspike wheatgrass for seed increase. Seed shipped March 5, 2007. FY07 fair stand with fair vigor establishing – no seed this year.

ID07012 Winterfeld Regar meadow brome for seed increase. Seed shipped March 1, 2007. FY07 excellent stand with excellent vigor – establishment year – no seed production.

ID07013 Winterfeld Magnar basin wildrye for seed increase. Seed shipped March 1, 2007. FY07 planting failed. **Cancel**

ID07014 Winterfeld Goldar bluebunch wheatgrass for seed increase. Seed shipped March 1, 2007. FY07 did not plant.

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. FY05 There is a good stand of native bluebunch wheatgrass, Sandberg bluegrass and Indian ricegrass near west fence-line producing about 750 pounds per acre. The disced and seeded stand near west fence has a good stand of crested wheatgrass with about 5 percent sagebrush invasion and producing about 1000 pounds per acre. The ripped, disced and seeded area has an excellent stand of primarily Nordan crested wheatgrass and Bozoisky Russian wildrye with 3-4 plants per square foot, excellent vigor and producing about 1300 pounds per acre this year. P27 Siberian wheatgrass, greenar intermediate wheatgrass and Trevois alfalfa are present, but in much lower amounts. **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. FY05 the Bozoisky Russian wildrye stand is maintaining very well with approximately 3 plants per square foot, excellent vigor and production about 1200 pounds per acre. Cattle seek out this species year around according to cooperator. **Next evaluation 2008.**

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. FY05 Plot 1: good stand with 2 plants per square foot - Bozoisky Russian wildrye 100% survival, Regar meadow brome failed, Trevois alfalfa 50% survival; stand producing about 1300 pounds per acre. Cattle and elk are utilizing the stand at about 60 percent utilization on Bozoisky and 30 percent utilization on alfalfa. Plot 2: excellent stand with 3 plants per square foot – Bozoisky 100 percent survival and Trevois 50 percent survival; stand is producing about 1700 pounds per acre; Cattle and elk are utilizing stand with about 85 percent utilization on Bozoisky and 30 percent utilization on alfalfa. Plot 3; fair stand of Critana thickspike wheatgrass with 9 plants per square foot and fair vigor; stand is producing about 700 pounds per acre. Cattle and elk are not utilizing this plot. Plot 4: good stand of Luna pubescent wheatgrass with good vigor and 5 plant per square foot; stand is producing about 1700 pounds per acre; Cattle and elk are not utilizing this stand. **Next evaluation 2008**.

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. **FY07** Very similar evaluation to FY03 evaluation – 100% survival for all species; Carolina poplar – height 55 feet – crown width 20 feet - sparsely branched partially due to shading by surrounding trees; Siouxland poplar – height 55 feet - crown width 19 feet - sparsely branched, good height, not filling in, tall and skinny; Robusta poplar – height 45 feet - crown width 20 feet - good growth, sparsely branched, lots of trunk with no limbs, galls on branches; White willow – height 30 feet - crown width 17 feet - lots of dead branches; Laurel willow – height 20 feet - crown width 12 feet -some dead branches; Coyote willow – height 25 feet - crown width 16 feet - lots of dead branches. **Cancel**

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. **FY07** Very similar evaluation to FY03 evaluation – 100% survival for all species; Carolina poplar – height 20 feet – crown width 11 feet; Siouxland poplar – height 37 feet - crown width 13 feet – excellent new growth – health vigor good; Robusta poplar – height 10 feet - crown width 4 feet – doing very poorly – little new growth – poor health and vigor. **Cancel**

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. **FY06** excellent stand of Rush with 4-5 plants/ft2 and excellent vigor. Plant height is 40- 60 inches and production is 2.5- 3.0 tons/acre. Stand is now 8 years old and is thick and healthy. **FY07** excellent stand, 6 plants per square feet, good vigor, 40-48 inch height, 3.15 tons/acre. **Next evaluation 2010.**

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, 9/99, 5/21/03 and 7/25/07. FY07 evaluation by Dan Ogle, Mark Olson and Nate Matlack - **Next evaluation FY10**.

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, 9/99, 5/21/03 and 7/25/07. FY07 evaluation by Dan Ogle, Mark Olson and Nate Matlack - **Next evaluation FY10**.

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

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. Evaluated 5/21/03. Evaluated 7/24/07 by Dan Ogle, Mark Olson and Nate Matlack - **Next evaluation FY10**.

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, 9/99, 5/20/03 and 7/25/07. FY07 evaluation by Dan Ogle, Mark Olson and Nate Matlack - **Next evaluation FY10**.

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, 9/99 5/19/03 and 7/24/07. FY07 evaluated by Dan Ogle, Mark Olson and Nate Matlack - **Next evaluation FY10**.

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, 9/99, 5/19/03 and 7/23/07. FY07 evaluated by Dan Ogle, Mark Olson and Nate Matlack - **Next evaluation FY10**.

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. Evaluated 7/7/92, 5/19/03 and 7/23/07. FY07 evaluation by Dan Ogle, Mark Olson and Nate Matlack - **Next evaluation FY10**.

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.

ID08001 Shiner Ranch Field Planting. Vavilov II Siberian wheatgrass seed ordered 9/27/07 and shipped 10/4/07 for November dormant planting.
Seed mixture 1 (5 ac): Vavilov II Siberian wheatgrass, Bozoisky Russian wildrye, falcata alfalfa;
Seed mixture 2 (75 ac): Vavilov Siberian wheatgrass, Bozoisky Russian wildrye, falcata alfalfa
Site Characteristics: Leadore gravelly loam soil, 2-6 % slope. South aspect, 5,600 feet elevation, 8-12 inch rainfall, non-irrigated, T17N R24E NE1/4 Section 2.

FIELD OFFICE: ST. ANTHONY
ID06009 John Taft – Henrys Lake WRP. Field planting of 100 Engelmann spruce and 100 quaking aspen. Planting completed June 20 and 21, 2006 at 7 separate locations. One gallon potted plants; Engelmann spruce - 3 feet tall and quaking aspen 4- 5 feet tall; were planted using a skid steer with mounted 10 inch auger to dig holes. Each tree was planted by hand, pressed in by foot pressure and watered with bucket following planting. Hydrology – soil moisture varied from saturated locations near ponds at south end of project to field capacity at ponds at north end of project.

FY07 Spruce – survival is poor with approximately 20% survival overall. Top growth die back is common with approximately half of the surviving plants green near base, but dead above. These are expected to die. Approximately 15 plants throughout entire WRP site show fair to good bud growth. Winter was open and plants were exposed most of winter – this may have resulted in top growth injury. Spring moisture since March has been very poor resulting in drought injury. Spruce is doing best in sites with saturated conditions. On sites that are drier and better drained, spruce is struggling.

FY07 Aspen – survival is good with approximately 50% survival overall. Top growth die back is common with approximately half of the surviving plants leafing along stem and about half sprouting from the base. Winter was open and plants were exposed most of winter – this may have resulted in top growth injury. Spring moisture since March has been very poor resulting in drought injury. Aspen is doing best in sites with very good soil moisture to saturated conditions. On site that are drier and better drained, aspen is struggling.
Site 1 birm near pond - was the only location where wildlife use was evident – probably moose.
Site 2 birm near pond

Site 3 wetland near road junction – aspen are in nearly standing water (water table within 6 inches of surface)
Site 4 upland just across bridge on right side of road
Site 5 upland to east of ponds on south end of property
Site 6 wetlands near ponds on south end of property

BLACKFOOT FIELD OFFICE
PAUL RICKS PLOTS - FIELD PLANTING – ID02006
(Evaluated by – Scott Engle/Cameron Williams/Karie Pappani/Dan Ogle – June 22-23, 2004)
Irrigated Plots (Approximately 28 to 32 inches of combined precipitation and irrigation)

Common Name	Cultivar	FY02 12/9/03 Initial Est. 2nd Year	FY04 Stand	FY04 Vigor	FY04 Spread	FY04 Weeds	FY04 6/23/04 Growth Stage	FY04 6/23/04 Lbs/Ac
Alfalfa	Forager	good	fair	good	N/A	low	harvested	---
Ladino clover	Jumbo	fair	good	good	N/A	moderate	harvested	---
Alfalfa	Rampage	good	good	excellent	N/A	low	harvested	---
Alice clover	---	good	good	good	N/A	moderate	harvested	---
Alfalfa	Rowdy	excellent	good	good	N/A	low	harvested	---
Cicer milkvetch	Lutana	poor	fair	fair	N/A	high	harvested	---
Alfalfa	Ranger	fair	good	fair	N/A	low	harvested	---
Kura clover	Endura	poor	poor	good	N/A	high	harvested	---
Birdsfoot trefoil	Bull	fair	excellent	good	N/A	moderate	harvested	---
Perennial ryegrass	Mara	good	excellent	poor	N/A	none	pre bloom	1550
Tall fescue	Fawn	good	good	fair	N/A	low	bloom	1920
Orchardgrass	Latar	good	good	fair	N/A	none	bloom	3180
Tall fescue	Johnstone	good	good	fair	N/A	none	bloom	3480
Orchardgrass	Potomic	good	good	good	N/A	none	bloom	3420
Tall fescue	Teton	good	good	good	N/A	none	bloom	4620
Orchardgrass	Baridana	excellent	excellent	good	N/A	none	bloom	2580
Tall fescue	Dovey	excellent	good	fair	N/A	none	bloom	2100
Orchardgrass	Paiute	good	good	good	N/A	none	bloom	2760
Tall fescue	Barcel	good	good	fair	N/A	none	bloom	2460
Meadow brome	Regar	good	excellent	good	low	none	bloom	2880
Tall fescue	Barcarella	good	good	good	N/A	none	bloom	3660
Meadow brome	Rebound	excellent	excellent	good	none	none	bloom	3480
Tall fescue	TF33	good	good	good	N/A	low	bloom	2940
Meadow brome	Paddock	good	excellent	good	none	none	bloom	3360
Meadow fescue	Bartura	good	good	good	N/A	low	bloom	3060
Timothy	Climax	fair	fair	good	N/A	moderate	bloom	2760
Mountain brome	Hakari	excellent	excellent	good	N/A	none	bloom	3240
Timothy	Barliza	poor	fair	good	N/A	high	bloom	2400
Switchgrass	9005438	good	good	good	N/A	moderate	vegetative	1500
Switchgrass	Blackwell	good	good	good	N/A	moderate	vegetative	2650
Switchgrass	9005439	good	fair	good	N/A	high	vegetative	3500
Sunflower	Multimedia	fair	fair	good	N/A	high	vegetative	900
Russian wildrye	Bozoisky	good	excellent	excellent	N/A	none	bloom	6200

Semi-Irrigated Plots
(Approximately 18 inches of combined precipitation and irrigation)

Common Name	Cultivar	FY02 12/9/03 Initial Est. 2nd Year	FY04 Stand	FY04 Vigor	FY04 Spread	FY04 Weeds	FY04 6/23/04 Growth Stage	FY04 6/23/04 Lbs/Ac
Alfalfa	Forager	good	good	good	N/A	low	harvested	---
Sainfoin	Eski	fair	good	good	N/A	moderate	harvested	---
Alfalfa	Rampage	good	fair	good	N/A	low	harvested	---
Sainfoin	Remont	fair	good	good	N/A	moderate	harvested	---
Alfalfa	Rowdy	good	excellent	excellent	N/A	low	harvested	---
Small burnet	Delar	fair	poor	fair	N/A	very high	harvested	---
Alfalfa	Trevois	good	good	good	N/A	moderate	harvested	---
Blue Flax	Appar	poor	fair	good	N/A	very high	harvested	---
Alfalfa	Ladak	good	good	good	N/A	low	harvested	---
Utah sweetvetch	Timp	poor	very poor	fair	N/A	very high	harvested	---
Western Yarrow	9057902	poor	poor	fair	N/A	very high	harvested	---
Ruby V. pointvetch	9063520	poor	failed	---	---	---	---	---
Western wheatgrass	Arriba	fair	good	good	excellent	low	bloom	4020
Western wheatgrass	Rosana	fair	excellent	fair	excellent	none	bloom	2880
Orchardgrass	Paiute	fair	good	good	N/A	low	bloom	4140
Mountain brome	Bromar	excellent	excellent	good	N/A	none	bloom	4900
Pubescent wheatgrass	Luna	good	good	good	fair	none	bloom	4410
Mountain brome	Garnet	good	good	fair	N/A	low	bloom	3080
Thickspike wheatgrass	Bannock	poor	poor	fair	none	high	bloom	1680
Crested wheatgrass	Douglas	very poor	poor	good	N/A	very high	bloom	3600
Thickspike wheatgrass	Critana	poor	fair	good	fair	moderate	bloom	3540
Smooth brome	Manchar	fair	good	excellent	fair	none	bloom	3780
Thickspike wheatgrass	Schwendimar	fair	fair	fair	poor	high	bloom	3420
Green needlegrass	Lodorm	fair	fair	good	N/A	high	bloom	2220
Intermediate wheatgrass	Reliant	excellent	good	good	poor	none	bloom	5160
Hybrid wheatgrass	Newhy	good	excellent	excellent	fair	none	bloom	4740
Intermediate wheatgrass	Rush	good	excellent	good	fair	none	bloom	5040
Big bluegrass	Sherman	poor	poor	good	N/A	moderate	bloom	4900
Intermediate wheatgrass	Greenar	good	good	good	fair	none	bloom	5340
Russian wildrye	Bozoisky	good	good	good	N/A	none	bloom	5250
Intermediate wheatgrass	Tegmar	good	good	fair	fair	none	bloom	3720
Canada bluegrass	Foothills	poor	poor	good	good	very high	bloom	2880
Hybrid wheatgrass	SL	fair	poor	poor	N/A	high	bloom	2280
Tall wheatgrass	Largo	good	excellent	poor	N/A	none	s. dough	3760

RS Hoffman wheatgrass	---	poor	fair	good	very poor	moderate	bloom	1740
Slender wheatgrass	San Luis	fair	good	fair	N/A	low	bloom	1800
Slender wheatgrass	Pryor	fair	good	good	N/A	low	bloom	1560
Tall wheatgrass	Alkar	fair	good	good	N/A	low	bloom	3120
Canada wildrye	Mandan	fair	fair	good	N/A	moderate	pre-bloom	950
Basin wildrye	Magnar	poor	poor	fair	N/A	very heavy	bloom	840
Idaho fescue	Joseph	poor	very poor	poor	N/A	very heavy	bloom	600
Basin wildrye	Trailhead	poor	fair	fair	N/A	very heavy	bloom	900
Russian wildrye	Mankota	fair	good	fair	N/A	low	bloom	4140
Bluebunch wheatgrass	Goldar	poor	very poor	fair	N/A	very high	bloom	---
Russian wildrye	Syn A	fair	good	good	N/A	low	bloom	3060

Dryland Plots (Irrigated Establishment Year – 10 to 12 inch rainfall zone)

Common Name	Cultivar	FY02 12/9/03 Initial Est. 2nd Year	FY04 Stand	FY04 Vigor	FY04 Spread	FY04 Weeds	FY04 6/23/04 Growth Stage	FY04 6/23/04 Lbs/Ac
Alfalfa	Forager	fair	fair	good	N/A	high	harvested	---
Beardless wheatgrass	Whitmar	very poor	very poor	poor	N/A	very high	harvested	---
Alfalfa	Rampage	good	good	good	N/A	moderate	harvested	---
Forage Kochia	Immigrant	poor	fair	good	N/A	high	harvested	---
Alfalfa	Rowdy	good	good	good	N/A	moderate	harvested	---
Indian ricegrass	Rimrock	poor	fair	fair	N/A	high	harvested	---
Alfalfa	Trevois	fair	excellent	good	N/A	moderate	harvested	---
Indian ricegrass	Nezpar	poor	fair	fair	N/A	high	harvested	---
Alfalfa	Ladak	fair	good	fair	N/A	moderate	harvested	---
Siberian wheatgrass	P-27	fair	fair	good	N/A	moderate	bloom	2580
Snake R. wheatgrass	Secar	poor	poor	fair	N/A	high	s. dough	900
Siberian wheatgrass	Vavilov	fair	excellent	excellent	N/A	very low	bloom	4500
Western wheatgrass	Arriba	fair	good	good	excellent	moderate	bloom	2640
Western wheatgrass	Rosana	fair	good +	good	excellent	low	bloom	3750
Crested wheatgrass	Nordan	poor	fair	good	N/A	high	bloom	3500
Streambank wheatgrass	Sodar	fair	good	good	good	moderate	bloom	2240
Pubescent wheatgrass	Luna	good	excellent	good	fair	very low	s. dough	3120
Crested wheatgrass	Ephraim	poor	fair	good	none	low	bloom	2380
Thickspike wheatgrass	Bannock	fair	good	good	good	moderate	bloom	3080
Crested wheatgrass	Hycrest	good	excellent	good	N/A	none	bloom	3640
Thickspike wheatgrass	Critana	good	good	good	fair	very low	bloom	2170
Crested wheatgrass	CD-II	good	excellent	excellent	N/A	none	bloom	3290
Thickspike wheatgrass	Schwendimar	fair	fair	good	fair	moderate	bloom	1575

Basin wildrye	Magnar	poor	poor	good	N/A	high	bloom	910
Sandberg bluegrass	High Plains	very poor	very poor	fair	N/A	very high	curing	975
Basin wildrye	Trailhead	poor	poor	good	N/A	high	bloom	1330
Bottlebrush Squirreltail	9019219	poor	poor	good	N/A	very high	s. dough	1170
Russian wildrye	Mankota	good	good	good	N/A	low	bloom	2240
Bluebunch wheatgrass	Goldar	poor	very poor	good	N/A	very high	bloom	350
Russian wildrye	Bozoisky	good	good	good	N/A	moderate	bloom	2380
Winterfat	Open Range	very poor	very poor	good	N/A	very high	bloom	---
Fourwing saltbush	S.R. Plains.	fair	fair	good	N/A	very high	vegetative	---
Winterfat	N. C. D.	very poor	fair	good	N/A	very high	bloom	---

PLANT MATERIALS

2007

UTAH EVALUATION SUMMARIES

FIELD, SEED INCREASE and DEMONSTRATION PLANTINGS

UTAH AREA 1
PLANT MATERIALS PLANTINGS

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 in 4 plots in late March 2003. FY07 no evaluations.
*** Plot 1:** Vavilov Siberian wheatgrass, Rush intermediate wheatgrass, and Goldar bluebunch wheatgrass – broadcast planted. FY03 initial evaluation during severe drought - Vavilov, P27 and Ephraim fair stands FY04 plantings generally look poor. FY05 no evaluation. FY06 Vavilov and Goldar failed. Rush poor stand with 0.3 plants/ft2 and fair vigor. Patch of smooth brome is also establishing in plot.
*** Plot 2:** Vavilov Siberian wheatgrass, Rush intermediate wheatgrass, and Goldar bluebunch wheatgrass – broadcast planted. FY03 initial evaluation during severe drought - Vavilov, P27 and Ephraim fair stands FY04 plantings generally look poor. FY05 no evaluation. FY06 Vavilov and Goldar failed. Rush poor stand with 0.3 plants/ft2 and fair vigor.
*** Plot 3:** Vavilov Siberian wheatgrass, Rush intermediate wheatgrass, and Goldar bluebunch wheatgrass – broadcast planted. FY03 initial evaluation during severe drought - Vavilov, P27 and Ephraim fair stands FY04 plantings generally look poor. FY05 no evaluation. FY06 Vavilov and Goldar failed. Rush fair stand with 2.0 plants/ft2 and good vigor.
*** 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 FY04 plantings generally look poor. FY05 no evaluation. FY06 All plots except Ephraim failed. Ephraim fair stand and 2.0 plants/ft2.

UT03005 Jon White – Logan FO 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. FY04 fair stands establishing for all species (Rush, Topar, Tegmar and Luna) with 40 percent survival, poor to fair vigor, approximately 20 inch heights for all except Rush with 24 inch height. FY05 no evaluation. FY06 Rush, Topar, Tegmar, Luna and Oahe all have fair to good stands with 3 plants/ft2 and fair vigor. FY07 no evaluation.

UT05001 Brian Shaffer – Tremonton FO saline demonstration planting. Volga mammoth wildrye, Arriba western wheatgrass, Trailhead basin wildrye, Washoe basin wildrye, Bozoisky Russian wildrye, Rosana western wheatgrass, Magnar basin wildrye, P27 Siberian wheatgrass, Vavilov Siberian wheatgrass, Sodar streambank wheatgrass, Syn A Russian wildrye and 9008027 silver buffaloberry (20 plants) were ordered on February 4, 2005. FY05 no evaluation. FY06 there is evidence that a number of species came up and made 2-3 leaves. Nothing appears to be surviving, but seeding will be evaluated in FY07 to be sure. FY07 no evaluation.

UT05002 John and Kyle Potter field plantings – 2 mixes. Mix 1: Anatone bluebunch wheatgrass, Nezpar Indian ricegrass, Maple Grove Lewis flax, Bandera Rocky Mountain penstemon, Magnar basin wildrye, Timp Utah sweetvetch, western yarrow and Maybell antelope bitterbrush; Mix 2: Goldar bluebunch wheatgrass, Rimrock Indian ricegrass, Appar blue flax, Bandera Rocky Mountain penstemon, Trailhead basin wildrye, Timp Utah sweetvetch, and Maybell antelope bitterbrush. Seed ordered February 4, 2005. FY05 not planted. FY06 planted October 19, 2005 – 2 mixes were planted on 0.5 acres each – each plantings was broadcast planted and then half of each planting was harrowed (thus four plots total). FY06 Mix 1 – no evidence of Anatone, Nezpar, Magnar or Maybell; good stand of western yarrow with 2-3 plants/ft2 and good vigor; fair to poor stand of Maple Grove, Bandera and Timp with less than 1 plant/ft2 and fair to good vigor. Mix 2 – no evidence of Goldar, Rimrock, Trailhead or Maybell; poor to fair stand of

Appar, Bandera and Timp with less than 1 plant/ft2 and fair to good vigor. No difference between broadcast and broadcast/harrow for either planting. FY07 no evaluation.

UT05003 Swaner Nature Preserve riparian planting. Peachleaf willow (accessions 9067375, 9067376, 9067541, 9067546, 9067549 and 9067560), Redosier dogwood (accessions 9023733, 9023739 and 9023740) and Blanchard blue elderberry cuttings were ordered February 4, 2005. Site characteristics: East Canyon Creek, Summit County, MLRA E47, Echocreek-Kovich loam soil, 1-2 percent slope, NW aspect, 6350 feet elevation, 16 inch precipitation, non-irrigated, T1S R4E SE ¼ Section 18. FY05 peachleaf willow 9067375 85% survival, fair vigor, 12-24" height; peachleaf willow 9067376 100% survival, good vigor, 24-36" height; peachleaf willow 9067541 73% survival, fair vigor, 12-18" height; peachleaf willow 9067546 100% survival, good vigor, 24" height; peachleaf willow 9067549 88% survival, fair vigor, 24" height; peachleaf willow 9067560 85% survival, good vigor, 24-36" height. All peachleaf willows are performing well under severe reed canarygrass competition. Redosier dogwood 9023733 10% survival, very poor vigor, 3" of new growth; redosier dogwood 9023739 failed; redosier dogwood 9023740 100% survival, poor vigor, 6" of new growth; Blanchard blue elderberry failed. Elderberry stock was not in containers and plants were very difficult to handle. Recommend not sending elderberry plants without containers in the future.FY06 peachleaf willow 9067375 50% survival, fair vigor, 18-24" height; peachleaf willow 9067376 77% survival, fair vigor, 24-36" height; peachleaf willow 9067541 57% survival, fair vigor, 18-24" height; peachleaf willow 9067546 67% survival, fair vigor, 18-24" height; peachleaf willow 9067549 67% survival, fair vigor, 24-36" height; peachleaf willow 9067560 78% survival, fair vigor, 36-48" height. All peachleaf willows are performing well under severe reed canarygrass competition and high water this spring. Redosier dogwood 9023733 failed; redosier dogwood 9023739 failed; redosier dogwood 9023740 failed; Blanchard blue elderberry failed. FY07 no evaluation.

UT07002 Niels Hansen seed increase planting. Northern Cold Desert winterfat seed shipped February 8, 2007. Seed will be planted the spring of 2007. FY07 no evaluation.

UT07003 Bill Hopkin field planting Randolph Field Office. Peachleaf willow (accessions 9076375, 9076376, 9067549, 9067560), black cottonwood (accessions 9067538, 9067562, 9067563, 9067568), Siouxland poplar, Carolina poplar and coyote willow cuttings to be shipped April 23, 2007. Cuttings shipped April 4. Site conditions – cobbly semi wet soil, 0-20 percent slopes, 6300 feet elevation and 12- 14 inch rainfall area. Cuttings were planted April 28, 2007. FY07 no evaluation.

UT07004 _______________ Logan Field Office. Peachleaf willow (accessions 9076375, 9076376, 9067549, 9067560) and coyote willow cuttings to be shipped April 9, 2007. Cuttings shipped April 4. FY07 no evaluation.

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. **FY06** May 16th – planting is excellent with approximately 75% Vavilov Siberian wheatgrass, 20% Nordan crested wheatgrass-Sodar streambank wheatgrass-Critana thickspike wheatgrass, 1% Nezpar Indian ricegrass, and 4% Richfield firecracker penstemon-Immigrant forage kochia-sweetclover-fourwing saltbush. The most severely disturbed site has an excellent stand and the moderately disturbed site has a good to excellent stand. The control with no ripping has a poor to failed stand. There are also plantings completed in years following the test plantings. The sites are typically moderately disturbed with good to excellent stands and species mixtures include additional species including Bozoisky Russian wildrye, rabbitbrush, Immigrant forage kochia and penstemon. On one west slope the seeding mixture included fourwing saltbush, shadscale in mixture with grasses and forbs. Due to droughty conditions, this planting only established shadscale approximately 60% of community and fourwing saltbush 10% of community. From these observations, the strongest species appear to be Vavilov Siberian wheatgrass, Bozoisky Russian wildrye, Richfield firecracker penstemon, Immigrant forage kochia, shadscale and fourwing saltbush. **Next evaluation planned for 2010.**

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.
FY03 no evaluation. FY04 stand/survival – Planting # 1 P27 fair/100%, Bannock fair/100%, Nezpar fair/100%, Mesa alfalfa fair/100% and Volga failed. Planting # 2 Vavilov fair/100%, Nezpar fair/100%, Bannock fair/100%, Magnar poor/25%, Volga failed, and Snake River Plains failed. FY05 Planting # 1 P27 fair stand with ½ plant/ft2 – Bannock fair stand with ¼ plant/ft2 – Nezpar poor stand with 1/10 plant/ft2 – alfalfa poor stand with 1/10 plant/ft2 – Volga failed. Mix has about 1 plant/ft2. Planting # 2 Vavilov good stand with 4 plants/ft2 - Nezpar poor stand with 1/10 plant/ft2 – Bannock fair stand with ½ plant/ft2 – Magnar and Volga failed – Snake River Plains fourwing saltbush fair stand with ¼ plant/ft2. Mix has 4.9 plants/ft2. Vavilov had the best survival of all plants in this trial and thus was able to respond to better moisture conditions that occurred this year. FY06 and FY07 no evaluation.

UT03004 Bob Bliss - Fillmore FO field planting - Durar hard fescue and western wheatgrass. Seed ordered March 20, 2003. FY03 - FY04 interseeding not planted. Poplar trees are struggling due to irrigation using dairy effluent. FY05 and FY06 and FY07 no evaluation.

UT04001 Blake Walbeck project – Richfield FO demonstration plots. P27 Siberian wheatgrass, Vavilov Siberian wheatgrass, Douglas crested wheatgrass and Ephraim crested wheatgrass. Seed packets ordered November 2003. FY04 - FY07 no evaluations.

UT04015 Soren Nielsen project – Manti FO. Riparian woody field planting – 9067538 black cottonwood. Cuttings ordered March 5, 2004. FY04 – FY06 no evaluations. FY07 very poor survival with 1 of 25 still alive - vigor is very poor. **Cancel**

UT05006 Lars Rasmussen – Fillmore FO seed increase. Maple Grove Lewis flax seed was purchased and shipped March 9, 2005. FY06 planting planned for fall 2006. FY07 no evaluation.

UT05007 Lars Rasmussen – Fillmore FO Seed increase planting of sagebrush penstemon *Penstemon speciosis.* Planting installed in 2005 using weed barrier material and full irrigation. Weed barrier materials utilized was the cloth type materials which broke down in less than a year resulting in heavy weed competition. An excellent stand is established (5/17/06) and some seed production is expected this year. Weed control is difficult requiring extensive hand rouging. FY07 no evaluation.

UT08001 Demonstration Plots – Fillmore FO planting planned for late November 2007.

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 poor 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. Fair stands of T28606 needle and thread and Magnar. Appar failed. Area is experiencing heavy wildlife use. FY04 Stands are experiencing heavy wildlife use – no livestock use for the last two years. Good vigor and stands of Hycrest, Ephraim and Nordan. Fair vigor and stands of Arriba, T28606 and Magnar. Poor stand and vigor of Appar – most plants are along the edge of planting. FY05 Stands are experiencing heavy wildlife use – no livestock use for the last three years. Good to excellent vigor and stands of Hycrest, Ephraim, Nordan, Arriba and T28606. Fair vigor and stand of Magnar. Appar failed. **Next evaluation FY08.**

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 green-up. FY04 due to lack of summer thunder storms there is only a fair stand with fair vigor for both Magnar and Trailhead. FY05 Magnar fair stand with good vigor, 50 inch height, 0.6 AUMs/ac – Trailhead fair stand with good vigor, 40 inch height and 0.4 AUMs/ac. **Next evaluation FY08.**

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. FY04 good stand and vigor – Rush is out performing Regar meadow brome pastures. Both Rush and Regar stands are being invaded by quackgrass. FY05 good to excellent stand with excellent vigor and producing 13 AUMs/ac irrigated. FY06 good to excellent stand with excellent vigor and producing 13 AUMs/ac irrigated. Early warm up and severe summer heat limited production. FY07 Prevedel trial looked good. Brett tried to plant alfalfa with the Rush but it has not done well. Furthermore with the alfalfa in it does not allow him to spray out weeds (knapweed) in the spring without affecting the alfalfa. He has decided he will end up spraying out the weeds and alfalfa and going back to a grass only pasture. He indicated that to increase the vigor of the pastures he needs/plans to fertilize. **Next evaluation FY10.**

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-FY04 excellent stand of all three species with excellent vigor and production. Stand continues to be irrigated. FY05 Tegmar excellent stand with good vigor, and 24-36 inch height. Topar excellent stand with good vigor and 24-36 inch height. Paiute excellent stand with good vigor and 24-36 inch height. Entire stand produced 1500 pounds/acre. Stand has not been grazed. **Next evaluation 2008.**

UT02001 Pete 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. FY04 good stands and vigor for both species. The plantings were hayed this year – Rush = 1.25 tons/acre and Topar = 1.0 ton/acre. Regrowth was grazed – estimate 0.25 AUMs/acre. FY05 - FY07 no evaluation.

UT05004 Mike Wilcox – Monticello FO field planting. This is a dormant spring or fall planting of Topar pubescent wheatgrass and Rush intermediate wheatgrass. Barnam loam soil, 3 percent slopes, south aspect, 6000 feet elevation, 14 inch precipitation, non-irrigated, T31N R26E Section 8. Seed ordered March 3, 2005. FY05 planted as a dormant fall planting. FY06 not planted – cooperator plans to plant in spring of 2007. FY07 no evaluation.

UT05005 Bruce Adams – Monticello FO field planting. This is a dormant spring or fall planting of Topar pubescent wheatgrass, Appar blue flax, Maple Grove Lewis flax, Timp Utah sweetvetch, Richfield firecracker penstemon and western yarrow for habitat improvement for Gunnison sage grouse. Site characteristics: silty clay loam soil, 3-6 percent slopes, south aspect, 6300 feet elevation, 12-14 inch rainfall zone, non-irrigated, T32S R25E SW ¼ Section 33. Seed ordered March 3, 2005. FY05 not planted. FY06 broadcast and harrow planting completed August 19, 2006 – plants germinated and looked good on evaluation date. FY07 During the evaluation, it was difficult to find established plants from the seeding but we did find a few which was encouraging. It was discussed that the plants that were observed did appear to have grown enough to make it until next year. It was also noted that there had been some effects from prairie dogs and rabbits. The planting area had a lot of weeds which could be expected in new seeding. This site will continue to be monitored and evaluated.

UT06001 Carol Vansteeter - Monticello FO field planting. Seed of Alma blue grama, Appar blue flax and Richfield Selection firecracker penstemon was ordered on May 23, 2006. FY06 broadcast and rake planting completed on November 15, 2006. Two days following seeding site was snow covered. FY07 no evaluation.

UT06002 Cody Holyoak - Price FO (Green River) field planting. Seed of Blackwell switchgrass, Cave in Rock switchgrass, and 905430 switchgrass was ordered June 26, 2006. Seed will be planted in spring 2007 due to irrigation system delay. FY07 Cody was not available but we talked with his wife. She indicated that he was going to plant in the next couple of days. The field looked prepared for seeding. Follow up will be planned with him in 4-6 weeks to document progress.

UT07001 James Wheeler – Monticello FO field planting. Seed of P-7 bluebunch wheatgrass, Anatone bluebunch wheatgrass, Regar meadow brome, Cache meadow brome, Rush intermediate wheatgrass, Topar pubescent wheatgrass, Paiute orchardgrass, Bozoisky Russian wildrye, Vavilov Siberian wheatgrass and Sherman big bluegrass were ordered on August 28, 2006. A dormant fall planting is scheduled for late October to early November. Site characteristics include MLRA 36, silty clay loam soil, 0-2 percent slopes, NE aspect, 14-16 inch precipitation, T32S R26E NE ¼ Section 31. FY06 seed was drill planted into prepared seedbed on November 17, 2006. Soil moisture and fall rain was good prior to and after planting. It turned cold and snowy soon after planting. FY07 this area is suffering from the current drought conditions. Kyle explained that they did have some grass coming up from the planting in the spring but not much since. We walked around and looked and in fact did find some dormant grass plants that had become established. Dan indicated that it looks as if they got established enough for them to come up this next spring. We did see quite a few weeds in the planting but that is to be expected in the early stages of a new planting. Kyle and his Dad are optimistic and look forward to this coming spring to see how the grasses come back.

United States Department of Agriculture

NRCS Natural Resources Conservation Service

2006
Aberdeen Plant Materials Center Progress Report of Activities

Issued January, 2007

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 Home Farm

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 evaluate and select plant materials and techniques for establishment and management of plants for use in resource conservation activities in the Western United States.

There are 27 PMCs nationwide, each serving a specific geographic and ecological area. The Aberdeen PMC serves portions of the Intermountain West including southern Idaho, western Utah, northern Nevada, western Wyoming and eastern 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
- Range and forest lands in poor ecological condition
- Riparian and wetland degradation
- Windbreak and shelterbelt demonstration
- Technology transfer and education

This report highlights some of the major activities at the PMC during 2006. For detailed information, contact us at the PMC or the Idaho-Utah Plant Materials Specialist.

South Bingham Soil Conservation District Purchases Farm for Plant Materials Research

In July 2005 The South Bingham Soil Conservation District purchased a 40 acre farm near Aberdeen to allow the PMC to expand plant testing research and seed production. The District installed a new irrigation system, windbreak and drip irrigation system, and gravel roads to meet the needs of the PMC.

The South Bingham Soil Conservation District has been an important partner with the PMC for many years. In 1955, the District purchased the "Home Farm" located 2 miles north of Aberdeen, where the PMC farming operations are headquartered.

Installing new Rocky Mountain juniper and Simon poplar windbreak

Foundation seed production fields of 'Magnar' basin wildrye, 'Goldar' bluebunch wheatgrass, and 'Bannock' thickspike wheatgrass were planted in 2006. In addition, a field of blue wildrye for Grand Teton National Park and an Initial Evaluation Planting of *Eriogonum* (buckwheat sp.) were also established in 2006 at the newly purchased Pearl Farm.

The PMC appreciates the support and cooperation provided by the South Bingham Soil Conservation District!

Native Plant Testing

The PMC is continuing to evaluate six native species for potential use in restoration of land in Idaho and Montana with the USDA Forest Service, Region 1. A total of 52 accessions of bluebunch wheatgrass, Idaho fescue, blue wildrye, tufted hairgrass, Sandberg bluegrass and western yarrow are being studied in replicated field trials. They were established at the PMC in 2004 to evaluate the collections and compare them with known industry releases.

Initial Evaluation plots of western yarrow with border rows of 'Appar' blue flax

The PMC is also continuing a similar evaluation in cooperation with Caribou-Targhee and Bridger-Teton National Forests to evaluate accessions of mountain brome and slender wheatgrass for potential release and use in eastern Idaho and western Wyoming.

The PMC began a cooperative effort with Grand Teton National Park in the spring of 2006 to increase seed of source collections from the Park to be used for restoration projects. Seed production fields of blue wildrye, Sandberg bluegrass, mountain brome and slender wheatgrass were planted in anticipation of seed harvest in 2007 and 2008.

In cooperation with the Great Basin Native Plant Selection and Increase Project, the PMC is evaluating propagation techniques and attempting to increase seed of native forbs that have been identified as high priority species. The species include: sulphurflower buckwheat, fernleaf biscuitroot, Gray's biscuitroot, nineleaf biscuitroot, sand penstemon, hotrock penstemon and sagebrush penstemon.

These native forbs were direct-seeded last fall into weed barrier fabric at the PMC and observations were made on seedling establishment and plant growth during 2006. We are expecting the plants to begin producing seed in 2007.

Off-Center Testing

The PMC is continuing its cooperation with the Great Basin Native Plant Selection and Increase Project, Brigham Young University and the Agricultural Research Service Eastern Oregon Agricultural Research Center to evaluate methods to determine effective ways to control crested wheatgrass and establish native species while minimizing weed invasion. A new Truax Roughrider range drill was delivered to the PMC and Technicians Boyd Simonson and Brent Cornforth modified the drill to improve seed flow and seed placement. A seed mixture developed by the cooperators was mixed with rice hulls at the PMC and plots were seeded near Tooele, UT and Burns OR in late October 2005. Treatments being evaluated include 1-way and 2-way disking and herbicide treatment (partial and full) to control crested wheatgrass. The studies were repeated again in the fall of 2006. In addition to this study, a drill comparison trial was also planted near Elko, NV in 2006.

Seeding crested wheatgrass diversification trial near Burns, OR

Breeder and Foundation Seed Production

The PMC is responsible for Breeder and Foundation seed production of 19 plant releases. During 2006, Foundation seed fields of 'Goldar' bluebunch wheatgrass, Anatone bluebunch wheatgrass, 'Paiute' orchardgrass, 'Bannock' thickspike wheatgrass, Maple Grove Selection Lewis flax, Richfield Selection firecracker penstemon, Clearwater Selection Venus penstemon, Northern Cold Desert Selection winterfat and Snake River Plains Selection fourwing saltbush were in production. New fields of Maple Grove Lewis flax, Bannock thickspike wheatgrass, 'Delar' small burnet, 'Magnar' basin wildrye and 'Goldar' bluebunch wheatgrass were also established.

The PMC is also cooperating with the Department of Defense in seed increase of test materials of western wheatgrass, Siberian wheatgrass and slender wheatgrass that will be used for further testing at military installations in the western United States.

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 more information was needed 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.

Streambank Soil Bioengineering Technical Training

Workshop participants install a rooted willow using the waterjet on the Hopi Reservation near Tuba City, AZ

As part of our technology transfer program, a three-day Streambank Soil Bioengineering Technical Training Workshop was developed. This workshop was formally a two day workshop, but based on additional technology, it was expanded to a three day course. The first day and a half of the workshop is devoted to the classroom where basic riparian dynamics, riparian zone vegetation, plant acquisition, bioengineering techniques, woody plant propagation, case studies, and project planning are discussed. The afternoon of the second day is held in the field discussing a proposed restoration site. The participants utilize the knowledge gained in the classroom to develop restoration plan alternatives. The plan alternatives are then discussed and the selected plan for the project site is discussed with the group. The third day is spent at the project site where participants install a series of bioengineering treatments on an eroding section of streambank based on the selected project plan.

This year, Streambank Soil Bioengineering Technical Training workshops were held in St. George UT in a continuing effort to help treat flood damaged areas. Workshops were also held in San Antonio, TX, Bismarck, ND, Salmon, ID and on the Hopi Reservation near Tuba City, AZ. A total of 215 people were trained in 2006.

Technical Assistance to Afghanistan

In May 2006, Chris Hoag, Wetland Plant Ecologist, traveled to Kabul, Afghanistan to provide advanced training to employees of the Ministry of Agriculture, Animal Husbandry, and Forestry. Chris and Jon Fripp, NRCS National Design, Construction and Soil Mechanics Center developed a 10 day class in Watershed Assessment, Management, and Rehabilitation and presented the course to 62 Ministry employees who have positions similar to Cooperative Extension Agents in the US. The Watershed training included classroom presentations and field trips to demonstrate watershed assessment techniques.

Watershed Assessment, Management, and Rehabilitation class in Kabul, Afghanistan in 2006. Class in the field discussing how to asses a small watershed. The second photo shows the Afghans using a small seed drill that was shipped to Afghanistan.

Wetland/Riparian Research

In 2006, one of the most interesting and useable tools that was developed at the PMC is the pot planter attachment for the Waterjet Stinger.

The Waterjet Stinger is a tool for outplanting dormant unrooted cuttings of willows (*Salix spp.*), cottonwoods (*Populus spp.*]), and dogwoods (*Cornus sericea).* The Waterjet Stinger uses water to hydrodrill a hole in the soil large enough to insert a 2- to 4-cm (0.75- to 1.5-in) diameter, dormant, unrooted cutting. This hole, after it is hydrodrilled, is actually full of a water–soil slurry. When the cutting is pushed into the hole, the water in the slurry percolates into the surrounding soil profile while the soil portion of the slurry settles around the cutting. This results in good soil-to-cutting contact, preventing air pockets near the stem, and allowing for better rooting potential. In addition, the water from the slurry creates a zone of moisture around the cutting that keeps the cutting hydrated for a longer period of time.

The original concept worked so well that we adapted a probe that allows the waterjet to be used to plant larger rooted container plants. We think this will increase the survival of container stock, especially in dry areas of the US, because: plants would be outplanted into a wet hole rather than a dry hole- mitigating loss of moisture from the container medium to the soil. Plants would have fewer air pockets around their roots, yielding better root-to-soil contact. A slurry would create a zone of moisture, a "water bulb," around the roots that would extend the time the root system has contact with favorable soil moisture.

The pot planter probe is similar to the original waterjet probe but includes larger vanes on the sides of the probe to create the larger hole needed for container plants. The vanes are 7.5 cm (3 in) wide, taper toward the nozzle, and are welded to the probe pipe at right angles to each other. In addition, because the nozzle tip did not have to be stainless steel, a standard pipe cap was used. Three holes were drilled into the cap similar to the original design. The outside holes are drilled at a slight angle so that the water sprays out in more of a fan arrangement, allowing the waterjet to drill a hole faster and wider.

A recent workshop on the Hopi Reservation in AZ was conducted to demonstrate the usability of the pot planter to establish riparian woody plants into a riparian area where poor grazing management had all but eliminated the woody riparian plants. There was no useable water on the site, so a 300 gal water tank in the back of a pickup was used as the water source. Several Hopi high school students helped plant a number of potted willows. The ease of use and the high success rate demonstrated that this technique can help reestablish riparian plant communities in very arid areas.

Aberdeen Plant Materials Center

Intermountain Plant Notes 2007

USDA NRCS Natural Resources Conservation Service

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A newsletter to inform you about activities at the Aberdeen Plant Materials Center

Who We Are

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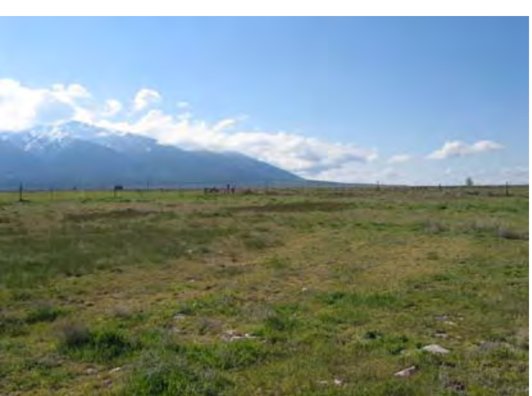
Coffee Point Off-Center Evaluation

Last November the PMC planted a large, multi-species, off-center evaluation planting at Coffee Point, 20 miles northwest of Aberdeen. The site is located on BLM land on an ecological site that historically supported a Wyoming big sagebrush/bluebunch wheatgrass plant community that receives an average of 8 to 12 inches annual precipitation. The evaluation planting includes 58 accessions of forbs, shrubs, and native and introduced grasses and is designed to test which accessions are best suited for use in low-precipitation sites in southern Idaho and northern Utah. Tested species include basin wildrye; Sandberg bluegrass; bottlebrush squirreltail; bluebunch, Snake River, thickspike, western and slender wheatgrasses; four shrubs; nine forbs and three introduced grasses. Evaluation of these plantings are planned to occur from 2007 through 2017 to determine long-term performance and survival of the test species.



Skull Valley Off-Center Evaluation

The NRCS Utah State office and Tooele Field Office are assisting the PMC with a second off-center test site where we plan to plant another large scale evaluation planting. Accessions are being assembled, and the site is being prepared for planting in November 2007. The current list of accessions includes many from the Coffee Point trial along with some new additions. The Skull Valley location is a sandy site, so we are able to test a slightly different suite of species adapted to those ecological conditions. Thanks to all who provided seed for both the Skull Valley and Coffee Point plantings.

Wild Buckwheat Initial Evaluation Planting

During the fall of 2006, the PMC planted 32 accessions of sulphurflower and parsnipflower, or whorled buckwheat, in an initial evaluation trial at the new Pearl Farm. The trial includes 10 accessions of sulphurflower and 22 accessions of parsnipflower buckwheat collected from native stands in Idaho, Wyoming, California and Oregon.

Native forbs or wildflowers and half-shrubs, are important for increasing biodiversity, improving wildlife habitat and providing food for birds and mammals. There is an ever increasing demand for native forb and half-shrub releases for use in revegetating rangelands in our service area, especially in regions occupied by sage grouse, in efforts to restore native habitats. Buckwheat species are common throughout the sagebrush and mountain regions of the West. Some species are also utilized in the xeriscaping industry and have potential for roadside beautification and diversification projects. The goal of this trial is to identify and release one or more superior sulphurflower and/or parsnipflower or whorled buckwheat accessions adapted for use in the Aberdeen PMC service area.

New Equipment

In March, the PMC acquired a new Wintersteiger Delta Plot Combine to harvest Foundation and other seed increase fields. The new combine is a much needed addition to the PMC list of equipment due to the increased production acres from the acquisition of the Pearl farm.

The PMC also plans to purchase a new greenhouse lighting system. This will facilitate growing plants during the winter months. The new lights will allow the PMC to produce significantly more, higher quality containerized seedlings than previously possible.

Indian Valley Sedge

In 2006 the PMC began propagating plants of Indian Valley sedge as part of a project to reestablish populations in its native habitat at the “Jewel Wetland” in southwestern Idaho. This unique species was first collected in the Weiser Valley by Marcus E. Jones on July 12, 1899, at Indian Valley, ID and it was not seen again for 100 years. The species was thought to be extinct, until 1999 when a population was discovered south of Council, in Adams County, ID. As a result, Indian Valley sedge was moved from the Idaho Native Plant Society’s Taxa Believed to be Globally Extinct category to the Global Priority 1 category.

This project is being coordinated by the NRCS Payette Field Office on a Wetland Reserve Program (WRP) site in cooperation with land owners Jon and Mary Trail, with support from the Land Trust of the Treasure Valley. The project involves several interested parties, including the USDA Forest Service Rocky Mountain Research Station and Idaho Department of Fish and Game. Volunteers from these agencies have assisted in seed collection and will be on hand to transplant greenhouse grown plants at the site this summer.

Seed Production for Grand Teton National Park

The PMC entered into an agreement with Grand Teton National Park to produce seed of several native grass species to preserve the park’s native plant resources and to revegetate park lands. In the spring of 2006 the PMC planted 2.7 acres of blue wildrye, 0.25 acres of Sandberg bluegrass, 1.0 acres of mountain brome and 1.0 acres of slender wheatgrass. Seed harvests will begin in 2007 and continue through 2008. The PMC will also be planting additional fields of Idaho fescue and bluebunch wheatgrass for the park in 2008.

Upcoming Releases

The PMC, in cooperation with the US Army Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory and the ARS Forage and Range Research Lab in Logan, UT, plans to release selections of Siberian wheatgrass and Western wheatgrass. These accessions were bred by the ARS and were tested over a seven year period by the Army at Camp Guernsey, WY and the Yakima Training Center, WA and other sites. The accessions were part of a project to identify and develop wear-resistant grass cultivars for use on military lands, and these lines have shown superior traits in germination and establishment. The PMC is increasing seed to prepare the varieties for commercial release. Foundation seed will be maintained by the PMC.

Foundation/Early Generation Seed Production

A major responsibility of the PMC is the production of Foundation seed of the center's plant releases. In 2006, the PMC produced over 6500 lbs of Foundation seed of Goldar bluebunch wheatgrass, Anatone bluebunch wheatgrass, Paiute orchardgrass, Bannock thickspike wheatgrass, Maple Grove Lewis flax, Richfield firecracker penstemon, Clearwater Venus penstemon, Northern Cold Desert winterfat, Snake River Plains fourwing saltbush, Delar small burnet and Magnar basin wildrye. In 2006 the PMC also shipped just over 6500 lbs of seed through the Utah Crop Improvement Association and the Idaho Foundation Seed program.

In 2007 the PMC is maintaining foundation seed production fields of Anatone, Snake River Plains, Northern Cold Desert, Delar, Maple Grove, Richfield, Clearwater, Bannock, Magnar, Goldar and Appar blue flax. Contact the UI Foundation Seed Program or the Utah Crop Improvement Association to request seed.

New Grass Display Nursery

In the spring of 2007, the PMC will be planting a new grass display nursery at the PMC home farm. The new nursery will include approximately 65 accessions showcasing releases and test materials of nearly 30 species suited for reclamation, restoration or irrigated pasture plantings in the PMC service area. The display is divided into three sections according to irrigation needs or reflecting natural precipitation ranges; 12 inches or less, 12 to 16 inches, and 16 inches or greater. This is a wonderful tool for land managers, cooperators and field office staff to see mature stands of the species that they may be considering for planting projects.

Native Species Evaluations

There are several initial and advanced test plantings in various stages currently underway at the PMC investigating native plant collections for potential future releases. In cooperation with USDA Forest Service Region 1 and 4, the PMC is evaluating collections of bluebunch wheatgrass, blue wildrye, Idaho fescue, tufted hairgrass, Sandberg bluegrass, mountain brome, slender wheatgrass and yarrow. The PMC is also evaluating collections of muttongrass, sulphurflower and parsnipflower buckwheat and basin wildrye. With luck you may be seeing new releases from these species in future years.

Call for Seed Collections or Stand Locations

We need your help! The PMC is planning to begin initial evaluations on accessions of dusky maiden (left) and hoary aster (right) starting in the spring of 2008. We are looking for seed collections or stand location information so PMC staff can visit sites and collect seed this summer.

These are two short-lived forbs common to the Intermountain west. Both species are commonly found growing in arid sites in a wide range of soils in sagebrush habitats throughout our service area. Dusky maiden flowers in early June, and seed is ready for harvest throughout July. Hoary aster typically flowers later in the season with seed becoming ripe during August and into September. Contact Derek Tilley at the PMC or Dan Ogle at the ID state office for more information or to provide site locations.

Recent Publications and Presentations

There are several new or revised publications from the Aberdeen PMC available to download at our website. Some of these include:

- Plant Guides for muttongrass (*Poa fendleriana*), black greasewood (*Sarcobatus vermiculatus*), parsnipflower buckwheat (*Eriogonum heracleoides)*, needle and thread (*Heterostipa comata*), Thurber's needlegrass (*Achnatherum thurberianum*), prairie junegrass (*Koeleria macrantha*) and the Sandberg bluegrass complex (*Poa secunda*).
- Technical Note 15. Managing Black Greasewood Sites.
- Revised Technical Note 19. Calibrating a Seed Drill for conservation Plantings.
- 26 revised Plant Release Brochures "Plants for Solving Resource Problems."
- 2006 Annual Technical Report.
- Coming soon: Field Guide for the Identification and Use of Common Riparian Woody Plants of the Intermountain West and Pacific Northwest Regions.

The PMC staff also gave a number of presentations and tours including:

- Weed suppression and native plant community restoration. Idaho Weed Conference. Nampa, ID.
- PMC tour for Upper Uncompahgre Project Personnel. Aberdeen, ID.
- Aberdeen PMC Report of Activities 2006: Great Basin native Plant Selection and Increase Project. Society for Range Management. Reno, NV.
- PMC tour for Great Basin Community College, Agronomy and Range Science students. Aberdeen, ID

TECHNICAL NOTE

USDA-Natural Resources Conservation Service
Boise, Idaho – Salt Lake City, Utah

TN PLANT MATERIALS NO. 15 FEBRUARY 2007

MANAGING BLACK GREASEWOOD SITES

Brock Benson, Area Range Conservationist, NRCS, Ogden, Utah
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This Technical Note provides a general description of black greasewood, its range, habitat, distribution and uses. It provides a discussion of soil chemistry including salinity and sodicity and how these conditions effect plant communities and influence management practices. Tables provide information on species commonly found in association with black greasewood habitats as well as species recommendations for seeding into existing or controlled black greasewood communities.

Mature Black Greasewood Plant on Utah Rangeland

Introduction

Black greasewood plant communities make up thousands of acres of western rangelands. These sites have long been disregarded by many as unproductive wastelands; however this native shrub is an integral part of many western arid to semi-arid ecosystems. These large shrubs provide cover for several species of wildlife including pronghorn antelope, badger, jack rabbits, coyotes and song birds.
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Sites occupied by black greasewood are often high in salinity or sodicity, and the presence of black greasewood may indicate a perched water table or wet to semi-wet saline conditions. Black greasewood plants can also be found in saline upland habitats including Wyoming and basin big sagebrush communities. Black greasewood is not only an indicator of saline or sodic soils but may also be an indicator of poor rangeland management practices.

Staminate or male flower "cones".

Plant description

Developing fruit (above), and mature fruit (left).

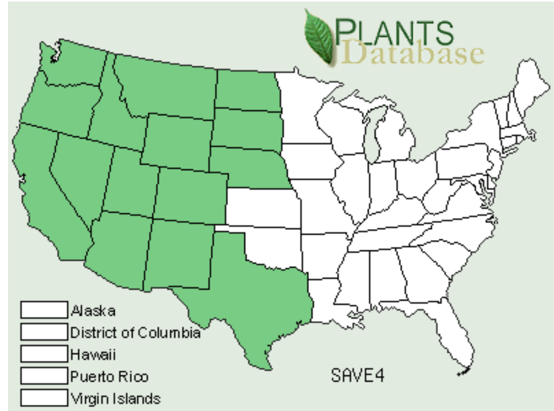
Black greasewood has traditionally been placed in the goosefoot family (Chenopodiaceae), but new evidence is leading systematists to place the genus in a distinct family, Sarobataceae. Black greasewood is a rapidly growing, tall (3 to 10 ft), erect spiny deciduous to semi-evergreen shrub (it is more deciduous in northern reaches and less so in the southern reaches of its range). Black greasewood has a long lifespan with very good seedling vigor. Leaves are bright green to light olive green in color, round, narrow and fleshy.

Black greasewood plants are generally monoecious (having separate male and female flowers on the same plant) but can also be dioecious (having separate male and female plants) [Hickman 1993]. The male (staminate) flowers are small and clustered in pine cone shaped spikes that are 1/2 to 1 inch long. Male flowers lack both sepals and petals. Flowers are found at the ends of the top most branches on the plant. The female (pistillate) flowers are green, small in size (about 3/16 in), very inconspicuous with a wing-like membrane that becomes enlarged as the fruit matures. The fruit is approximately 1/2 inch in size at maturity. Fruit are green while growing, turning reddish when nearing the end of development, and then tan when fully mature. Black greasewood plants flower in May through July with the fruit maturing in July through September. Both male flowers and female flowers can be found on plants from May through July. The male flowers persist on the plant through the end of the growing season, while the female flowers are found on the plant from mid July through November.

Bark is white on young plants and new growth, but turns gray to black on old growth. Spines are found along the branches and at the tips of the branches (spines are not considered to be true spines, but the ends of branches which grow out at about a 90 degree angle). These serve as mechanical protection from grazing.

Black greasewood stems showing spines.

Distribution:
Black greasewood can be found in saline wet to semi-wet seeps as well as dry upland communities in arid and semi-arid habitats from Alberta to Mexico, and in all western states east to Texas and North Dakota.



Distribution map for black greasewood. Courtesy of PLANTS Database, UDSA-NRCS.

Habitat:
Black greasewood plants inhabit a wide range of plant communities in the lowlands of the western deserts. Plants are typically found growing in saline soils that can be quite moist (wet to semi-wet saline) to dry uplands. Black greasewood is often the dominant species in the plant community, but plants are also found associated with seepweed, saltbush species, saltgrass, shadscale, basin big sagebrush and Wyoming big sagebrush communities. Some ecological sites may naturally only support a minor component of black greasewood, but black greasewood will often increase to become dominant under poor management circumstances giving the impression that it is a “greasewood site”.

Adaptation
Black greasewood tolerates mildly to strongly sodic soil as well as non-saline to strongly saline soils. It is normally found on soils that are primarily fine-textured and saline and/or sodic, but this plant will grow on a wide variety of soils from very heavy clays to cobbly loams. It has very high tolerance to sodic to saline affected soils. Plants are highly drought tolerant but can also tolerate high water tables and can survive prolonged flooding (up to approximately 40 days). Black greasewood plants can have an extremely long root system (reported from 1.5 meters (5 ft) to 6.1 meters (20 ft) long) with lateral roots 0.9 meters (3 ft) to 3.7 meters (12 ft) in length. Adventitious buds are found all along the lateral root system which initiate sprouting when the above ground plant or the root system is damaged. It also has the ability to crown sprout whenever the crown is damaged.

Uses of black greasewood
Wildlife habitat/forage: Although often considered poor browse, black greasewood provides important cover habitat for wildlife and livestock, especially during the winter. Livestock utilize greasewood for winter cover and early spring browse. Some wildlife species, such as jackrabbits, pronghorn antelope or prairie dogs, forage on the plant. The plants provide burrowing or resting sites for small mammals and birds. Plants are low to low fair in protein levels depending on soil and growing conditions.

***Caution*:** Black greasewood plants contain sodium and potassium oxalates and are toxic to livestock. Browsing black greasewood can be fatal if even low to moderate quantities are consumed without large quantities of other forage in the diet. Black greasewood is poisonous year round, but plants can be consumed safely in light to very moderate amounts in the spring while the leaves are growing, as long as there is a substantial amount of other preferable forage available. As the season progresses, toxins accumulate and the plant becomes the most toxic in the fall. Animals can also be poisoned in fall and winter by eating the leaves from the ground. Signs of poisoning develop 4 to 6 hours after an animal has eaten a toxic amount, approximately 2 pounds for sheep and 3 pounds for cattle (James et al 1980; Weathers 1998). However, grazing black greasewood properly, and with a great deal of caution, can be beneficial to the grazing animal (James et al 1988).

Ethnobotanical: The tough wood from black greasewood was used by Native American Indians for tools and firewood (Welsh et al 2003).

Salinity and Sodicity
Soil chemistry plays a very important role in choosing proper management practices, especially in black greasewood sites. In order to properly manage a site, one must first understand the underlying principles of the soils. These may be high in salinity or sodicity or both. Additionally, the soil hydrology is also

closely related to its chemistry and will have a strong influence in management decisions. Most of the following material on salinity and sodicity comes from Ogle and others (2004).

Salt-affected soils may contain excess soluble salts (saline soils), excess exchangeable sodium (sodic soils), or both (saline-sodic soils). Salt affected soils commonly contain a mixture of cations of sodium, calcium, magnesium and potassium and anions of chloride, sulfate, bicarbonate, carbonate and sometimes borate and nitrate. When the total salt, individual salt or combination of salts in the soil is high enough to retard plant growth, injure plant tissue, and/or decrease yields, the soil is referred to as salt affected. Western states have mostly saline soils with some saline-sodic soils and only isolated occurrences of sodic soils.

The original source of all salts in the soil is weathered bedrock and ancient saline sea-bottoms, although it is rare for sufficient salts to have accumulated in place from these sources. The major factor responsible for the formation of salt-affected soils is the redistribution of salts within the soil, with water as the primary carrier. Where rainfall is high, most salts are leached out of the soil. In arid regions, the salt levels accumulated in soils can be very high because of limited rainfall and reduced leaching. However, not all soils in arid regions are salt-affected because the soil parent materials are not contributing sources of salts. Indirect sources of salts include irrigation water coming from saline sources or saline water from groundwater wells.

The total concentration of ions in the soil water usually has more influence in affecting plants than the precise composition of the solution. Salinity is expressed in a number of ways: equivalents per liter (mol/l), milligrams per liter (mg/l) which equates to parts per million (ppm), electrical conductivity (EC) which is measured in decisiemens per meter (dS/m) or millimhos per centimeter (mmhos/cm) and total dissolved solids (TDS) (%). Soil surveys generally determine salinity by measuring the electrical conductivity (EC) of the soil solution and are expressed in millimhos/cm (mmhos/cm).

Saline soils are often referred to as “white alkali” because of the white salt crust that forms on the soil surface. Saline soils are characterized by the following: EC > 4, Exchangeable Sodium Percentage (ESP) < 15, and pH < 8.5. Saline soils can be easily reclaimed by application of sufficient water to promote leaching of salts beyond the root zone.

Sodic soils are often referred to as “black alkali” or “slick spots” because of the dissolved organic matter in the soil solution. Sodic soils are characterized by the following: EC < 4, ESP > 15, and pH > 8.5. The exchangeable sodium causes soil particles to disperse, resulting in decreased pore space within the soil and increased soil crusting. The loss of permeability due to less pore space can severely restrict water movement into the root zone resulting in plant stress from lack of water. Crusting can severely affect seedling emergence. Reclamation of sodic soils involves the application of gypsum or sulfur, leaching of salts, special tillage operations or a combination of these measures.

Saline-sodic soils having properties of both saline and sodic conditions are characterized by the following: EC > 4, ESP > 15, and pH < 8.5. Properties of saline-sodic soils are generally similar to those of saline soils; however, “black alkali” sodic conditions can be a problem if excess soluble salts are leached without addressing the excess sodium. Reclamation of saline-sodic soils is the same as sodic soils to ensure that excess salts and sodium are removed.

The soil salinity level can best be determined by taking soil samples in the upper 6 inches of the soils profile and measuring the electrical conductivity. Plants growing on the site can also provide an indication of the severity of salinization. The following table lists some of the commonly found plants that can be expected in saline and sodic soils of western rangelands (table 1).

Table 1. Plants Associated with Black Greasewood Communities

Common Name	Scientific Name	Salinity/sodicity tolerance
Black greasewood	*Sarcobatus vermiculatus*	very high
Inland saltgrass	*Distichlis spicata*	
Nuttall's alkaligrass	*Puccinellia airoides*	
Beardless wildrye	*Leymus triticioides*	
Shore arrowgrass	*Triglochin maritima*	
Glasswort	*Salicornia rubra*	
Seepweed	*Suaeda* spp.	
Pickleweed	*Salicornia* spp.	
Alkali cordgrass	*Spartina gracilis*	High
Slender wheatgrass	*Elymus trachycaulus*	
Spear saltbush	*Atriplex patula* var. *hastata*	
Alkali bluegrass	*Poa juncifolia*	
Alkali sacaton	*Sporobolus airoides*	
Foxtail barley	*Hordeum jubatum*	
Cinquefoil	*Potentilla* spp.	
Curley dock	*Rumex crispus*	Moderate
Poverty weed	*Iva axillaries*	
Kochia	*Kochia scoparia*	
Forage kochia	*Kochia prostrate*	
Plains bluegrass	*Poa arida*	
Western wheatgrass	*Pascopyrum smithii*	
Thickspike wheatgrass	*Elymus lanceolatus*	

Management

Although black greasewood is not considered to be a weedy species, sites containing the plant are often in poor ecological condition due to the combination of past management and the harsh environment in which the plant normally occurs. Recovering the health of sites that are in poor condition can be very challenging and may take years to achieve.

Characteristics of greasewood, such as adventitious buds and crown sprouting, make it relatively difficult to manage. Unlike black greasewood, big sagebrush species do not tolerate high levels of salinity or sodicity. In general, the more big sagebrush that is found on the site the better the chance of being able to successfully treat the site. Where there is very little to no big sagebrush, the treatment of the site will most likely fail or be a very poor investment of capital. Other criteria that should be considered are climate, available water holding capacity of the soil, depth of soil, soil surface texture, surface rock fragments and slope.

Control of black greasewood is not easily accomplished. 2, 4-D and 2, 4-D + dicamba (Banvel®) are the most common control methods, but these rarely work with a single application. Normally two applications on subsequent years are needed. Occasionally three applications are required to gain acceptable control. Picloram (Tordon®) works fairly well. Metsulfuron (Ally®, Cimmaron®, or Escort®) have produced mixed results. Metsulfuron, when it works, will work very well, but apparently there are some environmental factors that contribute to its effectiveness. These factors do not appear to be clearly defined at this time. Other mixes that have been successfully applied are 2, 4-D + Tordon and 2, 4-D + Metsulfuron. Adding the surfactant Quest® to any chemical application seems to improve the success of the control project. Spraying should be completed in the spring when plants are actively growing and the new leaves are about 1/2 to 3/4 in long. Be sure to read and follow pesticide label instructions.

Deep plowing to a depth of 10 inches or deeper and plowing in two directions is often the most effective treatment where soil conditions are favorable. After the first plowing, wait until the plants start growing again and then make the second pass at a 45 degree angle to the previous pass. Regrowth normally occurs in the next growing season but can happen in the year of the first plowing.

Where the site is not conducive to brush removal, but improving the understory is needed, broadcast seeding around the existing plants without disturbing them is an option. The likelihood of success for this type of seeding would be low; however, some of the seed should grow and improve the opportunity for livestock and wildlife use.

One way of seeding areas where a drill can not be used, due to soils being too fluffy or where there are shrubs or plant stumps in the way, is to broadcast or aerially apply seed and then put a large number of animals in the area for a short period of time to work the seed into the soil surface. Seed trampling works best where the soil surface is too soft to be drilled at the right depth, or where you are trying to seed around and/or through an existing stand of black greasewood.

Saline areas with a high water table can not be entered with heavy equipment during much of the year. It is very important that weed control and seedbed preparation are performed. Weed competition and heavy trash are the biggest obstacles in seeding and establishing plant materials on wet to semi-wet saline sites. It is also very important to take advantage of organic matter (plant litter), particularly if salinity/sodicity is associated with a high water table. The growing plants act as a biological pump, keeping the water table far enough below the surface to decrease evaporation and salt deposition on the soil surface. The roots and stems of plants that have been controlled chemically (herbicides), assist with soil structure, infiltration and percolation of moisture through the soil profile. Mechanical tillage can destroy organic matter and soil structure, retard infiltration and may cause salt accumulation on the soil surface. An ATV four-wheeler equipped with spray equipment can enter wet sites earlier in the spring than heavy equipment and may be the best alternative to control weed competition and maintain soil structure.

The optimum period to complete seedings for forage and cover type species in wet-saline soils is late fall and winter (November through February) when soils are frozen and during snow-free periods. The seed should be in the ground before the growing season so that it can take advantage of the diluting effect of early spring moisture on salt concentrations. Under irrigated situations, germination and seedling emergence can be improved with light – frequent irrigations during initial establishment.

Seedbed preparation is critical. With low to moderate salinity, a tilled, firm, weed-free seedbed is recommended. With high to very high salinity levels, particularly when a high water table is involved, tillage may not provide the best seedbed. Under these conditions, vegetation and weeds should be controlled chemically. The soil structure will remain intact and the decomposing stems and roots improve conditions for moisture infiltration into the soil, reduce evaporation from the soil surface, and protect emerging seedlings.

Planting depth for most species should be about 1/4 to 1/2 inch (see table 2 for additional information).

An alternate method of establishing rhizomatous grasses in saline-sodic soils is sprigging. Sprigging involves the planting of rhizomes over an area at a 3 to 4 inch depth. Specialized equipment for digging and planting sprigs is commercially available. Sprigs can also be planted with a tree planter. Plants can be established by sprigging at slightly higher salinity levels than by seeding because the rhizomes are more salt tolerant than seed and seedlings and are placed below the highest concentration of salts that form near the soil surface. Once established, rhizomatous grasses will spread and fill in vacant spaces. The availability of a source of sprigs in close proximity of the planting site, transportation costs, and equipment availability are the greatest limitations to this establishment method.

Areas of black greasewood that are burned, crowned, brush beat, or shallow plowed and/or shallow disked will often result in a much higher density of black greasewood. Over-grazing of the understory vegetation also gives greasewood the chance to increase on the site to the point of site domination.

Not all of the ecological sites where black greasewood is found are suitable for manipulation. Thus, extreme caution should be exercised when selecting which sites have the best potential to be improved.

The following points should be kept in mind when managing black greasewood sites:

- Proper grazing management of understory vegetation is critical to maintaining healthy greasewood sites.

- If proper grazing practices are not followed after improvements are made, the site will quickly revert back to their former state.

- Conditions such as low precipitation, high sodicity and high salinity can reduce the success of improvements.

- Black greasewood is a sprouting plant and will come back vigorously if only the plant crown is disturbed and the root system is not destroyed.

Species Selection

A salinity-sodicity soil assessment must be made prior to selection of site treatment alternatives. It is impractical to recommend a universal mixture covering all variables at potential planting sites. Species not only vary in their salinity tolerance, but also their ability to withstand a high water table or more droughty conditions. Table 2 provides a list of some plant species and releases which may be suitable for use in black greasewood sites.

Most species can be seeded by themselves or in combination with additional adapted species. Species compatibility needs to be considered when developing a seed mixture. Some species have very good seeding vigor; develop rapidly, often at the expense of other species in the seed mixture. It is recommended that tall wheatgrass be planted by itself, as it will completely dominate a planting after 4 to 5 years. Slender wheatgrass also develops rapidly, often developing seed-heads the establishment year. Although slender wheatgrass establishes quickly, providing cover and stability to the site, this species begins to decline after 2 to 5 years relinquishing itself to longer lived species in the mix. Slender wheatgrass should be included in seeding mixtures at a rate of about 1- 2 pounds per acre to avoid competitiveness with other species in the mixture. Both Russian wildrye and tall fescue are slow to develop and are not aggressive seedlings, but commonly dominate a site once established. If these species are desired, they should generally be planted by themselves or in alternate row plantings.

If gradients of soil salinity and/or soil moisture (water tables) are present, mixtures can be designed so each species will dominate in its most favored condition. A mixture of creeping foxtail, western wheatgrass, and beardless wildrye will sort along a wet saline gradient with creeping foxtail on mildly saline, wet end of gradient and beardless wildrye on the most saline, drier end of the gradient. A mixture of Altai wildrye and beardless wildrye will sort along a moisture gradient where Altai wildrye will be on the drier locations. If a site is too wet to traverse with equipment and salinity is low to moderate, creeping foxtail is recommended. An ATV four-wheeler equipped with seeding equipment can enter wet sites better than heavy equipment and may be the best alternative for seeding wet to very wet sites. The optimum period to complete seedings for forage and cover type species in wet to very wet soils is late fall and winter (November through February) when soils are frozen and during snow-free periods.

Beardless wildrye, tall wheatgrass, Russian wildrye, and 'Newhy' hybrid wheatgrass are the most salt-tolerant species on moderate to well drained areas. Beardless wildrye, tall wheatgrass, tall fescue and western wheatgrass are the most salt-tolerant species on wet areas (sites where the water table stays within three feet of the surface the entire growing season). Creeping foxtail is moderately salt tolerant and an excellent forage on wet areas when it can be utilized. Russian wildrye, tall wheatgrass and Altai wildrye are quite drought-tolerant and perform well on drier saline areas (sites where the water table drops below three feet of the surface during the growing season, or where no water table is present). Crested wheatgrass, Siberian wheatgrass, Russian wildrye, intermediate wheatgrass and pubescent wheatgrass are very drought tolerant and will perform very well in drier low to moderately saline areas.

Table 2. Suggested Plants and Seeding Rates for Planting Black Greasewood Sites

	Origin	Release(s)	*Scientific Name*	Salinity/sodicity tolerance	Full PLS rate/ac [a]	Seeding depth (in)
Wet sites						
Beardless wildrye	Native	Shoshone	*Leymus triticoides*	very high	10*	0-1/4 [a]
Tall wheatgrass	Introduced	Alkar; Largo; Jose	*Thinopyrum ponticum*	very high	15	1/4-3/4
Hybrid wheatgrass	Introduced	Newhy	*Elymus hoffmannii*	very high	12	1/4-1/2
Slender wheatgrass	Native	Pryor; San Luis; Revenue	*Elymus trachycaulus*	very high	12**	1/2-3/4
Altai wildrye	Introduced	Prairieland; Pearle; Eejay	*Leymus angustus*	very high	15	1/4-1/2
Tall fescue	Introduced	Kenmont; Fawn; Alta	*Schedonorus phoenix*	high	8	1/4-1/2
Western wheatgrass	Native	Rosana; Rodan; Arriba	*Pascopyrum smithii*	high	9	1/4-1/2
Strawberry Clover	Introduced	Salina	*Trifolium fragiferum*	high	6	1/8-1/4
Creeping foxtail	Introduced	Garrison	*Alopecurus arundinaceus*	moderate	5	1/8-1/4
Dryland Sites						
Russian wildrye	Introduced	Bozoisky II; Mankota; Swift	*Psathyrostachys juncea*	very high	9	1/4-1/2
Tall wheatgrass	Introduced	Alkar; Largo; Jose	*Thinopyrum ponticum*	very high	15	1/4-3/4
Slender wheatgrass	Native	Pryor; San Luis; Revenue	*Elymus trachycaulus*	very high	12	1/2-3/4
Crested wheatgrass	Introduced	Ephraim; Douglas; Hycrest II	*Agropyron cristatum*	high	8	1/4-1/2
Standard crested wheatgrass	Introduced	Nordan; Summit	*Agropyron desertorum*	high	8	1/4-1/2
Siberian wheatgrass	Introduced	P-27; Vavilov; Vavilov II	*Agropyron fragile*	high	9	1/4-1/2
Western wheatgrass	Native	Rosana; Rodan; Arriba	*Pascopyrum smithii*	high	9	1/4-1/2
Nuttall's alkaligrass	Native	Quill	*Puccinellia nuttalliana*	very high	4	1/8-1/4
Alkali sacaton	Native	Salado	*Sporobolus airoides*	high	3	1/8-1/2
Alkali cordgrass	Native		*Spartina gracilis*	high	4	1/8-1/4
Alkali bluegrass	Native		*Poa secunda–juncifolia*	high	3	0-1/4
Yellow sweetclover	Introduced	Madrid	*Melilotus officinalis*	moderate	6**	1/8-1/2

[a] Seeding information from Ogle and others (2006) and are the recommended critical area planting rates of 1.5 times the normal drill seeding rate.

Double these rates if seed is broadcast planted.

* Beardless wildrye requires over-wintering in soil for seed stratification and must be dormant fall planted

** Recommended in mixtures with no more than 2 lb/ac slender wheatgrass and 1 lb/ac sweetclover

The species listed for drier sites perform best in the 12 to 18 inch annual precipitation areas, but some may be adequate in lower rainfall areas as well. For sites with higher rainfall, wet site or irrigated species are recommended.

Slender wheatgrass performs well on both wet and dry sites, but is relatively short-lived (2 to 5 years). Yellow sweetclover performs well in moderate to low levels of salinity on drier sites, but is short-lived. These species could be included in mixtures for quick establishment and cover, but they will not persist over the long term. Both species could be considered as interim hay crops while soil amendments are being used or as green manure crops to improve soil tilth and organic matter, thus enabling the establishment of longer-lived species.

There are no commercially available legumes that will establish in very high saline soils. Strawberry clover is the most salt tolerant legume and it can be used only in wet to saturated conditions. The upper limit for establishment of other saline tolerant legumes is about 10 EC (mmhos/cm) or less.

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TECHNICAL NOTE

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

TN PLANT MATERIALS NO. 19 **APRIL 2007 REVISION**

CALIBRATING A SEED DRILL FOR CONSERVATION PLANTINGS

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INTRODUCTION

Many species of grasses, forbs, legumes and shrubs are planted to help solve resource problems. Some examples include seeding highly erodible cropland to permanent vegetative cover, seeding forages for irrigated pasture or hay, establishing permanent perennial vegetation on rangeland and planting critical areas such as roadsides, winter feedings areas or grassed waterways. To achieve the desired outcome of a seeding practice, an important step is the calibration of the seeding equipment so that the recommended amount of seed is uniformly planted.

Seeding rate recommendations are often given in pounds of Pure Live Seed (PLS) per acre. PLS seeding rates must be converted to bulk pounds per acre in order to calibrate planting equipment. Planting equipment varies considerably among cooperators so it is important to become familiar with the equipment being used.

General rules of thumb are used in setting PLS seeding rates. Seed mixtures commonly have both large and small seeded species. The following rules are used to establish those rates:

Large seed < 500,000 seeds/lb: 20-30 seeds/ft^2 = 12 seeds/ft at 6" row spacing
= 24 seeds/ft at 12" row spacing

Small seed > 500,000 seeds/lb: 40-50 seeds/ft^2 = 24 seeds/ft at 6" row spacing
= 48 seeds/ft at 12" row spacing

Critical area plantings: use 1.5 to 2 times the drill seeding rates shown above.

There are different methods to calibrate a drill.

Method #1: Determine the seeds per foot of row.

Method #2: Run the drill a given distance, weigh the seed dropped, then convert to pounds per acre.

Method #3: Determine the drive wheel circumference, turn it a given number of times, weigh the seed dropped, then convert to pounds per acre.

Method #4: Fill the drill with a weighed amount of seed, seed a measured area, reweigh what is left in the drill, then calculate the pounds per acre.

Method #5: Calculate a rice hull to seed ratio, then set the drill for seeding barley.

Method #6: Consult the seed chart on the inside of the drill cover.

Most people try to use Method #6 because drills generally have a handy chart glued to the inside of the cover and it will list some species, along with seeding rates and drill settings. The charts work well for crops like barley, wheat and sorghum. Unfortunately, the charts DO NOT work well for conservation seedings. Many conservation seedings are mixtures of species. These mixtures have different sized seeds. Some species flow better than others and many times we need to add dilutants such as rice hulls or cracked grain to the seed mix in order for the drill to operate properly.

This technical note provides information on preferred calibration methods (Methods #1 through #5) and the steps required to calibrate seeding equipment for each. It also provides examples to assist the planner and cooperator with drill calibration to complete successful seedings that help solve resource problems.

PRELIMINARY STEPS IN CALIBRATION

Preliminary Step 1 - become familiar with the drill(s) being used. Perform necessary maintenance and check to ensure the drill is in proper operating condition. You can expect to find rusty openers that inhibit seed flow, overzealous greasing and oiling that will interfere with seed flow, and tubes clogged with nesting materials from field mice. Ask the cooperator what species, rates and settings they have used previously or refer to the seed chart with the drill for settings. If the seed mix includes rice hulls, a setting for barley will be a good starting point as mixtures with rice hulls generally flow about the same as barley. This information will provide a good starting point to begin calibration.

Check drill gates or flaps to ensure they are in the proper position for the size and kind of seed being planted and start calibration from a wide-open position and close down to the desired position.

Preliminary Step 2 - determine the bulk seeding rate per acre. Based on the PLS seeding recommendation from the Field Office Technical Guide, Idaho Plant Materials Technical Note No. 24, determine the PLS seeding rates for the mixture. PLS information (purity and viability) will be on the seed tag or seed analysis report. If a carrier such as rice hulls is being used, the amount of rice hulls in the seed mix also needs to be known.

Refer to Idaho Plant Materials Technical Notes: No. 4, Reading Seed Packaging Labels and Calculating Seed Mixtures; No. 7, Grass Legume–Forb Seed Dilution with Rice Hulls; No. 14, Seed Production Standards for Conservation Plants in the Intermountain West; and No. 24, Grass, Grass-Like, Forb, Legume and Woody Species for the Intermountain West for details in determining bulk seeding rates. These Technical Notes can be found at:

http://www.id.nrcs.usda.gov/programs/tech_ref.html#Technotes

To calculate bulk seeding rate use the following formula:

PLS pounds per acre ÷ percent PLS = Bulk seeding rate per acre

Example:

A seeding recommendation for a grass/alfalfa mix includes 7.5 pounds PLS/ac meadow brome and 1.25 pounds PLS/ac alfalfa. Percent PLS for meadow brome as determined from the seed tag is 85 % and alfalfa is 90 %. (PM TN No. 4)

Meadow brome
7.5 pounds PLS per acre ÷ 85 % PLS = 8.8 bulk pounds per acre

Alfalfa
1.25 pounds PLS per acre ÷ 90 % PLS = 1.4 bulk pounds per acre

Rice hulls needed for this mix is 5.1 pounds per acre (PM TN No. 7)

CALIBRATION METHODS

Method 1 - Seed per Linear Row Foot

First calculate a row spacing factor based on the row spacing of the drill. The row spacing factor converts square feet into linear feet based upon the drill spacing. The row spacing factor is calculated as follows:

$$\textbf{Row spacing factor} = \frac{\textbf{522,720 linear inches of row/ac at 12 inch spacing}}{\textbf{Drill spacing (inches)}}$$

Example:

Using a drill with 7 inch row spacing, the row spacing factor is

$$\frac{522{,}720}{7} = 74{,}674$$

Next, calculate the number of seeds per linear row foot with the following formula:

$$\frac{\textbf{Pounds bulk seed/ac x no. seeds per pound}}{\textbf{Row spacing factor}}$$

The pounds bulk seed per acre will have been previously calculated based on the seeding recommendation and the number of seeds per pound can be found in Table 1 of this document as well as Plant Materials Technical Note No. 24, Grass, Grass-Like, Forb, Legume and Woody Species for the Intermountain West.

Example:

Meadow brome 8.8 pounds bulk per acre, 93,000 seeds per pound

$$\frac{8.8 \times 93{,}000}{74{,}674} = 10.9 \text{ (round to 11) seeds per foot with 7 inch row spacing}$$

Alfalfa 1.4 pounds bulk per acre, 200,000 seeds per pound

$$\frac{1.4 \times 200{,}000}{74{,}674} = 3.7 \text{ (round to 4) seeds per foot with 7 inch row spacing}$$

Once the desired number of seeds per foot of drill row has been calculated for each species in the mixture, set the initial setting on the drill. The initial setting will be based on the drill seeding chart or discussion with the cooperator. Release tension on the disks on the drill, and run the drill for at least 20 feet on a clean hard surface protected from wind at the normal planting speed. Make sure that all the drill flutes are feeding properly. Stop the drill and count seed from each species along a distance of 5 feet from 4 rows (two on each side of the drill) to get an average of the number of seeds of each species per foot. Make adjustments to the drill and repeat the above procedure until seed counts are within 10 percent of the desired rate. Check results with one more trial at the same setting.

If a seeding project is using different drills or drills with different row spacing, calibration will need to be done for each drill. If row spacing is different among drills, the number of seeds per foot will also need to be calculated for each drill with different row spacing. If during the calibration process, one species is consistently short, check to make sure the seed mixture is thoroughly mixed. Be sure to record the drill settings for future reference.

Method 2 - Seed Weight-Distance

First compute the area of a 100 foot test run based on the width of the drill to be used for the seeding.

$$\boldsymbol{\frac{\text{Drill width (feet) x 100 foot test run}}{43{,}560 \text{ ft}^2/\text{ac}} = \text{acreage of test run}}$$

Example:

$$\frac{\text{10 foot drill x 100 foot test run}}{43{,}560 \text{ ft}^2/\text{ac}} = 0.02 \text{ ac}$$

Next, calculate the amount of seed mixture required for test run.

Meadow brome	8.8 bulk pounds per acre
Alfalfa	1.4
Rice hulls	5.1
Total	15.3 bulk pounds per acre

15.3 x 0.02 ac = 0.306 pounds of seed mix for test run

Then, determine the amount of seed that will be delivered through each drill spout during the test run.

$$\frac{\text{Pounds of mix for test run}}{\text{Number of spouts on drill}} = \text{pounds of mix per spout}$$

$$\frac{\text{0.306 pounds of seed mix for test run}}{\text{10 spouts on drill}} = \text{0.0306 pounds mix per spout}$$

Since a small amount of seed is being weighed, it is desirable to convert the amount to grams (0.0306 pounds x 454 grams/pound = 13.89 grams per spout for 100 foot test run).

Then, you need to measure and stake off 100 feet and run the drill for at least 6 feet before coming to the first stake to prime the drop tubes. Stop and remove the drill spouts to be weighed from the disks and place a container under the spouts to collect the seed. Drive at a constant speed (the same speed that seeding will take place). Measure a minimum of 2 spouts on each side of drill. Stop and weigh seed from each of the spouts and check with calculated amount. Make necessary adjustments in the drill settings. As with the previous method, make adjustments to the drill and repeat the above procedure until seed weight is within 10 percent of the desired rate. Check results with one more trial at the same setting. If during the calibration process, one species is consistently short, check to make sure the seed mixture is thoroughly mixed. Be sure to record the drill settings for future reference.

A modification to this method, known as the catch-all method, basically involves removing all the spouts and collecting seed from each spout during the calibration trial. The target rate would be the total pounds of seed mix for the test run as shown above (0.306 pounds).

Method 3 - Wheel Circumference

This method involves measuring the drill drive wheel or coulter circumference (perimeter) in feet and determining the number of revolutions the wheel must turn to cover a pre-determined length of run (usually 100 feet). This method only works on drills where the drive wheel can be turned by hand without pulling the drill. A variation to this method that also works quite well is to count the number of revolutions the drive wheel makes in a 100 foot run. It is extremely important that the air pressure in the tires on the drill be maintained at recommended levels during both calibration and seeding. If a consistent air pressure is not maintained, actual seeding rates can be different than the rate calibrated.

First, determine the area covered in 100 feet using the following equation:

$$\mathbf{\frac{\text{Drill width (feet) x 100 foot test run}}{43{,}560\ ft^2\ /acre} = \text{area (acres) of test run}}$$

Example:

$$\frac{\text{10 ft x 100 feet}}{43{,}560\ ft^2/ac} = \text{0.02 acres}$$

Once the distance of the test run is determined, you need to measure the circumference (perimeter) of the drive-wheel and determine the number of revolutions the drill drive wheel must turn to equal the distance of the test run. The calculation for determining the number of rotations is:

$$\frac{\textbf{Distance of test run (feet)}}{\textbf{Wheel circumference (feet)}} = \textbf{number of drive wheel rotations for test run}$$

Example:

$$\frac{100 \text{ feet}}{4.7 \text{ feet}} = 21.3 \text{ wheel rotations for test run}$$

Note: measurements of test run length and wheel circumference should be to the nearest tenth of a foot to insure reasonable accuracy.

Then, remove a spout from a disk opener on the left and right side of the drill and turn the drive wheel or coulter until all of the spouts are dropping seed uniformly to prime the drop tubes.

Turn the drive wheel the number of rotations that were calculated or counted, catch the seed in cans or other clean containers and weigh the collected seed.

Calculate the amount of seed mixture required for test run:

Meadow brome	8.8 bulk pounds per acre
Alfalfa	1.4
Rice hulls	5.1
Total	15.3 bulk pounds per acre

15.3 x 0.02 ac (area of test run) = 0.306 pounds of seed mix for test run

Determine the amount of seed that should be delivered through each drill spout during the test run.

$$\frac{\text{Pounds of mix for test run}}{\text{Number of spouts on drill}} = \text{pounds of mix per spout}$$

Example:

$$\frac{0.306 \text{ pounds of seed mix for test run}}{10 \text{ spouts on drill}} = 0.0306 \text{ pounds mix per spout}$$

Since a small amount of seed is being weighed, it is desirable to convert the amount to grams (0.0306 pounds x 454 grams/pound = 13.89 grams per spout for test run).

As with previous methods, make adjustments to the drill and repeat the above procedure until seed weight is within 10 percent of the desired rate. Check results with one more trial at the same setting. If during the calibration process, one species appears to be consistently short, check to make sure the seed mixture is thoroughly mixed. Be sure to record the drill settings for future reference.

Method 4 - Acreage Weight Method

This method basically involves seeding a known area (less than 1 acre), weighing the amount of seed used and making adjustments to the drill. You can either use the acreage gauge on the drill, if there is one and it is in working condition, or measure the distance traveled multiplied by the drill width. Weigh an amount of seed mix, fill the drill and plant the measured area. Remove the seed remaining in the drill and weigh it. Make adjustments to the drill and repeat the above procedure until seed weight is within 10 percent of the desired rate. Be sure to record the drill settings for future reference. Example:

> Determine acreage of test run and the amount of seed needed for test run. Using a 10 foot drill and a test run of 1000 feet:
>
> $$\frac{10 \text{ feet} \times 1000 \text{ feet}}{43{,}560 \text{ ft}^2/\text{ac}} = 0.23 \text{ acres for test run}$$
>
> 15.3 pounds seed mixture x 0.23 acres = 3.5 pounds
>
> Weigh an amount of seed greater than needed for test run (perhaps 5 pounds in this example) and load into drill and seed a test run. Remove remaining seed from drill and weigh.
>
> Initial weight minus seed used should be within 10 percent of recommended rate (3.2 to 3.9 pounds in this example for the test run).

This method is less desirable because all the seed used for the calibration is lost until the calibration is within the recommended rate.

Method 5 – Calculate rice hull to seed ratio

This method is fairly simple but is less precise because it assumes seed bushel weights do not vary much. Rice hulls are a good dilutant because they are inexpensive, flow well in most drills, aid with feeding small and/or fluffy seeds, and most seed suppliers have rice hulls in stock. It is recommended to use #1 Grade rice hulls. Poor quality rice hulls do not flow as well and are less effective in carrying small or fluffy seeds.

First, set the drill at the 2 bushels per acre for barley. Test the setting by running the drill with a small amount of barley and counting the total number of seeds per running foot for 10 rows. Divide the total by ten to obtain the average number of barley seeds in a foot of row. The number of barley seeds per foot can be easily converted to bushel weights using the following table. In all likelihood, the drill setting will be off and will need a little fine-tuning to get an accurate 2 bushel setting. Record the “measured 2 bushel setting” along side the chart on the drill.

Converting 2 bushels of Barley to seeds per linear foot

Drill Row Spacing	Barley seeds/ linear foot
6 inches	15.0
7 inches	17.5
8 inches	20.0
9 inches	22.5
12 inches	30.0
14 inches	34.5

Second, convert your seeding weights to bushels for each component of the seed mix. The following table provides average bushel weights of common conservation species and rice hulls:

Average bushel weights for common conservation plant materials

Fairway crested wheatgrass	24.5	Smooth brome	21.3
Nordan crested wheatgrass	25.8	Meadow brome	21.7
Tall wheatgrass	18.3	Basin wildrye	17.3
Intermediate wheatgrass	21.2	Orchardgrass	19.5
Pubescent wheatgrass	23.4	Creeping foxtail	10.6
Beardless wheatgrass	21.4		
Siberian wheatgrass	24.2	Cicer milkvetch	63.2
Snake River wheatgrass	20.0	Sainfoin	28.6
Bluebunch wheatgrass	33.0	Birdsfoot trefoil	63.5
Big bluegrass	16.7	Proso millet	52.6
Canby bluegrass	18.5	Small burnet	21.6
Sheep fescue	23.5	Alfalfa	60.0
Tall fescue	24.5	Blue flax	47.5
Indian ricegrass	42.8		
Rice Hulls	9.0	Barley	48.0

Note: you can also weigh a bushel of each component of your seed mixture prior to the mixing process and use that figure if the species is not listed here.

Example:

The plan is to seed 8 pounds of Snake River wheatgrass, 2 pounds of blue flax, and 3 pounds of big bluegrass per acre (bulk weight).

Snake River Wheatgrass	8 lb per ac	÷ 20.0 lb per bushel	=	0.40 bu
Blue flax	2	÷ 47.5	=	0.04
Big bluegrass	3	÷ 16.7	=	0.18
Subtotal	13		=	0.62 bu

2 bushels - 0.62 bushels seed = 1.38 bushels of rice hulls

1.38 bushels x 9 lb per bushel rice hulls = 12.42 lb hulls

You will need 12.42 lb rice hulls per acre. The hulls and seed are mixed before placing them in the drill which has been set to seed 2 bushels of barley per acre.

REFERENCES

Calibrating a Drill. USDA NRCS Plant Materials Technical Note No. 30, Bozeman, MT May 1985.

Grass, Grass-Like, Forb, Legume, and Woody Species for the Intermountain West. USDA NRCS Plant Materials Technical Note No. 24, Boise, ID; Bozeman, MT; Spokane, WA February 2007.

Grass-Legume-Forb Seed Dilution with Rice Hulls. USDA NRCS Plant Materials Technical Note No. 7, Boise, ID October 1990.

Reading Seed Packaging Labels and Calculating Seed Mixtures. USDA NRCS Plant Materials Technical Note No. 4, Boise, ID October 2002.

Seed Production Standards for Conservation Plants in the Intermountain West. USDA NRCS Plant Materials Technical Note No. 14, Boise, ID December 2001.

Seeding Rate and Row Spacing Calculations for Rangeland Plantings. USDA NRCS Range Technical Note No. 30, Boise, ID March 1985.

Setting a Drill for Seed Increase Plantings. USDA NRCS Plant Materials Technical Note No. 19, Boise, ID October 1990.

Table 1
PLANT ADAPTATION and SEEDING RATES
<u>from Plant Materials Technical Note No. 24</u>

Common Name	Longevity	Seedling Vigor	Character	Seeds/Lb	1 lb/Acre Seeds/ft[2]	Precip	Soil	Depth	PLS Rate
GRASSES									
Bentgrass, Redtop	Long	Low-Med.	Sod	4,990,000	115	+18	wet	0-1/4	0.5
Bluegrass, Big	Medium	Low-Med.	Bunch	925,000	21	+ 9	cl-sl	0-1/4	2
Bluegrass, Canby	Long	Low-Med.	Bunch	925,000	21	+ 9	c-sl	0-1/4	2
Bluegrass, Canada	Long	Low-Med.	Sod	1,600,000	36	+18	cl-sl	1/4-1/2	2 (6 sod)
Bluegrass, Kentucky	Long	Low-Med.	Sod	2,200,000	50	+18	cl-sl	0-1/4	2 (4 sod)
Bluegrass, Mutton	Long	Low-Med.	Bunch	890,000	20	+10	cl-s	1/8-1/4	2
Bluegrass, Sandberg	Long	Low-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	5
Canarygrass, Reed	Long	Med.-Rapid	Sod	506,000	12	+18	c-sl	1/4-1/2	4
Dropseed, Sand	Long	Low	Bunch	5,298,000	122	+ 7	fsl-s	0-1/4	1
Fescue, Hard	Long	Low	Bunch	560,000	13	+14	c-sl	0-1/4	4
Fescue, Idaho	Long	Very Low	Bunch	450,000	10	+16	cl-sl	1/4-1/2	4
Fescue, Red	Long	Low	Sod	614,000	14	+18	c-sl	0-1/4	4 (15 sod)
Fescue, Sheep	Long	Low	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 (40 sod)
Foxtail, Creeping	Long	Low	Sod	750,000	17	+18	c-l	1/8-1/4	3
Hairgrass, Tufted	Long	Low	Bunch	2,500,000	57	+18	c-sl	0-1/4	1.5
Junegrass, Prairie	Medium	Low-Med.	Bunch	2,315,000	53	12-20	sil-s	1/4-1/2	1
Needlegrass, Green	Long	Low	Bunch	180,000	3-4	8-20	cl-sl	1/4-1/2	6
Needlegrass, Thurber	Long	Low	Bunch	180,000	3-4	8-16	cl-sl	1/4-1/2	8
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	15-25
Sacaton, Alkali	Long	Low-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. Low	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

Table 1 from 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 (continued)									
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
Wheatgrass, Intermediate	Long	Rapid	Sod	80,000	2	+13	cl-sl	1/4-1/2	10
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	10
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 (24 sod)
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	8
Wildrye, Altai	Long	Low	Bunch	73,000	2	+14	saline	1/4-1/2	12
Wildrye, Basin	Long	Low	Bunch	130,000	3	+8	sil-sl	1/4-3/4	7
Wildrye, Beardless	Long	V. Low	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. Low	Sod	55,000	1	+12	ls-s	1/4-1/2	15
Wildrye, Russian	Long	Low	Bunch	170,000	4	+8	c-sl	1/4-1/2	6

Table 1 from 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 - LEGUMES									
Alfalfa	Medium	Medium	Erect	200,000	5	+14	sil-sl	1/8-1/2	5 (10- 15 hay)
Aster	Medium	Low	Erect	800,000	18	+12	cl-sil	0-1/2	2
Balsamroot, Arrowleaf	Long	V. Low	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	4
Crownvetch	Long	Medium	Prostrate	98,000	2	+15	sil-sl	1/4-1/2	13
Flax, Blue	Short	Low-Med.	Erect	278,000	6	+10	sil-sl	0-1/8	4
Globemallow	Long	Low	Erect	750,000	17	+7	saline	1/8-1/4	2
Milkvetch, Cicer	Long	Low	Erect	130,000	3	+15	c-l	1/4-1/2	7
Penstemon, Venus	Medium	V. Low	Erect	1,090,000	25	+16	cl-sl	0-1/8	2
Penstemon, Firecracker	Short	V. Low	Erect	315,000	7	+10	cl-sl	0-1/8	4
Penstemon, Palmer	Medium	V. Low	Erect	294,000	7	+10	cl-sl	0-1/8	4
Penstemon, Rocky Mtn.	Medium	V. Low	Erect	286,000	7	+18	cl-sl	0-1/8	2
Sagewort, Louisiana	Short-Med.	Medium	Erect	3,750,000	86	+12	cl-sl	0-1/4	0.25
Sainfoin	Medium	Low-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	Low	Erect	70,000	2	+10	cl-sl	1/8-3/4	18
Trefoil, Birdsfoot	Long	Low	Erect	375,000	9	+18	c-s	1/4-1/2	5
Yarrow, Western	Medium	Low	Prostrate	4,124,000	95	+8	cl-sl	0-1/4	0.5

Common Name	Longevity	Seedling Vigor	Character	Seeds/Lb	1 lb/Acre Seeds/ft^2	Precip	Soil	Depth	PLS Rate
SHRUBS									
Bitterbrush, A.	Long	Low	Shrub	15,400	0.4	+10	cl-sl	1/2-1.0	70 (1/4*)
Buckwheat, Whorled	Long	Low	Half-Shrub	135,700	3.0	+15	sl-sil	0-1/4	plants
Buckwheat, Snow	Medium	Low	Half-Shrub	500,000	11.5	+7	rocky	0-1/4	plants
Buckwheat, Sulphurflower	Long	Low	Half-Shrub	209,000	5.0	+14	sl-sil	0-1/4	plants
Buffaloberry, Silver	Long	Low	Shrub	40,000	0.9	12-20	sc	1/2	plants
Ceanothus/Snowbrush	Long	Low	Shrub	94,000	2.2	+16	sil-s	1/4-1/2	plants
Chokecherry	Long	Low	Shrub	4,790	0.1	+12	sil-s	1/2-1.0	plants
Cinquefoil, Shrubby	Long	Low	Shrub	1,000,000	23.0	+18	wet-all	surface	plants
Clematis	Long	Low	Creeping Vine	315,000	7.2	+10	moist	-----	plants

Table 1 from 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 (continued)									
Current, Golden	Long	Low	Shrub	233,000	5.4	+12	sil-sl	1/16-1/4	plants
Current, Wax	Long	Low	Shrub	251,000	5.8	+12	sil-sl	1/16-1/4	plants
Dogwood, Redosier	Long	Low	Shrub	18,500	0.4	+16	moist	-----	cuttings
Elderberry, Blue/Red	Medium	Low	Shrub	205,000	4.7	+18	gravelly	-----	plants
Hawthorn, Black	Long	Low	Sm. Tree	22,600	0.5	+12	cl-sl	0-1/4	plants
Kinnikinnick	Long	Low	Creeping Shrub	40,000	0.9	+18	cl-sl	-----	plants
Kochia, Forage	Long	Low	Half-Shrub	395,000	9.0	+8	cl-sl	0-1/16	2.0 (1/40*)
Mountain Mahogany	Long	Low	Shrub	48,000	1.1	+14	rocky	0-1/2	plants
Oregongrape	Long	Low	Creeping Shrub	45,000	1.0	+15	moist	1/4-1/2	plants
Rabbitbrush, Green	Long	Low	Shrub	782,000	17.9	+10	sil-s	surface	plants
Rabbitbrush, Rubber	Long	Low	Shrub	693,000	15.9	+10	sil-s	surface	plants
Rose, Woods	Long	Low	Shrub	50,000	1.1	+12	l-sl	1/2	1.0 (1/40*)
Sagebrush, Big spp.	Long	Low	Shrub	1,700,000	39.0	8-18	cl-sl	0-1/8	0.5 (1/40*)
Sagebrush, Black	Long	Low	Shrub	907,000	20.8	+10	limy	0-1/8	0.5 (1/40*)
Saltbush, Fourwing	Long	Low	Shrub	52,000	1.2	8-16	l-s	1/4-3/4	20 (1/4*)
Saltbush, Gardner	Long	Low	Shrub	114,000	2.6	6-16	l-s	1/4-3/4	10 (1/4*)
Serviceberry	Long	Low	Shrub	82,000	1.9	+14	sil-sl	1/4-1/2	plants
Shadscale	Long	Low	Shrub	64,900	1- 2	+6	cl-sil	1/4-3/4	20 (1/4*)
Silverberry	Long	Low	Shrub	3,800	0.1	+14	sil-sl	0-3/4	plants
Snowberry	Long	Low	Shrub	76,000	1.7	+14	sil-sl	0-1/2	plants
Sumac, Skunkbush	Long	Low	Shrub	20,300	0.5	+14	rocky	1/2-1.0	plants
Syringa (Mockorange)	Long	Low	Shrub	8,000,000	183.7	+18	moist	-----	plants
Winterfat	Long	Low	Half-Shrub	123,000	2.8	+7	limy	0-1/8	9 (1/4*)

* 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 approximately 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.

TECHNICAL NOTE

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

TN PLANT MATERIALS NO. 24 **FEBRUARY 2007 REVISION**

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

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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. Additional information can be found in plant guides, plant fact sheets and other appropriate guides. Consult the USDA-NRCS, PLANTS Database at http://plants.usda.gov/ for additional information.

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 accessions (< 500,000 seeds per pound) and 40-50 seeds/ft^2 for the smaller seed size accessions (> 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 2006 as found 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.

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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 is 115. Recommend pure stand seeding rate is 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. It is 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 is 0-1/4 inch. Adapted variety is 'Sherman'. Average seeds/ft^2 at 1 lb. rate is 21. Recommend pure stand seeding rate is 2 lb/ac.

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

Canby bluegrass is 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. It is adapted to 9 to 15 inch precipitation zones. Use only in native seed mixtures due to its slow establishment. Planting depth is 1/4 inch or less. Adapted variety is 'Canbar.' Average seeds/ft^2 at 1 lb. rate is 21. The recommended pure stand seeding rate is 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 is 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 is 36. The recommended pure stand seeding rate is 2 lb/ac. The recommended seeding rate for turf applications is 6 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. Planting depth is 1/4 inch or less. Numerous adapted varieties have been developed in the northwest and are available. Average seeds/ft^2 at one pound rate is 50. Recommended seeding rate is for turf applications is 4 lb/ac.

Bluegrass, Mutton (Muttongrass) *Poa fendleriana*

Muttongrass is a perennial bunchgrass growing to 2.5 feet tall. It is an important understory component in juniper, pinon pine – juniper, ponderosa pine and sagebrush steppe plant communities. It is also occasionally found in aspen, Engelmann spruce and lodgepole pine plant communities. It is a drought tolerant species found most commonly on well drained clay loam to silt loam to sandy to gravelly soils. It is adapted to areas receiving 10 to 22 inches annual precipitation. There are no releases currently available. However Aberdeen PMC currently has this species under advanced evaluation. Planting depth is 1/8 - 1/4 inch or less. Average seeds/ft^2 at one pound rate is 20. Recommended pure stand seeding rate is 2 lb/ac. It is best utilized in low rainfall area native mixes.

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. Mountain Home Source Identified release originating from the Mountain Home, Idaho areas is also available. Planting depth is 1/4 inch or less. Average seeds/ft^2 at one pound rate is 21. Recommended pure stand seeding rate is 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 smooth brome does. It is an excellent choice in areas that are prone to early to late spring frost. It is productive and compatible in mixtures with legume species such as alfalfa, sainfoin, cicer milkvetch, and birdsfoot trefoil. Planting depth is 1/4 to 1/2 inch. Varieties include ‘Cache’, 'Fleet', ''Montana PVP', 'MacBeth PVP', 'Paddock' and 'Regar'. Average seeds per ft^2 at 1 lb. rate is 2. Recommended pure stand seeding rate is 10 lb/ac.

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

Mountain brome is a short-lived vigorous native bunchgrass which reaches full productivity in 1- 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 is 1/4 to 1/2 inch. Adapted varieties are 'Bromar', susceptible to seed head smut and Garnet Tested Class Germplasm, which is believed to be more smut resistant. Average seeds per ft^2 at 1 lb. rate is 2. The recommended pure stand rate is 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 is 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 seeding rate is 5 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 very high annual yields on moist fertile soils, high in nitrogen and organic matter. It becomes sod-bound with infertile soil conditions. 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 is 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 seeding rate is 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 is 1/4 inch. No varieties have been released. Average seeds per ft^2 at 1 lb. rate 122. Recommend pure stand seeding rate is 1.0 lb/ac.

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

A very fine-leaved, 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 is 0-1/4 inch. 'Durar' is the adapted variety. Average seeds per ft^2 at 1 lb. rate 13. The recommended pure stand seeding rate is 4 lb/ac.

Fescue, Idaho *Festuca idahoensis*

Idaho fescue is 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 is 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 is 10. Recommended pure stand seeding rate is 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. They perform best on acidic soils (pH 5.5-6.5) and overall production increases 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 is 0-1/4 inch. Average seeds per ft^2 at 1 lb. rate 14. Recommended pure stand seeding rate is 4 lb/ac. The recommended seeding rate for turf applications is 15 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. It is 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 is 0-1/4 inch. Adapted varieties are 'Covar' and 'Bighorn'. Average seed per ft^2 is 16 at a 1 lb. rate. The recommended pure stand seeding 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. It should only be recommended as a monoculture seeding or if in a mixture, seeded in an alternate row planting because it is very competitive and tends to out-compete other species in a seeding mixture. Planting depth is 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 is 5. The recommend pure stand seeding rate is 5 lb/ac. The recommended seeding rate for turf applications is 40 lb/ac.

Foxtail, Creeping *Alopecurus arundinaceus*

Creeping foxtail is a long-lived, cool-season, dense sod forming introduced grass that is adapted to wet- slightly saline-acidic-poorly drained 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. It is compatible with cicer milkvetch in a mixture. 'Garrison' and 'Retain' are well-adapted cultivars: Seed is very light and difficult to seed without the use of cracked corn, 2 bushels of rice hulls, or other carrier. Planting depth is 1/8 to 1/4 inch. The average seeds per ft^2 at 1 lb. rate is 17. The recommend pure stand seeding rate is 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. Corvallis PMC has released Willamette and Tillamook Selected class releases, but they are not recommended for planting in the Intermountain region. Average seeds per ft^2 at 1 lb. rate 57. Recommended seeding rate is 1.5 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, 0.5- 2 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. The recommended pure stand seeding rate is 1 lb/ac. Not recommended in pure stands.

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

Green needlegrass is a cool season, medium to 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. It is widely adapted from Alberta to New Mexico. High seed dormancy levels are 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. The average seeds per ft^2 at 1 lb. rate is 4. Recommend pure stand seeding rate is 6 lb/ac.

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

Letterman needlegrass is 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, but most often found on clayey to loamy soils. No releases are available. Native seed mixtures should specify "Source Identified" seed. Average seeds per ft^2 at 1 lb. rate is 4. The recommend pure stand seeding rate is 5 lb/ac.

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

Needle and Thread is a cool season, tufted, perennial, native bunchgrass, 1-3 feet tall. It is 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 mixtures should specify "Source Identified" seed. The average seeds per ft^2 at 1 lb. rate is 3. Seeding rate is 6 lb/ac.

Needlegrass, Thurber's *Achnatherum thurberianum* or *Stipa thurberiana*

Thurber's needlegrass is 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 mixtures should specify "Source Identified" seed. The average seeds per ft^2 at 1 lb. rate is 3. Seeding rate is 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 optimum 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. Not well adapted to areas that are cold and very dry in winter and areas that commonly experience mid to late spring frost. 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 seeding rate is 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). It 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 is 5. Recommend pure stand seeding rate is 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. It is 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 is 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 seeding rate is 15-25 lb/ac.

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 is 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 is 4. Seeding rate is 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. It 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 is 10. Seeding rate is 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. It can also be used for ground cover and erosion control on cut or burned-over timberland. Planting depth is 1/8 to 1/2 inch. Adapted varieties are 'Climax', 'Mohawk'. The average seeds per ft^2 at 1 lb. rate is 28. Recommend pure stand seeding rate is 3 lb/ac.

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

Beardless wheatgrass is 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 forage 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 is 3. The recommended pure stand seeding rate is 7.0 lb/ac.

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

Bluebunch wheatgrass is 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 is 1/4 to 1/2 inch. Adapted varieties are Anatone Selected class germplasm for use above 10 inches of precipitation and 'Goldar' and 'P7' for use above 12 inches of 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"). The average seeds per ft^2 at 1 lb. rate is 3. Recommend pure stand seeding rate is 7.0 lb/ac.

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

Fairway type crested wheatgrass is 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 is 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'. The average seeds per ft^2 at 1 lb. rate is 4. Recommend pure stand seeding rate is 5.0 lb/ac.

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

Standard type crested wheatgrass is 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 is 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 seeding rate is 5 lb/ac.

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

This crested wheatgrass is a hybrid cross between Standard type and induced tetraploid Fairway type crested wheatgrass. Seedlings are extremely vigorous during germination and early establishment. It survives under greater competition than other crested wheatgrasses. Yields more forage (15-20%) in younger stands; is an outstanding seed producer, but more stemmy. It occupies same sites as standard and Fairway crested wheatgrass. It is especially useful in drier sagebrush - cheatgrass sites and survives in areas with 9-16 inches precipitation. It does not persist as well as Standard type crested wheatgrass or Siberian wheatgrass in very droughty sites. Planting depth is 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 seeding rate is 5 lb/ac.

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

Intermediate wheatgrass is 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. It is 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 three irrigation applications 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. It is 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 is 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 seeding rate is 10 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. It is 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 is 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 is 8 lb/ac.

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

Pubescent wheatgrass is a long-lived, late maturing, introduced sod-forming grass adapted to low-fertility sites and coarse to medium textured soils. It is very similar to intermediate wheatgrass (except it has pubescence on leaves and seed heads) and is 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 three irrigation applications 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. It is 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), 'Manska' and 'Greenleaf'. Average seeds per ft^2 at 1 lb. rate 2. Recommend pure stand seeding rate is 10 lb/ac.

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

Siberian wheatgrass is 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 is 1/4 to 1/2 inch. Adapted varieties include 'P-27', 'Vavilov' and 'Vavilov II' (recently released with improved seedling vigor). Average seeds per ft^2 at 1 lb. rate is 4. Recommend pure stand seeding rate is 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 is 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. 'First Strike' is a germplasm recently released by ARS. Average seeds per ft^2 at 1 lb. rate 3.0. Recommend pure stand seeding rate is 6 lb/ac. Limit slender wheatgrass to 1- 2 pounds PLS per acre in native mixtures. Higher rates limit the establishment of slower developing native species in a seed mixture.

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 adapted to most bluebunch wheatgrass sites, but is best suited for the lower precipitation areas (8 to 12 inches). (See bluebunch wheatgrass). The only variety available is 'Secar'. It is an early maturing bunchgrass with good seedling vigor and establishes well in native seed mixtures. It is considered more drought tolerant than released bluebunch wheatgrasses. Average seeds per ft^2 at 1 lb. rate is 3. Recommend pure stand seeding rate is 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 is 1/4 to 1/2 inch. The only variety is 'Sodar'. Average seeds per ft^2 at 1 lb. rate 3. Recommend pure stand seeding rate is 6 lb/ac. Seeding rate for turf and critical area applications should be approximately 24 lb/ac.

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

Tall wheatgrass is 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. It is 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. It is also adapted to intermediate and favorable sagebrush, mountain brush, and juniper sites where its drought tolerance is evidenced. Planting depth is 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 seeding rate is 10 lb/ac on good soils. Increase seeding rate to 14 lb/ac. on saline soils.

Wheatgrass, Thickspike *Elymus lanceolatus* ssp. *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. It can tolerate moderate grazing and considerable trampling. It is 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 is 1/4 to 1/2 inch. Improved varieties include 'Bannock', '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. Average seeds per ft^2 at 1 lb. rate is 3. Recommend pure stand seeding rate is 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. It 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 is 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 is 8 lb/ac. Not recommended in pure stands. Recommended 50% mixed stand seeding rate is 4.0 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. It is 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', ‘Mustang’ and 'Prairieland' are released varieties. Average seeds per ft^2 at 1 lb. rate 2. Recommended pure stand seeding rate is 12 lb/ac.

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

Basin wildrye is a slightly spreading, robust, large native bunchgrass. Basin wildrye is tall, coarse, long-lived, and highly palatable early in spring, 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. The old coarse growth is readily utilized under winter grazing when protein supplements are provided. Best adapted to moderately saline or alkaline lowlands, flood plains, and 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 is 1/2 to 3/4 inch. Adapted cultivars are 'Magnar' (blue-green upright leaves) and 'Trailhead' (green overhanging leaves) selected for excellent drought tolerance. Washoe was selected for high tolerance to acidic conditions and should be useful in mine reclamation situations. Average seeds per ft^2 at 1 lb. rate is 3. Recommended pure stand seeding rate is 7 lb/ac. Basin wildrye is highly recommended for native species mixtures.

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

Beardless wildrye is 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 is 0-1/4 inch in a firm weed free seedbed. Adapted variety is '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 is 4. Recommended pure stand seeding rate is 6 lb/ac.

Wildrye, Blue *Elymus glaucus*

Blue wildrye is 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. Planting depth is 1/4 to 1/2 inch. No Intermountain West adapted varieties have been released, but a selection is being developed by the Pullman PMC. Northwest coastal releases are not recommended for the Intermountain West. They include 'Arlington' and 'Elkton'. Average seeds/ft^2 at 1 lb. rate is 3. Recommended pure stand seeding rate is 7 lb/ac.

Wildrye, Canada *Elymus canadensis*

Canada wildrye is 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. Planting depth is 1/4 to 1/2 inch. 'Mandan' was released from Bismarck, North Dakota PMC. Average seeds/ft2 at 1 lb. rate is 3. Recommended pure stand seeding rate is 7 lb/ac.

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

Mammoth wildrye is a coarse textured, 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 is 1. The recommended seeding rate is 15 lb/ac.

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

Russian wildrye is 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. Plant this species in areas receiving at least 8 inches of precipitation. It is adapted to sagebrush, mountain brush, juniper-pinyon, and moderately saline sites. It is 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 II’ and '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, the Bozoisky-Select, Bozoisky II and Mankota releases should be the varieties of choice and they should be planted in 18 inch or wider rows and in alternate rows when planted with other species. Average seeds per ft^2 at 1 lb. rate is 4. The recommend pure stand seeding rate is 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-grown 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-grown 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-grown 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-grown 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-grown 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-grown 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-grown 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-grown 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. It 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 alfalfas. Seedings should occur in mid spring to avoid risk to a killing frost. Seed requires inoculation with nitrogen-fixing bacteria before planting. The 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. It is adapted to well-drained intermediate and favorable sagebrush, juniper, mountain brush, and ponderosa pine sites. It 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 FS 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 is 1/16 to 1/2 inch in a very firm, weed-free seedbed. Average seeds per ft^2 at 1 lb. rate 5. Full seeding rate for pasture and range plantings is 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 grazing situations to help reduce bloat problems.

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

Blueleaf aster is 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. Planting depth is 0 to 1/2 inch. 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 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 seeding rate is 20 lb/ac.

Clover, Alsike *Trifolium hybridum*

Alsike clover is 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 is 1/8- 1/4 inch. Adapted variety is 'Aurora'. Average seeds per ft^2 at 1 lb. rate is 16. Pure stand seeding rate 3 lb/ac. Recommended 25% mixed stand seeding rate is 1 lb/ac for grazing 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 is 1/8- 1/4 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 seeding rate is 1.5 lb/ac for grazing 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 is 1/4 inch or less. Average seeds per ft^2 at 1 lb. rate is 7. Pure stand seeding rate is 4 lb/ac. Recommended 25% mixed stand seeding rate is 1 lb/ac for grazing 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. It requires medium to high fertility and adequate moisture for optimum production. It is not tolerant of strongly acid or strongly alkaline conditions and is not tolerant of poor drainage. It 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 is 18. Pure stand seeding rate is 4 lb/ac. Recommended 25% mixed stand seeding rate is 1 lb/ac for grazing situations.

Crownvetch *Coronilla varia*

Crownvetch is a long-lived, introduced 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 acidic 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 is 2. Pure stand seeding rate is 13 lb/ac. Recommended 25% mixed stand seeding rate is 3 lb/ac for grazing situations.

Flax, Blue and Lewis flax *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 when 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 Selected class germplasm (*Linum lewisii)* is a new native release by the Forest Service and Aberdeen PMC. Average seeds per ft^2 at 1 lb. rate is 6. Pure stand seeding rate is 4 lb/ac. Not recommended in pure stands.

Globemallow, Gooseberry Leaf and Scarlet *Sphaeralcea grossulariifolia* 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 is 17. Pure stand seeding rate is 2 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 is 1/4 to 1/2 inch. Recommended varieties include 'Lutana', 'Monarch' and 'Windsor'. Average seeds per ft^2 at 1 lb. rate is 3. Pure stand seeding rate is 7 lb/ac. Recommended 50% mixed stand rate is 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 is 7. Pure stand seeding rate is 4 lb/ac. 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 is 7. Pure stand seeding rate is 4 lb/ac. Not recommended in pure stands.

Rocky Mountain Penstemon *Penstemon strictus*: A perennial native semi-evergreen forb that is long-lived and 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. It has good potential as an ornamental. 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 this species in late fall-early winter on soil surface to 1/8-inch depth. Average seeds per ft^2 at 1 lb. rate is 7. Pure stand seeding rate is 2 lb/ac. Not recommended in pure stands.

Venus 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 Venus penstemon from Aberdeen PMC. Due to hard seed, plant this species in late fall-early winter at soil surface to 1/8-inch depth. Average seeds per ft^2 at 1 lb. rate is 25. Pure stand seeding rate is 2 lb/ac.

A number of additional penstemon species are currently under development including sagebrush penstemon, sand penstemon and hotrock penstemon

A number of other penstemon species are also seeded primarily for soil stabilization on depleted, disturbed and erosive areas and used as ornamentals, but no releases have been made. These include Low penstemon, Rydberg penstemon and thickleaf penstemon.

Sagewort, Louisiana (cudweed sagewort) *Artemisia ludoviciana*

Louisiana sagewort is a perennial, rhizomatous, long-lived, fast-growing, native forb to sub-shrub 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 is 86. The pure stand seeding rate is 0.25 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; however, it is 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. It is 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. It is 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. Plant in spring or fall at seeding depth of 1/2 to 3/4 inch. Adapted varieties are 'Eski', 'Melrose' and 'Renumex' for dryland plantings and 'Remont' for irrigated plantings. Average seeds per ft^2 at 1 lb. rate is 0.4. The full seeding rate is 34 lb/ac. The recommended 50% mixed stand rate is 17 lb/ac for pasture situations.

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

Sweetclover is an introduced, tall, stemmy, deep rooted, biennial legume. It produces an abundance of forage the first two years and is commonly utilized as a cover crop for perennial seedings. It reseeds and maintains good stands where perennials do not crowd it out and in years of above normal precipitation. It is a poor quality forage at mid to later growth stages. It is adapted to many sites including sagebrush-grass to subalpine areas, moist salty lowlands, road cuts and roadsides but does not tolerate acid soils. It maintains stands in grass where ample moisture is available. It is 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. The planting depth is 1/8 to 1/2 inch. Adapted variety is 'Madrid'. Average seeds per ft^2 at 1 lb. rate is 6. Pure stand seeding rate is 4 lb/ac. Recommended 25% mixed stand rate is 1 lb/ac for pasture situations or 5 to 10% mixed stand seeding rate of 0.12 to 0.25 lb/ac for cover-crop situations.

Sweetvetch, Northern or 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 is 2. Pure stand seeding rate is 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. It 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 is 1/4 to 1/2 inch. Recommend alternate row plantings to allow birdsfoot trefoil to establish when planted as part of a seeding mixture that includes grasses. Adapted varieties are 'Empire' (decumbent growth), and 'Maitland' (erect growth). Average seeds per ft^2 at 1 lb. rate is 9. Pure stand seeding rate 5 lb/ac. Recommended 50% mixed stand seeding rate is 2.5 lb/ac for grazing 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 released Great Northern Selected class germplasm from a source in northwestern Montana. The Forest Service is expected to release Eagle Selected class germplasm from a source near Boise, Idaho in the near future. Average seeds per ft^2 at 1 lb. rate is 95. Pure stand seeding rate is 0.5 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 is 0.4. Pure stand seeding rate is 1.5 lb/ac. Not recommended for pure stands. Recommended rate in mixture is approximately 0.25 pound PLS per acre. This species is most commonly established with nursery grown plants.

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 is 0.4. Pure stand seeding rate is 1.5 lb/ac. Not recommended for pure stands. Recommended rate in mixture is approximately 0.25 pound PLS per acre. This species is most commonly established with nursery grown plants.

Buckwheat, Snow *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 nectar for bees. The seed matures 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 xeriscape plantings. The Pullman PMC released ‘Umatilla’ snow buckwheat in 1991 and commercial seed production is underway. Average seed per ft^2 at 1 lb. Rate is 12. The pure stand seeding rate is 2 lb/ac. Not recommended in pure stands. Recommended seeding rates in mixes is 0.5 pound PLS per acre. This species is most commonly established with nursery grown plants.

Buckwheat, Sulphur-flower *Eriogonum umbellatum*

Sulphur-flower buckwheat is a perennial half-shrub that grows on rocky or gravelly mountain foothills and canyon areas that receive 12-25 inches precipitation. It is often found growing in association with mountain big sagebrush and antelope bitterbrush plant communities. It usually is less than 2.0 feet tall. The leaves are about an inch long, shiny green on top and wooly pubescent below. The flowers are clusters of sulphur-yellow-orange-reddish somewhat rounded showy heads. They are an excellent source of late season nectar for bees. The seed matures in late fall and seedlings emerge in early spring. Insects are attracted to this plant and it is important food sources for small birds. Wildlife use sulphur-flower buckwheat for cover and forage. It has great ornamental appeal and should be an ideal plant for xeriscape plantings. There are no releases of sulphur-flower buckwheat. However, collection and evaluation of this species is underway at Aberdeen, ID PMC. Average seed per ft^2 at 1 lb. Rate is 5. The pure stand seeding rate is 4 lb/ac. Not recommended in pure stands. Recommended seeding rates in mixes is 0.5 pound PLS per acre. This species is most commonly established with nursery grown plants.

Buckwheat, Whorled *Eriogonum heracleoides*

Whorled or parsnip-flower buckwheat is a perennial half-shrub that grows on rocky or gravelly mountain foothills and canyon areas that receive 12-25 inches precipitation. It is often found growing in association with mountain big sagebrush and antelope bitterbrush plant communities. It usually is less than 2.5 feet tall. The leaves are covered with dense white pubescent hairs making the foliage appear green – blue-grayish in color. The flowers are white to cream and showy, and are an excellent source of late season nectar for bees. The seed matures in late fall and seedlings emerge in early spring. Many insects are attracted to this plant and it is important food sources for small birds. Wildlife use whorled buckwheat for cover and forage. It has great ornamental appeal and should be an ideal plant for xeriscape plantings. There are no releases of whorled buckwheat. However, collection and evaluation of this species is underway at Aberdeen, ID PMC. Average seed per ft^2 at 1 lb. Rate is 3. The pure stand seeding rate is 8 lb/ac. Not recommended in pure stands. Recommended seeding rates in mixes is 0.5 pound PLS per acre. This species is most commonly established with nursery grown plants.

Buffaloberry, Silver *Shepherdia argentea*

Silver buffaloberry is 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 use 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, 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 stratification at $68\text{-}86^0$ 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. It is sought out by big game and livestock. It 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. This species is most commonly established with nursery grown plants.

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. It is more common in silty or moderately acidic, moderately basic, and weakly saline soils. It is an aggressive root and sucker sprouting species after fire. It has 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 species. 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. Pure stand seeding rate 1-2 lb/ac. Mixed stand seeding rate 1/4 lb/ac. Not recommended for pure stands. This species is most commonly established with nursery grown plants.

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

Shrubby cinquefoil is 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. This species is most commonly established with nursery grown plants.

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, affecting 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. This species is most commonly established with nursery grown plants.

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

Golden currant is a fast growing native shrub, which 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 currant is an excellent erosion control plant, because it spreads both vegetatively and by seed. Golden currant is used in conservation plantings and has fairly good saline tolerance. Golden currant 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 is 5.4 to 5.8. Not recommended for pure stands. Mixed stand seeding rate is approximately 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*

Elderberry is a native, medium shrub with broad crowns, straight trunks, 3- 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 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 the only release. Elderberry is not recommended for seedings and should be established with container stock.

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

Hawthorn is 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. Its preferred habitat is 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 generally not recommended for seedings and should be established or planted with container stock.

Kinnikinnick (Bearberry) *Arctostaphylos uva-ursi*

Kinnikinnick is 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°C to 104°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 a drill is used for seeding, seed should <u>not</u> be placed deeper than 1/16-inch. Seeding can be in combination with other perennial species. One cultivar, 'Immigrant' has been released. The ARS in Logan, Utah is evaluating other accessions with taller statures that would extend above winter snow to provide livestock and wildlife better access to forage for winter grazing. Average seeds per ft^2 at 1 lb. rate is 9. Recommended full seeding rate is 0.5 lb/ac. It is not recommended in pure stands. Recommended seeding rate in mixtures 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 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 is 1. Mixed stand seeding rate is 1/4 lb/ac. Not recommended for pure stands. This species is most commonly established with nursery grown plants.

Oregongrape (Barberry) *Mahonia* spp.

Oregongrape is 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 is 1.0. Seeding rate in mixtures is 1/4 lb/ac. Not recommended for pure stands. This species is most commonly established with nursery grown plants. 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. It 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 is 18. Pure stand seeding rate is 0.5 lb/ac. Not recommended for pure stands. It can be difficult to establish by seeding. Recommended rate in mixes is approximately 1/40 of a pound PLS per acre. This species is most commonly established with nursery grown plants.

Rabbitbrush, Rubber *Ericameria nauseosa* 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. It can be difficult to establish from seed. Average seeds per ft^2 at 1 lb. rate is 16. Pure stand seeding rate is 0.5 lb/ac. Not recommended for pure stands. Recommended rate in mixtures is approximately 1/40 of a pound PLS per acre. This species is most commonly established with nursery grown plants.

Rose, Woods *Rosa woodsii*

Woods rose is 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. It is 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 is moderately palatable to livestock and big game. It provides good cover and winter food for birds and small mammals, for erosion control, and as an ornamental. It has 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 is 1. Pure stand seeding rate is 1.5 lb/ac. Mixture seeding rate is 1/4 lb/ac. Not recommended for pure stands. This species is most commonly established with nursery grown plants. Young seedlings can be transplanted at 1 to 2 years of age.

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

Big sagebrush with its 4 major subspecies (basin, Wyoming, mountain and 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 is; Basin 39, Mountain 45, Wyoming 39. Pure stand seeding rate is 1 lb/ac. Not recommended for pure seedings. Recommended rate in mixtures is 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 receives 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 seed is also recommended. Seed at 0-1/8 inch depth. Average seeds per ft^2 at 1 lb. rate is 21. Not recommended for pure stands. Recommended seeding rate in mixtures is 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) plants. 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 browse 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 variety 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 elevations of the Northern Great Plains on clayey saline soils. The most recent release by Aberdeen PMC, Snake River Plains Selected 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 is 1. Pure stand seeding rate is 1 lb/ac. Not recommended for pure stands. Recommended rate in mixtures 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 3. Not recommended for pure stands. Recommended rate in mixes is approximately 1/4- 1/2 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 2. Pure stand seeding rate 1.0 lb/ac. Not recommended for pure stands. Recommended rate in mix is approximately 1/4 of a pound PLS per acre. This species is most commonly established with nursery grown plants.

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. This species is most commonly established with nursery grown plants. 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 2. Pure stand seeding rate 1- 3 lb/ac. Not recommended in pure stands on upland sites. Recommended rates in mixes is approximately 1/4 of a pound PLS per acre. This species is most commonly established with nursery grown plants. Young seedlings can be transplanted at 1 to 2 years of age.

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. It 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. Pure stand seeding rate 1- 2 lb/ac. Not recommended for pure stands. Recommended rate in mixes is approximately 1/4 pound PLS per acre. This species is most commonly established with nursery grown plants. 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. It 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. This species is most commonly established with nursery grown plants.

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. A recent release by Aberdeen PMC is Northern Cold Desert Selected Class Germplasm. It has better cold tolerance than past releases and is recommended for southern

Idaho, northern Nevada and northern Utah. Bridger PMC released Open Range Selected Class Germplasm in 2002 for use in the Northern Rocky Mountains and Northern 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 is 3. Pure stand seeding rate is 0.5 lb/ac. Not recommended for pure stands. Recommended rate in mixtures is 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	Low-Med.	Sod	4,990,000	115	+18	wet	0-1/4	0.5
Bluegrass, Big	Medium	Low-Med.	Bunch	925,000	21	+ 9	cl-sl	0-1/4	2
Bluegrass, Canby	Long	Low-Med.	Bunch	925,000	21	+ 9	c-sl	0-1/4	2
Bluegrass, Canada	Long	Low-Med.	Sod	1,600,000	36	+18	cl-sl	1/4-1/2	2 (6 sod)
Bluegrass, Kentucky	Long	Low-Med.	Sod	2,200,000	50	+18	cl-sl	0-1/4	2 (4 sod)
Bluegrass, Mutton	Long	Low-Med.	Bunch	890,000	20	+10	cl-s	1/8-1/4	2
Bluegrass, Sandberg	Long	Low-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	5
Canarygrass, Reed	Long	Med.-Rapid	Sod	506,000	12	+18	c-sl	1/4-1/2	4
Dropseed, Sand	Long	Low	Bunch	5,298,000	122	+ 7	fsl-s	0-1/4	1
Fescue, Hard	Long	Low	Bunch	560,000	13	+14	c-sl	0-1/4	4
Fescue, Idaho	Long	Very Low	Bunch	450,000	10	+16	cl-sl	1/4-1/2	4
Fescue, Red	Long	Low	Sod	614,000	14	+18	c-sl	0-1/4	4 (15 sod)
Fescue, Sheep	Long	Low	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 (40 sod)
Foxtail, Creeping	Long	Low	Sod	750,000	17	+18	c-l	1/8-1/4	3
Hairgrass, Tufted	Long	Low	Bunch	2,500,000	57	+18	c-sl	0-1/4	1.5
Junegrass, Prairie	Medium	Low-Med.	Bunch	2,315,000	53	12-20	sil-s	1/4-1/2	1
Needlegrass, Green	Long	Low	Bunch	180,000	3-4	8-20	cl-sl	1/4-1/2	6
Needlegrass, Thurber	Long	Low	Bunch	180,000	3-4	8-16	cl-sl	1/4-1/2	8
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	15-25
Sacaton, Alkali	Long	Low-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. Low	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

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, 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
Wheatgrass, Intermediate	Long	Rapid	Sod	80,000	2	+13	cl-sl	1/4-1/2	10
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	10
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 (24 sod)
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	8
Wildrye, Altai	Long	Low	Bunch	73,000	2	+14	saline	1/4-1/2	12
Wildrye, Basin	Long	Low	Bunch	130,000	3	+8	sil-sl	1/4-3/4	7
Wildrye, Beardless	Long	V. Low	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. Low	Sod	55,000	1	+12	ls-s	1/4-1/2	15
Wildrye, Russian	Long	Low	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/ft²	Precip	Soil	Depth	PLS Rate
FORBS - LEGUMES									
Alfalfa	Medium	Medium	Erect	200,000	5	+14	sil-sl	1/8-1/2	5 (10- 15 hay)
Aster	Medium	Low	Erect	800,000	18	+12	cl-sil	0-1/2	2
Balsamroot, Arrowleaf	Long	V. Low	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	4
Crownvetch	Long	Medium	Prostrate	98,000	2	+15	sil-sl	1/4-1/2	13
Flax, Blue	Short	Low-Med.	Erect	278,000	6	+10	sil-sl	0-1/8	4
Globemallow	Long	Low	Erect	750,000	17	+7	saline	1/8-1/4	2
Milkvetch, Cicer	Long	Low	Erect	130,000	3	+15	c-l	1/4-1/2	7
Penstemon, Venus	Medium	V. Low	Erect	1,090,000	25	+16	cl-sl	0-1/8	2
Penstemon, Firecracker	Short	V. Low	Erect	315,000	7	+10	cl-sl	0-1/8	4
Penstemon, Palmer	Medium	V. Low	Erect	294,000	7	+10	cl-sl	0-1/8	4
Penstemon, Rocky Mtn.	Medium	V. Low	Erect	286,000	7	+18	cl-sl	0-1/8	2
Sagewort, Louisiana	Short-Med.	Medium	Erect	3,750,000	86	+12	cl-sl	0-1/4	0.25
Sainfoin	Medium	Low-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	Low	Erect	70,000	2	+10	cl-sl	1/8-3/4	18
Trefoil, Birdsfoot	Long	Low	Erect	375,000	9	+18	c-s	1/4-1/2	5
Yarrow, Western	Medium	Low	Prostrate	4,124,000	95	+8	cl-sl	0-1/4	0.5

Common Name	Longevity	Seedling Vigor	Character	Seeds/Lb	1 lb/Acre Seeds/ft[2]	Precip	Soil	Depth	PLS Rate
SHRUBS									
Bitterbrush, A.	Long	Low	Shrub	15,400	0.4	+10	cl-sl	1/2-1.0	70 (1/4*)
Buckwheat, Whorled	Long	Low	Half-Shrub	135,700	3.0	+15	sl-sil	0-1/4	plants
Buckwheat, Snow	Medium	Low	Half-Shrub	500,000	11.5	+7	rocky	0-1/4	plants
Buckwheat, Sulphurflower	Long	Low	Half-Shrub	209,000	5.0	+14	sl-sil	0-1/4	plants
Buffaloberry, Silver	Long	Low	Shrub	40,000	0.9	12-20	sc	1/2	plants
Ceanothus/Snowbrush	Long	Low	Shrub	94,000	2.2	+16	sil-s	1/4-1/2	plants
Chokecherry	Long	Low	Shrub	4,790	0.1	+12	sil-s	1/2-1.0	plants
Cinquefoil, Shrubby	Long	Low	Shrub	1,000,000	23.0	+18	wet-all	surface	plants
Clematis	Long	Low	Creeping Vine	315,000	7.2	+10	moist	-----	plants
Current, Golden	Long	Low	Shrub	233,000	5.4	+12	sil-sl	1/16-1/4	plants
Current, Wax	Long	Low	Shrub	251,000	5.8	+12	sil-sl	1/16-1/4	plants
Dogwood, Redosier	Long	Low	Shrub	18,500	0.4	+16	moist	-----	cuttings
Elderberry, Blue/Red	Medium	Low	Shrub	205,000	4.7	+18	gravelly	-----	plants
Hawthorn, Black	Long	Low	Sm. Tree	22,600	0.5	+12	cl-sl	0-1/4	plants
Kinnikinnick	Long	Low	Creeping Shrub	40,000	0.9	+18	cl-sl	-----	plants
Kochia, Forage	Long	Low	Half-Shrub	395,000	9.0	+8	cl-sl	0-1/16	2.0 (1/40*)
Mountain Mahogany	Long	Low	Shrub	48,000	1.1	+14	rocky	0-1/2	plants
Oregongrape	Long	Low	Creeping Shrub	45,000	1.0	+15	moist	1/4-1/2	plants
Rabbitbrush, Green	Long	Low	Shrub	782,000	17.9	+10	sil-s	surface	plants
Rabbitbrush, Rubber	Long	Low	Shrub	693,000	15.9	+10	sil-s	surface	plants
Rose, Woods	Long	Low	Shrub	50,000	1.1	+12	l-sl	1/2	1.0 (1/40*)
Sagebrush, Big spp.	Long	Low	Shrub	1,700,000	39.0	8-18	cl-sl	0-1/8	0.5 (1/40*)
Sagebrush, Black	Long	Low	Shrub	907,000	20.8	+10	limy	0-1/8	0.5 (1/40*)
Saltbush, Fourwing	Long	Low	Shrub	52,000	1.2	8-16	l-s	1/4-3/4	20 (1/4*)
Saltbush, Gardner	Long	Low	Shrub	114,000	2.6	6-16	l-s	1/4-3/4	10 (1/4*)
Serviceberry	Long	Low	Shrub	82,000	1.9	+14	sil-sl	1/4-1/2	plants
Shadscale	Long	Low	Shrub	64,900	1- 2	+6	cl-sil	1/4-3/4	20 (1/4*)
Silverberry	Long	Low	Shrub	3,800	0.1	+14	sil-sl	0-3/4	plants
Snowberry	Long	Low	Shrub	76,000	1.7	+14	sil-sl	0-1/2	plants
Sumac, Skunkbush	Long	Low	Shrub	20,300	0.5	+14	rocky	1/2-1.0	plants
Syringa (Mockorange)	Long	Low	Shrub	8,000,000	183.7	+18	moist	-----	plants
Winterfat	Long	Low	Half-Shrub	123,000	2.8	+7	limy	0-1/8	9 (1/4*)

* 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 approximately 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, Mutton	None
Bluegrass, Sandberg	'High Plains' and Mountain Home	Brome, Meadow	‘Cache’, 'Fleet', 'Montana', 'MacBeth', 'Paddock', '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	'Garrison' 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 'Hycrest II'
Wheatgrass, Intermediate	'Amur', 'Oahe', 'Reliant', 'Rush' and 'Tegmar'	Wheatgrass, Newhy	'Newhy'
Wheatgrass, Pubescent	'Greenleaf', 'Luna', and 'Manska'	Wheatgrass, Siberian	'P-27', 'Vavilov' and Vavilov II
Wheatgrass, Slender	'Pryor', 'Revenue', ‘First Strike’ and 'San Luis'	Wheatgrass, Snake River	'Secar'
Wheatgrass, Streambank	'Sodar'	Wheatgrass, Tall	'Alkar', 'Jose', 'Largo' and 'Platte'
Wheatgrass, Thickspike	'Bannock', 'Critana', and 'Elbee'	Wheatgrass, Western	'Arriba', 'Barton', 'Flintlock', 'Rodan' and 'Rosana'
Wildrye, Altai	'Eejay', ‘Mustang’, 'Pearl' and 'Prairieland'	Wildrye, Basin	'Magnar', 'Trailhead' and Washoe
Wildrye, Beardless	'Shoshone'	Wildrye, Blue	'Arlington'
Wildrye, Canada	‘Mandan’	Wildrye, Mammoth	'Volga'
Wildrye, Russian	‘Bozoisky II’, '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'	Buckwheat, snow	Umatilla
Buckwheat, Sulphur-flower	None	Buckwheat, Whorled	None
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 Germplasm
Silverberry	None	Snowberry	Okanogan Germplasm
Sumac, Skunkbush	'Bighorn'	Syringa (Mockorange)	Colfax Germplasm and St. Maries Germplasm
Winterfat	Northern Cold Desert Germ, Open Range Germ, and ‘Hatch'		

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TECHNICAL NOTES

USDA-Natural Resources Conservation Service
Boise, ID

TN PLANT MATERIALS NO. 27 **DECEMBER 2006**
Revision

Plant Germplasm Development: Traditional and Alternative Approaches

The enclosed brochure entitled "The AOSCA Native Plant Connection" provides information on traditional (variety or cultivar) and alternative approaches (pre-variety releases) to release plants used in solving natural resource problems.

This publication was prepared by Stanford A. Young, Seed Certification Specialist, Utah State University, Barry Schrumpf, Oregon Seed Certification Service and Eugene Amberson, Wisconsin Crop Improvement Association. Published by Association of Official Seed Certifying Agencies (AOSCA).

THE AOSCA

NATIVE PLANT CONNECTION

Association of
Official Seed
Certifying Agencies

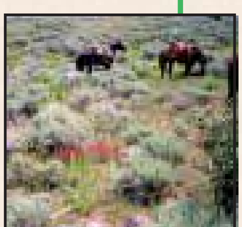
THE AOSCA NATIVE PLANT CONNECTION

The Need for Native Plant Genetic Source Information

Large-scale natural and human-caused ecosystem disturbances generate a voluminous demand for native plant reproductive materials (most commonly seed) intended for restoration, revegetation, and stabilization of natural communities. This demand is enhanced by an increasing interest in establishing populations of native wildflowers, grasses, trees, and shrubs in parks, wildlife refuges, roadsides, tree farms and orchards, and residential landscapes.

Road cut stablization and restoration.

The reproductive materials required to satisfy these planting needs have some special constraints. Most plant species consist of more or less continuous genotypic arrays reflecting differential adaptation to variation in soils, climates, and disturbance regimes across a species' range of distribution. Long-term success in restoring a species to a given site is dependent upon obtaining adapted plant materials. Adapted plant materials are most likely to originate from the same site or nearby sites with similar physical and biological environments, unless the species' population is known to be broadly adapted or particular accessions have proven to be widely adapted within the species' range of distribution.



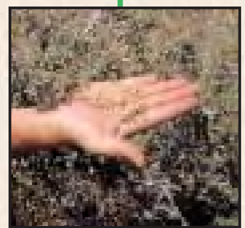
Wasatch Mountain Range wildlands.

For some broadly adapted species characterized by copious seed production, wildland collection can supply a significant seed volume for direct plantings. For most species, however, accessions consisting of limited quantities of seed obtained from defined wildland stands must be increased in fields or nurseries. Unfortunately, accurate documentation of collection site and/or cultivated production has often been unavailable to those seeking site-appropriate native plant materials. This situation led to the expansion of AOSCA third-party inspection and labeling programs to specifically address the needs of the native seed and plant industry.

Collecting antelope bitterbrush with seed hopper.

How AOSCA is Meeting this Need

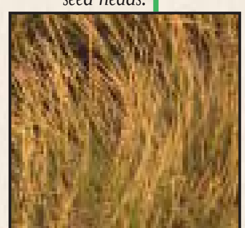
AOSCA has implemented certification requirements and standards that accommodate plant germplasm (whether newly acquired accessions or named varieties) of native grasses, forbs, and woody plants. These certification procedures provide third-party verification of source, genetic identity, and genetic purity of wildland collected or field or nursery grown plant germplasm materials. This bulletin defines AOSCA plant germplasm types, describes certification procedures and labeling, and summarizes supporting guidelines, tables, and flow charts.



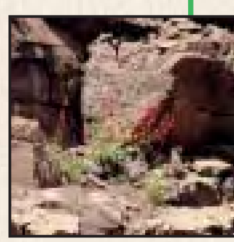
Seeds of antelope bitterbrush.

Plant Germplasm Development: Traditional and Alternative Approach

Bluebunch Wheatgrass seed heads.



The traditional approach for plant germplasm development is to produce varieties with known adaptability and proven superior or unique characteristics that are distinct, uniform, and stable. A typical variety (or synonymous term "cultivar") originates from natural populations or genetically manipulated (i.e. mass selection, recombination, induced mutation, or biotechnological methods) populations of a species. These (1) unevaluated bulk populations form pools from which (2) breeding lines or clonal groups are selected on the basis of desirable traits; (3) inbred lines or clonal synthetic progenies are then developed with traits of interest proven to be heritable; and (4) a Variety/Cultivar is formally released with distinctive traits documented as uniform and stable when evaluated over multiple locations and years.



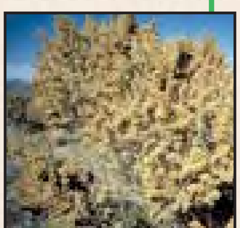
Firecracker penstemon, wildland site.

As an alternative to formal variety release, AOSCA Pre-Variety Germplasm (PVG) categories facilitate orderly procurement, production, and distribution of plant germplasm materials. The PVG categories offer a parallel progression with the first three above numbered stages for variety development. They are respectively designated as (1) Source Identified Class (unevaluated germplasm identified only as to species and location of the wild growing parents), (2) Selected Class (germplasm showing promise of desirable traits,

Indian ricegrass seed.

having been selected either within or as a common site comparison among accessions or populations of the same species), and (3) Tested Class (germplasm for which progeny testing has proven desirable traits to be heritable). This progression may also serve as a route leading to formal (4) Variety/Cultivar release if eligibility requirements are satisfied.

The four defined AOSCA plant germplasm types are thus based upon verification of species and source, and the extent of distinctive trait identification, selection, and stabilization documented for a given plant germplasm accession or population. Figure 1 illustrates the sequential progression of AOSCA germplasm types; the dual tracks are explained in the following section.



Fourwing saltbush mature seed.

Natural and Manipulated Genetic Tracks

Germplasm originating from a wildland (native, naturalized, or feral) stand is assigned a genetic status of either "manipulated-track" or "natural-track" (note the germplasm accession arrows in Fig. 1). The natural-track is reserved for those germplasm accessions that are an unrestricted representation of the intact wildland plant population on the original site. Additionally, genetic manipulation must be purposefully avoided when such accessions are increased in field or nursery production, compared with other accessions on common sites, and/or tested for trait heritability and adaptability.

Accessions that are purposefully or inadvertently hybridized with other accessions or selected for distinctive traits within the population (whether on the original site or in succeeding field or nursery generations) are routed to the manipulated-track. This routing is further illustrated by the center arrow portion of Fig. 1. If a germplasm following either track or at any stage of development is altered from its defined genetic identity, it reverts to bulk population status until granted approval as a newly defined germplasm on the manipulated-track.

Purple coneflower.

Germplasm assigned to either track follows a similar progression relative to AOSCA germplasm types, and is appropriate for end use depending on the objectives for the planting site. To facilitate this germplasm status distinction, “natural-track” recognition as applicable to a specific germplasm should be so noted on certification tags (see Additional Label Information section).

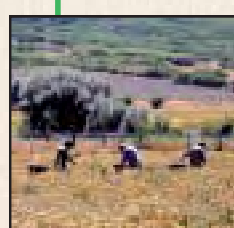
Firecracker penstemon, seed field production.

Practical Application of AOSCA Plant Germplasm Types

Conditioning wildland shrub seed.

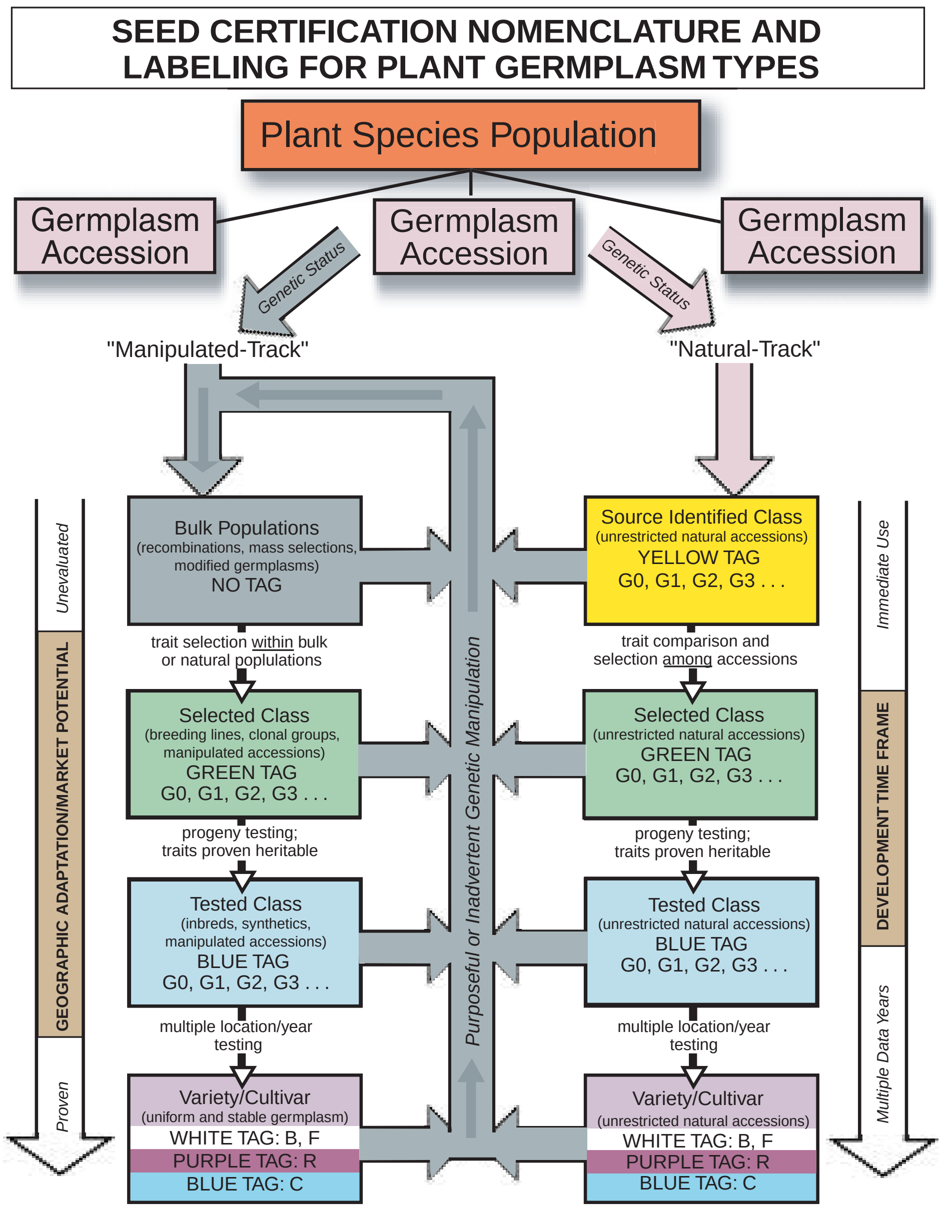
Formal variety release is applicable when geographic adaptability and market potential are well defined, and is necessary when seeking protection under the Plant Variety Protection Act. Utilization of PVG categories is applicable when a) identification and propagation of species and/or ecotypes at various stages of evaluation are needed for timely (often immediate) restoration of specific geographic areas, b) market potential is limited beyond specific geographic areas, and/or c) accommodating consumer special plant material demands (refer to both sidebars in Fig. 1).

A germplasm accession may potentially be shepherded through PVG categories on either genetic track to achieve formal release. For most native plant accessions, however, germplasm evaluation and comparison are designed to facilitate native plant use in localized site revegetation rather than for advancement toward formal release. In this context, a germplasm designation within any PVG category (Source identified, Selected, or Tested) is a legitimate end product. Many public and private agencies follow internally established protocols for germplasm acquisition, study, development, and/or release, though such formality is not a basic requirement in utilizing PVG certification. Germplasm eligibility for a given PVG category must be supported by documentation submitted to and accepted by an AOSCA seed certification agency.



Western yarrow, seed field production.

FIGURE 1. *Germplasm development flow chart.*



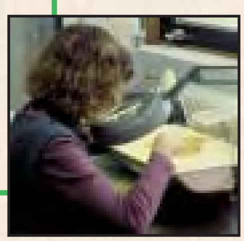
Generation Limitation, Designation, and Labeling

The number of field or nursery increase generations allowed (as well as length of stand, isolation distances required, and seed purity and viability standards) for all germplasm types may be specified by AOSCA. Factors considered are the mode of reproduction, genetic stability, plant longevity, and seed characteristics of individual species. The AOSCA generation limit for sexually reproduced or apomictic Pre-Variety Germplasm is five (unless otherwise specified), while vegetative generations may be unlimited.

Grayhead prairie coneflower.

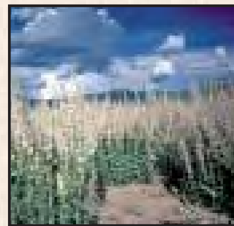
Natural-track wildland collected seed is by definition Generation zero (G0) since it is an unrestricted representation of an intact G0 parent population. For a manipulated-track germplasm the G0 parent plants, which by convention for cultivated populations produce G1 seed, must be formally defined by the developer in consultation with an AOSCA agency. As shown in the pre-variety germplasm class boxes in Fig. 1, generations are designated G0, G1, G2, G3, etc., which are analogous to the variety/cultivar generation designations of Breeder, Foundation, Registered and Certified.

Variety/cultivar tags are color coded to signify generation (white for Breeder and Foundation, purple for Registered, and blue for Certified). PVG tags are color coded only according to category (yellow for Source Identified, green for Selected, and blue for Tested), so specific generation information must be listed on PVG tags (Figure 2). The notation specifies both the generation of the tagged material and the number of increase generations permitted, e.g. G1/3 or G4/5. An accelerated downgrading of generation for marketing purposes may be specified on the tag such that the material would not be eligible for planting stock, e.g. G3/3 or G5/5.



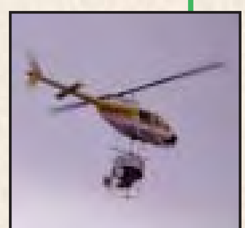
Wildland seed analysis.

Additional Label Information



Palmer penstemon, seed field production.

Though individual certification agency labeling formats may vary somewhat, other information listed on PVG tags (Fig. 2) normally includes a) the scientific and common species names; b) germplasm identification term (optional); c) production location (state and county or similar geographic description) and elevation of the field or nursery; d) source site (location and elevation of the defined G0 material); e) whether the defined G0 material is indigenous at its source site (yes, no, or unknown); f) whether the tagged material is "natural-track" in status (yes or no); and g) certification and/or seed lot numbers. Additional site characteristics, selection criteria, and/or testing results may be available from the germplasm collector/developer.

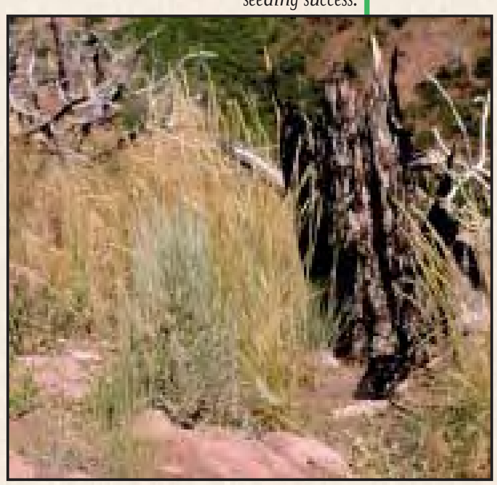


Aerial fire rehabilitation seeding.

When a pre-variety germplasm is offered in commerce attendant with an optional germplasm identification term (i.e. accession number or notation of origin or specific trait), the word "Germplasm" must follow (e.g. ARS 2936 Germplasm Scarlet Globemallow; Southern Iowa Germplasm Canada Wildrye) to avoid misconstruing the term as an official variety/cultivar name.

Variety/cultivar tags (Breeder, Foundation, and Registered are similar in format to the Certified example shown in Fig. 2) provide little information beyond kind (species), variety name, and certification/lot number, since the formal release notice would supply pertinent variety source and development information. It is recommended, however, that "natural-track" status (if applicable) and known regions or zones of adaptation be listed on the tag for native plant varieties/cultivars.

Fire rehabilitation seeding success.



The AOSCA Process for Certified Production of Native Plant Seed

AOSCA seed certification agencies (acting as a third-party) require seed collectors/producers to follow established requirements, procedures, and standards to assure germplasm identity and purity for the seed consumer.

A. Wildland Collection

Wildland collected seed can be used for direct sales to end users, for establishment of field/ nursery production, or for entry into plant germplasm development programs. Certification procedures include:

- Pre-Collection Application filed before harvest
- Proper permitting and/or permission for collecting on public and private lands
- Site Identification Log filled out during and after harvest
- Verification of the collection site and identification and evaluation of plant and seed samples before, during, and/or post harvest
- Tagging of the seed lot after compliance with applicable requirements and standards; seed purity and viability analysis may be required
- Germplasm accessions acquired within established protocols of recognized public or private agencies are normally eligible (with appropriate data on file in lieu of the above procedures) to enter the certification process as planting stock

B. Field/Nursery Production

Stock seed or plants for establishing certified field/nursery production must be of an eligible generation and have appropriate labeling. Certification procedures include:

- Application for Certification
- Verification of origin and generation of planting stock
- Seedling inspection
- Field inspection before harvest to check compliance with species requirements for isolation and genetic purity (control of prohibited and other specified weeds or other species may be required)
- Tagging of the seed lot after compliance with applicable requirements and standards; seed purity and viability analysis may be required

Native collector in mountain big sagebrush stand.

FOR FURTHER INFORMATION

Harvesting basin wildrye.

Contact the official seed certifying agency in your country, state or province for further information, application forms, or help in following wildland plant materials certification procedures. A list of certifying agencies is available from the AOSCA Office:

Association of Official Seed Certifying Agencies
55 SW Fifth Avenue, Suite 150
Meridian, ID 83642-8638, USA

Telephone: (208) 884-2493
Fax: (208) 884-4201
Website: www.aosca.org

All photos by Stanford A. Young

Bulletin Authors:

Stanford A. Young, Seed Certification Specialist, Utah State University

Barry Schrumpf, Oregon Seed Certification Service, Oregon State University

Eugene Amberson, Wisconsin Crop Improvement Association.

Prairie restoration project.

FIGURE 2. *AOSCA Pre-Variety Germplasm and Variety/Cultivar tag examples.*

SOURCE IDENTIFIED SEED

Agency logo here

Species Name	*Sporobolus heterolepis*
Common Name	Prairie Dropseed
Germplasm ID,Gen.	G3/5
G3 State,County,Elev.	WI,Dane,800 ft.
G0 State,Region,Elev.	WI,Southwest,790 ft.
G0 Indigenous?	Yes
Natural-Track?	Yes
Lot:	2999-SPOHET-3-SE; 03346

MEMBER OF ASSOCIATION OF OFFICIAL SEED CERTIFYING AGENCIES

TESTED CLASS SEED

Agency logo here

Species Name	*Dalea candida*
Common Name	White Prairie Clover
Germplasm ID,Gen.	Antelope,G2/5
G2 State,County,Elev.	MT,Carbon,3350 ft.
G0 State,County,Elev.	ND,Stark,2400 ft.
G0 Indigenous? Yes	Cert. #: 026962
Natural-Track? Yes	Lot #: SFD-02-FLD20-1

MEMBER OF ASSOCIATION OF OFFICIAL SEED CERTIFYING AGENCIES

FIGURE 2. *AOSCA Pre-Variety Germplasm and Variety/Cultivar tag examples.*

SELECTED CLASS SEED

Agency logo here

Species Name	*Krascheninnikovia lanata*
Common Name	Winterfat
Germplasm ID,Gen.	Northern Cold Desert,G2/3
G2 State,County,Elev.	OR,Malheur,2300 ft.
G0 State,County,Elev.	ID,Bingham,4100 ft.
G0 Indigenous?	No
Natural-Track?	No
Cert. #:	00497
Lot #:	KL203

MEMBER OF ASSOCIATION OF OFFICIAL SEED CERTIFYING AGENCIES

CERTIFIED CLASS SEED

Agency logo here

KIND:	Mountain Big Sagebrush
VARIETY:	Hobble Creek, “Natural-track”
CERT. #:	WC-1852
LOT #:	ArTrVaHC-02001

MEMBER OF ASSOCIATION OF OFFICIAL SEED CERTIFYING AGENCIES

TECHNICAL NOTES

USDA-NATURAL RESOURCES CONSERVATION SERVICE
BOISE, IDAHO

TN PLANT MATERIALS NO. 33 **DECEMBER 2006**
REVISION

PLANT AND SEED VENDORS

FOR

IDAHO-MONTANA

NEVADA-EASTERN OREGON

UTAH-EASTERN WASHINGTON

WYOMING

Dan Ogle, Plant Materials Specialist, Boise, Idaho
Derek Tilley, Range Conservationist, PMC, Aberdeen, Idaho
Loren St. John, Manager, PMC, Aberdeen, Idaho

Attached is a seed and plant vendor's list for the Intermountain West and Northern Great Plains states. Users of this list should note that this is only a partial listing of conservation plant and seed sources (retailers, wholesalers, nurseries and private growers) for each state. If you find the information to be inaccurate, please contact Dan Ogle, (208) 685-6987 or Loren St. John or Derek Tilley, (208) 397-4133 with the proper information so this list can be updated.

This does not constitute an endorsement of the vendors, nor does it guarantee the reliability or quality of products.

PLANT MATERIALS TECHNICAL NOTE NO. 33 **DECEMBER 2006 REVISION**

PLANT AND SEED VENDORS FOR IDAHO, MONTANA, NEVADA, EASTERN OREGON, UTAH, EASTERN WASHINGTON AND WYOMING

IDAHO

All Seasons Landscape Nursery	3376 E. Overland Rd., Meridian, ID 83642	(208) 888-6268
Allied Seed, Inc.	1917 E. Fargo Ave., Nampa, ID 83651	(208) 466-9218
Aloha Landscape and Nursery	4291 S. Cloverdale Rd., Boise, ID 83704	(208) 362-2062
Asgrow Seed Co.	1811 E. Florida Ave.,Nampa, ID 83651	(208) 466-3351
Bakker Bros. of Idaho	Eastland Dr. South, Twin Falls, ID 83301	(208) 459-1900
W.R. Baxter Wholesale Nursery	2615 Pioneer Ave., Emmett, ID 83617 P.O. Box 621Meridian, ID 83642	(208) 365-6011
Boise Valley Seed, Inc.	R.R.10, Darrow Land, Caldwell, ID 83651	(208) 459-7211
Brown King Nursery	1407 Arthur Street, Caldwell, ID 83605	
Buffaloberry Farm	51 East Lake Fork Rd, McCall, ID 83638	(208) 634-3062 bufberry@ctc.net
BYU Idaho	Landscape and Horticulture Dept. 500 South Center, Rexburg, ID 83440	(208) 496-2018
Cedera Seed Company	PO Box 97, 118 Hwy 31, Swan Valley, ID 83449	(208) 483-3683 www.cederaseedinc.com
Clayton Wholesale Nursery	6622 Joplin Road , Nampa, ID 83651	(208) 286-7801
Clearwater Nursery	PO Box 488, Bellevue, ID 83313	(208) 788-5774
Clifty View Nursery	Route 1, Box 509, Bonners Ferry, ID 83805	(208) 267-7129 www.cliftyview.com
Cloverdale Nursery	2528 N. Cloverdale Rd., Boise, ID 83704	(208) 375-5262

Coeur d'Alene Landscaping	Box 1556, Coeur d'Alene, ID 83814	
Coeur d'Alene Nursery - USDA FS	3600 Nursery Rd., Coeur d'Alene, ID 83814	(208)765-7375
Cold Hardy Plant Material Inc	PO Box 714, Bonners Ferry, 83805	(208) 267-2798
Crookham Company	301 Warehouse Avenue,Caldwell, ID 83651	(208) 459-7451 www.crookham.com
D&G Turf Farm and Nursery	1267 N. Cloverdale Rd., Boise, ID 83704	
De Giulio Ranches		(208) 765-5030 (208) 765-0830
Dahlin's Landscape Nursery	Route 1, Box 304, Priest River, ID 83856	
Donnelly Nursery	11911 Franklin Rd., Boise, ID 83709	(208) 375-2000
Double D Feed and Seed, Inc.	215 Broadway Ave., Melba, ID 83641	(208) 495-1126
Du-Rite Nursery and Landscaping	5321 W. Cherry Lane, Meridian, ID 83642	(208) 888-1359
Eagle Landscaping and Nursery	P.O. Box 8, 988 East State Street, Eagle, ID 83616	(208) 939-8723
Erico Nursery	P.O. Box 209, Plummer, ID 83851	
Fantasy Farms Nursery	PO Box 157, Peck, ID 83545	(208) 486-6841
Ferry Morse Seed Co.	3015 E. Comstock, Nampa, ID 83651	
Ford Seed Co., Inc.	2918 Woody Dr., Boise, ID 83703	(208) 342-8088 9kss9@cable1.net
Forest Tree Nursery	College Forestry, Wildlife and Range Science, University of Idaho, Moscow, ID 83843	(208) 885-3888 www.seedlings@uidaho.edu
Frontier Seed Prod&Consulting	1406 East F Street, Moscow, ID 83843 Frank Wolf, Consultant Shelly Gilmore, Owner	www.sgilmore@turbonet.com (509) 330-0273 (208) 883-1806

Fruitland Nursery	P.O. Box 332, Fruitland, ID 83619	(208) 452-4204
Garden and Landscape Nursery	2900 N. 32nd, Boise, ID 83703	(208) 343-0755
Garden Center West, Inc.	11500 Fairview Ave., Boise, ID 83704	(208) 376-3322
Globe Seed and Feed Company	224 4th Ave., Twin Falls, ID 83301	(208) 733-1373
Gooding Seed Company	Box 57, Gooding, ID 83330	(208) 934-8441 gsco@goodingseed.com
Graft Nursery and Landscaping	1602 East 16th, Burley, ID 83318	
Grassland West Company	Box A, Culdesac, ID 83524	(208) 843-5121 berickson@grasslandwest.com
Greenhurst Nursery & Garden Cen	3209 S. Happy Valley Rd., Nampa, ID 83651	(208) 466-5783
Green Ranch, The	P.O. Box 2597, Boise, ID 83701	(208) 336-3312
Green Things Nursery	P.O. Box 1900, 2230 Michigan, Orofino, ID 83544	(208) 476-3022
Green Thumb, Inc.	2113 Idaho Avenue, Caldwell, ID 83605	(208) 459-3349
Greenway Seed Co.	1703 E. Chicago St., Caldwell, ID 83605	(208) 454-8342
Harker Bros.	Southside Blvd., Nampa, ID 83651	(208) 495-2308 (208) 466-5783
Hash Company Nurs. and Lndsc.	Troy Highway, Moscow, ID 83843	(208) 875-1030
Hash Tree Co.	Box 72A, Princeton, ID 83857	(208) 875-1030 www.hashtree.com
High Altitude Gardens	P.O. Box 1048, Hailey, ID 83340	(208) 788-4363 support@seedstrust.com
Hillcrest Farms, Inc.	Route 1, Grangeville, ID 83530	
Hillside Nursery and Landscaping	2350 W. Hill Road, Boise, ID 83702	(208) 343-2545 www.hillsidenursery.com
Hoffmans Greenhouse and Nursery	3332 Caldwell Blvd., Nampa, ID 83651	(208) 466-1977

Hothouse, The	563 North 3rd Street, Montpelier, ID 83254	
Howards Nursery and Greenh.	7106 Ustick Rd., Boise, ID 83704	(208) 322-6000
Idaho Grimm Growers	Box 276, 395 S. Broadway, Blackfoot, ID 83221	(208) 785-0830 idgrimm@quest.net
Idaho State Nursery	University of Idaho, Moscow, ID 83843	(208) 885-7023
Inland Gardens	2124 Longmont Ave., Boise, ID 83705	(208) 342-6953
Intermountain Landscape Co.	P.O. Box 1087, Hailey, ID 83333	
Jacklin Seed Company	17300 Jacklin Ave., Post Falls, ID 83854	(208) 773-7581 www.jacklin.com
Jayker Tree Farms, Inc.	801 E. Beacon Light Rd., Eagle, ID 83616	(208) 939-0014 erict@jayker.com
Jayker Wholesale Nursery	4042 W. Chinden, Meridian, ID 83642	(208) 887-1790 info@jayker.com www.jayker.com
John's Gourmet Gardens	9010 Burnett Dr., Boise, ID 83709	(208) 362-4439
Johnson's Quality Evergreens	HCR 68, Box 293, Cocolalla, ID 83813	(208) 263-7700
Kellog Mills	223 Roedel Ave., Caldwell, ID 83605	(208) 459-0777
Kimberly Nurseries	Route 3,Twin Falls, ID 83301	(208) 735-3992 www.kimberlynurseries.com info@kimberlynurseries.com
Lake Creek Seed	15700 S. Idaho Rd., Worley, ID 83876	(509) 291-6661
Levig Nursery	Star Route 1, Kings Row, Bonners Ferry, ID 83805	(208) 267-2136
Lucky Peak Nursery USDA Forest Service	15169 E Hwy 21, Boise, ID 83716	(208) 343-1977 cfleege@fs.fed.us

McDonald's Garden Store	Route 2, Public Avenue, Moscow, ID 83843	
Mosman, David	Rt. 2, Box 43, Craigmont, ID 83523	(208) 937-2552 mosman@camasnet.com
Moss Greenhouses Inc	269 S 300 E, Jerome, ID 83338	(208) 324-1000
Mountain Seed Nursery	Route 1, Box 271, Moscow, ID 83843	
Mountain View Nursery	Route 3, Box 170, Sandpoint, ID 83864	
Musser Seed Co., Inc.	301 Fourth Ave. South, Caldwell, ID 83605	(208) 459-8243
Native and Xeric Plants Inc	8625 Bill Burns Rd, Emmett, ID 83617	(208) 365-4331 jenn@nativeandxericplants.com
Native Landscapes Inc	PO Box 4012, 810 S. Main St, Unit A, Hailey, ID 82333	(208) 578-2200 info@coolnativelandscapes.com
Native Seed Foundation	HCR 62 Box 332A, Co Rd 73, Moyie Springs, ID 83845	(208) 267-1477 www.nativeseedfoundation.com
Nishek Nursery	Route 1, Box 516, Bonners Ferry, ID 83805	(208) 267-7191
Nishitani Greenhouse	P.O. Box 325, Caldwell, ID 83606	(208) 459-0567
North American Plant Breeders	2323 11th Ave., North Ext., Nampa, ID 83651	(208) 467-2191
North Woods Nursery Inc	PO Box 149, Elk River, ID 83827	(208) 826-3408
Northern Natives Nursery	903 E. Lincoln, Emmett, ID 83617	
Northplan/Mountain Seed	PO Box 9107, Moscow, ID 83843-1607	(208) 882-8040 norplan@moscow.com
Northrup-King and Company	Box 124, Twin Falls, ID 83605	
Northrup-King and Company	223 Roedel Ave., Caldwell, ID 83605	(208) 459-0844
Northwest Nursery	P.O. Box 455, Sandpoint, ID 83864	
Northwest Turf and Garden	843 Lilac, Meridian, ID 83642	(208) 888-4467

North Woods Nursery, Inc.	PO Box 149, Elk River, ID 83827	(208) 826-3408
OR/ID Native Plant Seed Growers Assoc.	5000 N.W. 1st Ave., New Plymouth, ID 83655	(208) 278-3789 iskinner261@msn.com
Palouse Prairie Natives	1461 Thorn Creek Rd, Genesee, ID 83832	(208) 882-9143 ppnatives@starband.net
Pickle Butte Farms	Route 4, Box 344, Caldwell, ID 83605	
Pineview Horticultural Services	10188 N Taryne St, PO Box 757, Hayden, ID 83835	(208) 772-7294 seedguys@verizon.net
Plato Nursery	HRC 60, Box 1, Bonners Ferry, ID 83805	(208) 267-3742
Pleasant Hill Farms	1101 Anderson Road, Troy, ID 83871	(208) 877-1600 mason@moscow.com
Ponderosa Garden Center and Nursery	6305 North Black Cat Rd., Meridian, ID 83642	
Potlach Corporation-Lewiston Nursery	PO Box 1388, Lewiston, ID 83501	(208) 799-1138 Abbie.Acuff@potlachcorp.com
Providence Nursery	Route 1, Box 588, Sandpoint, ID 83864	
Puffer-Ridge Farms	Baldy Road, P.O. Box 132, Sandpoint, ID 83864	
Purple Sage Farms, Inc.	11741 Bullock Lane, Middleton, ID 83644	(208) 585-6140
Reggear Tree Farm	1525 Loseth Rd, Orofino, ID 83544	(208) 476-5913 (208) 476-7739 rreggear@valint.net
Research Nursery (U of I)	Univ. of ID, PO Box 441137, Moscow, ID 83844	(208) 885-3888 (208) 885-6226 seedlings@uidaho.edu
Riteway Industries	Route 1, Box 31-B, Potlatch, ID 83855	
Rogan, Steve Co.	32121 Ave., Caldwell, ID 83605	(208) 632-3001

Rogers Bros. Seed Co.	Madison Ave., Nampa, ID 83651	(208) 467-1159
Rudy-Patrick Company, The	Box 1130, Nampa, ID 83651	
Sand Hollow Nursery	R.R.7, Caldwell, ID 83605	(208) 459-7389
Seeds BLUM		(208) 342-0858
Seed Specialists, Inc.	2723 S Cole Rd, Boise, ID 83709	(208) 562-0479 dantheseedman@aol.com
Seeds Trust-High Altitude Gardens	PO Box 1048, Hailey, ID 83333	(208) 788-4363 higarden@micron.net
SeedyCo		(208) 452-4614
Sherwood Forest Nursery	244 N. 2nd East, P.O. Box 781,Rexburg, ID 83440	
Shields of Nampa, Inc.	1618 Avenue South, Nampa, ID 83651	(208) 466-3584
Silva Star Co., The	R.R. 1, Box 64-A, Potlatch, ID 83855	
Silver Springs Nursery	HC 62, Box 86, Moyle Springs, ID 83845	(208) 267-5753 ssninc@dmi.net
Simplot Soilbuilders	17505 Simplot Blvd., Caldwell, ID	(208) 459-3694
Skinner Farms		(208) 278-3789
Smith Garden Square, Inc.	415 North 22nd Street, Lewiston, ID 83501	(208) 743-1116
Smith Tree Plantation	824 N. 55 E., Idaho Falls, ID 83401	(208) 529-8733
Spencer Mountain	P.O. Box 3, Cocolalla, ID 83813	
Sterling Nursery	1090 S 2200 W, Sterling, ID 83210	(208) 328-2461
Storey Feed and Seed Co.	503 E. 1st., Meridian, ID 83642	(208) 888-4436

Sun Mountain Natives	1406 East F St., Moscow, ID 83843	(208) 883-7611 www.sunmountainseeds.com rgilmore@turbonet.com
Sunseeds, Inc.	1832 Garrity Blvd., Nampa, ID 83651	(208) 466-4679
Sun Valley Garden Center	271 Northwood Way, Ketchum, ID	(208) 726-3404
Trail Creek Nursery	707 S Hwy 33, Victor, ID 83455	(800) 336-2470 cctrailcreek@msn.com
Twin Butte Evergreens	416 N. Blaine Street, Moscow, ID 83843	
Union Seed Co. Inc.	PO Box 339, Nampa, ID 83651	(208) 466-3568
University of Idaho Nursery	UofI, 1025 Plant Science Rd, Moscow, ID 83844	(208) 885-3888 seedlins@uidaho.edu
Webb Nursery	162 Glendale Rd, Bellevue, ID	(208) 788-2066
Western Premium Seed, Inc.	4696 Overland Rd.,Boise, ID 83705	(208) 343-0871
Western Forest Systems	3731 15th St, Lewiston, ID	(208) 743-0147 schaeferjk@velocitus.net
Wildlife Habitat Nursery	1025 E. Hatter Creek Rd, Princeton, ID 83857	(208) 875-2500 (208) 875-1246 wild@potlatch.com
Witte, Franz: Lndsc. Contr./Nurs.	9770 W. State St., Boise, ID 83703	(208) 853-0808 info@franzwitte.com
Young's Nursery and Landsc.	Orchard and Ramsey Rds., P.O. Box 570, Hayden Lake, ID	(208) 772-5479

MONTANA

ADC Native Plant Nursery	PO Box 582, #1 9th Street Island Drive, Livingston, MT 59047	(406) 222-7600 www.adc-services.com info@adc-services.com
Adsit Farm and Ranch Service	Decker, MT 59025	(406) 757-2223
AgriBasics Seed Co	1400 Minnesota, Billings, MT 59101	(406) 252-8012
AgriBasics Seed Co	100 S. Broadway, Belgrade, MT 59714	(406) 388-4232
AgriBasics Seed Co	900 16th North, Great Falls, MT 59403	(406) 453-4321
Agrineeds	Box 622, Livingston, MT 59047	(406) 222-0332
A.L. Bruce Seed Company	Townsend, MT 59664	(406) 266-3835
Alpine Nursery	1763 Highway 2 East, Kalispell, MT 59901	
Amsterdam Store	6680 Amsterdam Rd., Manhattan, MT 59741	(406) 282-7223
Badland Tree and Landscaping	2550 River Road N., Havre, MT 59501	(406) 265-9790
Barber Seed Service, Inc.	HC 76, Box 62, Denton, MT 59430	(406) 567-2211
Beartooth Grain and Feed	Box 1088, Red Lodge, MT 59068	(406) 446-1418
Beebe Grain	712 E. Front, Butte, MT 59701	
Big Sky Wholesale Seeds	P.O. Box 852, Shelby, MT 59474	(406) 434-5011 www.bigskyseeds.com
Billings Nursery and Landscaping	7900 Frontage Rd., Billings, MT 59101	(406) 656-2410 jmrbl@aol.com
Bitterroot Nursery	521 East Side Hwy., Hamilton, MT 59828	(406) 961-3806
Bitterroot Restoration	445 Quast Lane, Corvallis, MT 59828	(406) 961-4991 x 20 www.bitterrootrestoration.com
Blackfeet Community College Greenhouse	PO Box 819, Browning, MT 59417	(406) 338-5441 x 270 wilbert_jfish@bfcc.org

Blake Nursery	Otter Creek Rd., Big Timber, MT 59011	(406) 932-4195 www.blakenursery.com
Bridger Tree Farm	8860 Bridger Canyon Rd., Bozeman, MT 59715	(406) 587-3406
Buffalo Bill Nursery	Route 2, Box 66, Plains, MT 59859	(406) 826-3405
Burta, Bud	Rd. 2, #2241, Lewistown, MT 59457	(406) 538-8397
Canyon Creek Nursery	Billings, MT 59101	
Caras Nursery and Landscape	2727 S 3rd St, Missoula, MT 59804	(406) 543-3333 caras@cnl.myrs.net
Carey, Del	Box 1, Volborg, MT 59351	(406) 421-5562
Cashman Nursery	P.O. Box 242, Bozeman, MT 59715	(406) 587-3406
Cenex Seed Co.	P.O. Box 1748, Billings, MT 59103	(406) 656-7150
Cenex/Farmers Union Oil	Box 339, Chinook, MT 59523	
Cenex Seed Plant	Box 956, Miles City, MT 59301	(406) 232-4760
Cenex/Farmers Union Oil	1820 St. Charles, Fort Benton, MT 59422	(800) 497-8295
Cenex/Farmers Union Oil	105 2nd Ave. North, Froid, MT 59226	(406) 766-2339
Cenex/Farmers Union Oil	Box 2483, Great Falls, MT 59403	(406) 453-2070
Cenex/Farmers Union Oil	1545 Northern Ave., Worden, MT 59058	(406) 967-3100
Cenex/Power Farmers Elev. Co.	Box 215, Power, MT 59468	(406) 463-2281
Cenex Supply and Marketing	4570 N. Reserve, Missoula, MT 59802	(406) 543-8383
Cenex Supply and Marketing	1408 Hwy 93 So., Ronan, MT 59864	(406) 676-2201
Central Feed Co.	220 East Main, Lewistown, MT 59457	(406) 538-5451
Chadwick Landscape Nursery	2101 East Custer Ave., Helena, MT 59601	(406) 442-3931

Circle S Seeds	Box 130, 14990 Madison Frontage Rd, Three Forks, MT 59752	(406) 285-3269 circles@imt.net
Clear Creek Herford Ranch	PO Box 595, Chinook, MT	(406) 357-4207
Co-op Supply, Inc.	700 North Montana St., Dillion, MT 59725	(406) 683-2308
Co-op Supply Inc.	Box 36, Valier, MT 59486	(406) 279-3277
Confederated Salish & Kootenai Tribes Forestry Nursery	104 Main St SE, Ronan, MT 59864	(406) 676-3755 x 6032 greenhouse@cskt.org
Cramer Irrigation and Seed	Box 432, Hysham, MT 59038	(406) 342-5281
CX Ranch, Inc.	341 Rd. 422, Circle, MT 59215	
Chip Dye	HC 50, Box 4, Alzada, MT 59311	(406) 828-4487
CS & KT Forestry Tribal Nursery	104 Main St., S.E., Ronan, MT 59864	(406) 676-3755 info@cskt.org
Earth and Wood Craftsman, Inc.	3204 Highway 93 South, Stevensville, MT 59870	
Eastern Montana Seeds	HC Box 3050, Forsyth, MT 59327	(406) 356-2374
Eisenman Seed Co.	P.O. Box 129, Fairfield, MT 59436	(406) 467-2521
Farmers Exchange	115 Main St., Stevensville, MT 59870	(800) 240-5441
Forestry Seeds	Lewistown, MT 59457	
Forsyth Seed Co.	Box 185Forsyth, MT 59327	(406) 356-7627
Four Winds Nursery	5853 E. Shore Rd., Polson, MT 59860	(406) 887-2215
Gallatin Farmers Co.	114 Northern Pacific, Belgrade, MT 59714	(406) 388-6242
Garden City Seeds	1324 Red Crow Rd., Victor, MT 59875 778 Hwy 93, Hamilton, MT 59840	(406) 961-4837 www.seeds@juno.com www.saphirepress.com

Glacier Nursery	4343 Montana Hwy 35, Kalispell, MT 59901	(406) 775-2248 www.glaciernursery.com
Grain Growers Oil Co.	Box 847, Scobey, MT 59263	(406) 487-2741
Grouse Springs Nursery	5853 East Shore Route, Polson, MT 59860	(406) 887-2696
Gregor, R.M. Landscaping	1310 Greene St., Helena, MT 69501	
Harding Land and Cattle Co.	Box 3022, Miles City, MT 59301	(406) 232-2754
Hardy Trees	P.O. Box 9346, Kalispell, MT 59904	
Harris, Loyd A.	3921 Springhill Rd., Bozeman, MT 59715	(406) 587-5696
Harvest States Co-op	Box 66, Valier, MT 59486	(406) 279-3615
Hi-Mountain Farm	Route 1, Box 29, Seligman, MT	
Heartland, Inc.	Belgrade, MT 59714	(406) 388-4232
Heisel Nursery	4463 Springhill Rd., Bozeman, MT 59715	(406) 587-4858
K and K Seed Co.	Route 3, Conrad, MT 59425	
K-W Feed and Grain, Inc.	Box 1389, Big Timber, MT 59011	(406) 932-5132
Lake Milling, Inc.	Box 288, Hamilton, MT 59840	(406) 363-2334
Lawsons Greenhouse	1405 Hillside Dr., Bozeman, MT 59715	(406) 586-5771
Lawyer Nursery, Inc.	950 Hwy. 200 West, Plains, MT 59859	(406) 826-3881 (800) 551-9875 seeds@lawyernursery.com trees@lawyernursery.com www.lawyernursery.com
Laurel Co-op Assn,	Box 7, Edgar, Mt 59026	(406) 962-3792
Lone Pine Ranch	HC 31, Box 3125, Wolf Point, MT 59201	(406) 525-3390
Mannakee Seed Co.	Box 68, Cascade, MT 59421	

Marchie's Nursery	1845 South Third West, Missoula, MT 59801	(406) 542-2544
Montana Bitterroot Gardens	1990 Lower Valley Rd., Kalispell, MT 59901	
Montana Conservation Seedling Nursery	2705 Spurgin Rd, Missoula, MT 59804	(406) 542-4244 jjustin@mt.gov
Montana Merchandising Co.	Box E, Great Falls, MT 59405	(800) 332-1812
Montana Seeds, Inc.	Route 3, Conrad, MT 59425	(406) 278-5547
Morning Creek Gardens	880 Blackmer Lane, Columbia Falls, MT 59912	(800) 250-4644 (406) 756-1971
Mountain Brooks Nursery	P.O. Box 1114, Eureka, MT 59917	
Mountain Home Nursery	Deborgia, MT 59830	
Muggli, Hugo Inc.	Tongue River Stage, Miles City, MT 59330	(406) 232-5578
Nature's Enhancement	2980 Eastside Hwy., Stevensville, MT 59870	(406) 777-3560 natures_enhancement_inc@msn.com
Northern Ag Service	HC65, Box 5500,Hwy 2 East	(406) 654-2022
Northland Seed Co.	PO Box 1675, Billings, MT 59101	(406) 252-0568
Northrup-King and Co.	Box 398, Billings, MT 59103	(406) 252-0508
Patrick Seed Farms, Inc.	HC 72, Box 7300, Malta, MT 59538	(406) 654-1958
Peterson, Ed	Rt. 1, Box 2908, Troy, MT 59935	
Pioneer Hi-Bred Int'l	Box 400, Wibaux, MT 59353	(406) 654-1958
Plum Creek Forest Nursery	PO Box 188, Pablo, MT 59855	(406) 675-3500 kcameron@plumcreek.com
Powder River Seed Co.	Box 673, Broadus, MT 59317	
Quality Seed Co.	P.O. Box 31, Lewistown, MT 59457	(406) 538-8738

Renn's Blue Spruce Nursery	6305 Highway 2 East, Columbia Falls, MT 59912	
Reynolds Feed and Seed	3460 Buffalo Trail, Molt, MT 59057	(406) 669-3219
Salish & Kootenai Tribal Native Plant Nursery	PO Box 117, Pablo, MT 59855	(406) 275-4795 dawn_thomas@skc.edu
Shades of Green Nursery	3403 Cooney Dr., Helena, MT 59601	(406) 442-7033
Skorupa, Bill	Rt. 1, Box 1211, Bridger, MT 59014	(406) 662-3358
Snow Line Tree Co., Inc.	Highway 93 South, Kalispell, MT 59901	(406) 752-1440
Spanish One	Conrad, MT 59425	(406) 627-2329
State Nursery Company	Helena, MT 59601	
Swan River Greenhouse and Nursery	175 Swan River Rd., Bigfork, MT 59911	(406) 837-3375
Townsend Seeds, Inc.	P.O. Box 1338, Townsend, MT 59644	(406) 266-4444
Treasure State Seed, Inc.	Box 698, 2380 Hwy 89, Farifield, MT 59436	(406) 467-2557 Treasure@3rivers.net
Tri-Valley Feed	Rt. 62, Box 3252, Livingston, MT 59047	(406) 222-1132
Two Dog Seed Co.	800 Steel Bridge Rd., Kalispell, MT 59901	(406) 752-3656
Valley Feed	Rt. 62, Box 3252, Livingston, MT 59047	(406) 222-1132
Valley Nursery	Box 4845, 6000 N. Montana Ave, Helena, MT 59604	(406) 458-3992
Wanner Nursery	Corvallis, MT 59828	
West Butte Ranch	Box 32, Sweetgrass, MT 59484	(406) 937-2281
West Feeds/Agribasics	1420 Minnesota Ave., Billings, MT 59101	(406) 252-5196
Western Seed and Supply, Inc.	1308 Round Butte Rd, Ronan, MT 59864	(406) 676-4100

Westland Seed, Inc.	1308 Round Butte Rd, Ronan, MT 59864	(800) 547-3335 westland@ronan.net
Wildflower Seeds	16000 Hwy 10A West, Anaconda, MT 59711	(406) 563-8048
Wildwood Landscaping	P.O. Box 322, Big Sky, MT 59716	

NEVADA

Cactus Joe's Blue Diamond Nursery	12740 Blue Diamond Rd, Blue Diamond, NV 89004	(702) 875-1968 cactusjoe@cactuscactus.com
Comstock Seed	917 Hwy 88, Gardenerville, NV 89460	(775) 746-3681 www.comstockseed.com
Duckwater Shoshone Nursery	PO Box 140068, Duckwater, NV 89314	(775) 863-0299
Las Vegas Nursery, NV Division of Forestry	9600 Tule Springs Road, Las Vegas, NV 89131	(702) 486-5411
Mojave Desert Nursery	PO Box 62066, Boulder City, NV 89006	(702) 293-3940
Native Plant Farm & Tree Movers	5005 Old US Hwy 395 N, Washoe Valley, NV 89704	(775) 691-1490 nativeplantfarm@softcom.net
Native Oak Nursery	Las Vegas, NV 89123	(702) 263-9198
Sierra Valley Farms	1329 County Road A-23, PO Box 79, Beckwourth, CA 96129	(530) 932-0114 www.sierravalleyfarms.com svfarms@plumas.com
Star Nurseries	4810 Wynn Rd., Las Vegas, NV 89103	(702) 871-3240 www.starnursery.com
Washoe Nursery, NV Division of Forestry	885 Eastlake Blvd, Carson City, NV 89704	(775) 849-0213

EASTERN OREGON

Andrews Seed Company	580 S. Oregon, Ontario, OR 97914	(541) 889-9109
Confederated Tribes of the Umatilla Reservation	PO Box 638, 73820 Highway 331, Pendleton, OR 97801	(541) 310-1071 tribalnativeplants@wtechlink.com

Geertson Seed Farm	1665 Burroughs Rd., Adrian, OR 97901	(541) 339-3768
Huckleberry Lane Nursery	69117 Huckleberry Rd, North Bend, OR 97459	(541) 756-7328
Lumberman's Inc	Baker City, OR	(541) 523-6551
Pendleton Grain Growers	1000 SW Dorian St, Pendleton, OR 97801	(541) 687-8000
The Plantworks LLC	1805 U Ave, La Grande, OR 97850	(541) 963-7870 plantworks@oregontrail.net
Round Butte Seed Growers	PO Box 117, 505 C. St, Culver, OR 97734	(541) 546-5222 x 18 bspaulding@rbseed.com
Winter Creek Restoration	63405 Deschutes Market Rd., Bend, OR 97701 PO Box 1543, Bend OR 97709	(541) 948-0063 winterfarmsinc@aol.com
Vibbert Ranch	9655 NE Myrtle Ave, Madras, OR 97741	(541) 475-7309 meganv@bend.com
UTAH		
Barton Seed	222 East Union, Manti, UT 84642	(435) 835-9200 cell: (435) 851-2347
Big J Enterprises	360 N. 400 W., Delta, UT 84624	(435) 864-2804
C & S Intermtn. Seed Enter.	Box 74 or Box 62,Ephraim, UT 84627	(801) 283-4383
Central Utah Seed	825 N. 400 E., Ephraim, UT 84627	(435) 283-4344 codyc@sisna.com
The Cotton Mill	385 W. Telegraph Rd., Washington City, UT 84780	(435) 634-1880 www.starnursery.com
Fremont Trading Company, Maple Leaf	450 S 50 E, Ephraim, UT 84627	(435) 283-4701 maplelf@cut.net
The Garden Niche	10650 S. 700 E., Sandy, UT 84070	(801) 523-5020

Granite Seed	1697 West 2100 North, Lehi, UT 84043	(801) 768-4422 granite@graniteseed.com www.graniteseed.com
Great Basin Natives	75 West 300 South, PO Box 114, Holden UT 84636	(435) 795-2303 www.greatbasinnatives.com gbn@greatbasinnatives.com
Harvest Moon Seed Co.	PO Box 532, Richfield, UT 84701	(435) 979-8549
Hermansen's Mill	PO Box 250, Gunnison, UT 84634	(435) 528-3136
Hillview Water Gardens	1044 East Hillview Dr., Salt Lake City, UT 84124	(801) 261-4912
Inouye, Charles	Box 396, Gunnison, UT 84634	
Intermountain Cactus	1478 N. 750 E, Kaysville, UT 84037	(801) 546-2006 intermtcactus@aol.com
Intermountain Farmers Association	460 S. Main St., Ephraim, UT 84627	(435) 283-4529
Intermountain Seed Co.	270 West 300 North, Ephraim, UT 84627	(435) 283-4703 ecc3@cisna.com
Lone Peak State Nursery	271 W Bitterbrush Lane, Draper, UT 84020	(801) 571-0900 glennbeagle@utah.gov edietrimmer@utah.gov www.ffsl.utah.gov/lonepeak/nursery/LPN
Maple Leaf Industries	480 S. 50 E., Ephraim, UT 84627	(801) 283-4701 maplelf@cut.net
Maughan Seed Company	PO Box 72, 194 W. 300 S., Manti, UT 84642	(435) 835-0401 maughanseed@mail.manti.com
Mountain Valley Seeds	1800 S. W. Temple #600, SLC, UT 84115	(801) 486-0480 www.mvseeds.com info@mvseeds.com

Mountain West Seed Co., Inc.	19 N. 100 W., Ephraim, UT 84627	(435) 283-4704 mtnwseed@cut.net
Mountain Wildland Seed Co.	Box 3201, Logan, UT 84321	(801) 283-4701
Native Plants Inc	417 Wakara Way, Salt Lake City, UT 84108	(800) 533-8498 (801) 582-0144
Oasis Seed Coop.	2730 West 4000 South, Oasis, UT 84650	(435) 864-3614
Overson Farm Center	Cedar City, UT 84720	(435) 586-4469
Paul's Seeds	PO Box 355, 92 Church St., Eureka, UT 84628	(435) 433-6924 treatswithoutwheat@yahoo.com
Plummer Seed Co.	228 East 200 North, Ephraim, UT 84627	(435) 283-4822 (435) 283-4844 mark@plummerseedco.com
Porter Lane Nursery	262 W 400 S, Centerville, UT 84014	(800) 533-8498
Progressive Plants	9180 S. Wasatch Blvd., Sandy, UT 84093	(801) 942-7333 info@progressiveplants.com
Steve Regan Co.	451 South 400 West, Salt Lake City, UT 84101	
Stevens Bros Wldlnd Sds & Nurs	Box 496, Ephraim, UT 84627	
Stevenson Intermountain Seed	PO Box 2, 488 S 1090E, Ephraim, UT 84627	(435) 283-6639 ron@stevensonintermountainseed.com
Sun Mountain Growers	336 N. Mountain Rd., Fruit Heights, UT 84037 PO Box 332, Kaysville, UT 84037	(801) 941-5535 sunmtngrowers@earthlink.net
Wagstaff Seed	PO Box 68, 1900 E. Oakhill Ln., Wallsburg, UT 84082	(435) 654-3439 f.wagstaff@att.net
William Roger Steward and Sons	Box 124, Ephraim, UT 84627	F.wagstaff@att.net
Porter Walton Co.	Box 1919, 522 South Third West, Salt Lake City, UT 84110	

Wheatland West Seed	PO Box 513, 1780 N. Hwy 69, Brigham City, UT 84302	(800) 676-0191 www.wheatlandwest.com oboyce@wheatlandseed.com
Wildland Nursery	370 E 600 N, Joseph, UT 84739	(435) 527-1234 janett@wildlandnursery.com

EASTERN WASHINGTON

Alpine Wildseed	1308 N. Alder, #1, Ellensburg, WA 98926	(509) 933-3063 ken@wildlanders.com www.wildlanders.com
Arnold Thomas Seed Services	Lowden, WA 99360	(509) 529-4580
Bear Creek Nursery	PO Box 411, Northport, WA 99157	
BFI Seed Co	1145 S. Jefferson, Moses Lake, WA 98837	(509) 765-6348 jbenson@bfinativeseeds.com
Central Marketing Inc	517 Northtown Office Bldg, Spokane, WA 99207	(509) 484-4554
Clearwater Seed Co.	665 N Riverpoint Blvd, Suite 142, Spokane, WA 99202	(509) 343-3108 clearwaterseed@comcast.net
Coleville Tribal Forestry Greenhouse	PO Box 72, Nespelem, Wa 99155	(509) 634-2896
Columbia Basin Nursery	PO Box 458, Quincy, WA 98848	(509) 787-4411
Coulee Co-op	310-W. Main, Coulee City, WA 99115	(509) 632-5292
Davenport Seed Corp	PO Box 187, Davenport, WA 99122	(509) 725-1235
Derby Canyon Natives	PO Box 385, 9750 Derby Canyon Rd., Peshastin, WA 98847	(509) 548-9404
Firstline Seeds	11703 Rd 1 SE, Moses Lake, WA 98837	(509) 765-1772
Full Circle	3132 Rd “O” NE, Moses Lake, WA 98837	(509) 765-5617
Gibson’s Nursery	S. 1401 Pines Rd, Spokane, WA 99206	(509) 928-0973
Golden West Services	524 S. 7th, Sunnyside, WA 98944	(509) 839-4700

Grassland West	908 Port Dr, Clarkston, WA 99403	(509) 758-9100 styner@grasslandwest.com
Hillview Gardens	5405 W. Metaline Ave, Kennewick, WA	(509) 783-2695
Inland NW Native Plants	PO Box 30292, Spokane, WA 99223	(509) 448-7992
Jacklin Seed Co	PO Box 181, Ritzville, WA 99169	(509) 659-1065
Kinder Garden Nursery	1137 S. Hwy 17, Othello, WA 99344	(509) 488-5017
Krause Nursery	S. 205 Pines, Box 14130, Spokane, WA 99215	(509) 926-1572
Lamb Nursery	East 101 Sharp Ave, Spokane, WA 99202	(509) 328-7956
L&H Seeds	4756 W Hwy 260, Connell, WA 99326	(509) 234-4433 lhseeds@direcway.com
Landmark Seed Co.	N. 120 Wall St., Suite 400, Spokane, WA 9920	(800) 268-0180 orlin@landmarkseed.com
LMF Feeds Inc	N 39124 Sherman Rd, Deer Park, WA 99006	(509) 276-6018
McLean Seed Co.	PO Box 815, Coulee City, WA 99115	(509) 632-8709
Methow Natives	19 Aspen Lane, Winthrop, WA 98862	(509) 996-3562 methownatives@methownet.com www.methownatives.com
Moses Lake Cons. Dist. Nursery	1775 SE Hwy 17, Moses Lake, WA 98837	(509) 765-5333
Nelson Landscaping Service	N 10801 Newport Hwy, Spokane, WA 99218	(509) 466-6050
Newell Wholesale Nursery	PO Box 372, Ethel, WA 98542	(206) 985-2460
Pendleton Grain Growers	Pasco, WA	(509) 786-7469
Peterson, Greg	6754 Partridge Dr. N.E., Moses Lakes, WA 98837-9524	(509) 765-7946 wagrassman@hotmail.com

Plants of the Wild	PO Box 538, E 900 Main, Tekoa, WA 99033	(509) 284-2848 x 26 kathy@plantsofthewild.com www.plantsofthewild.com
Rainier Seeds, Inc.	PO Box 1064, 1404 Fourth S, Davenport, WA 99122	(800) 828-8873 (509) 725-1235 www.rainierseeds.com
Rain Shadow Nursery	641 Camion Road, Ellensburg, WA 98926	(509) 968-4778 rainshdw@sisna.com
Spring Creek Nursery	3226 W. Montgomery Rd., Deer Park, WA 99006	(509) 276-8278 (509) 838-1957 springcreekdpark@aol.com
Walla Walla Grain Growers	North 2nd St, Walla Walla, WA 99362	(509) 529-3253
Wildlands Inc	1941 Saint St, Richland, WA 99352	(509) 375-4177
Wolfkill Feed & Fertilizer	11763 Rd 1 SE, Moses Lake, WA 98837	(509) 765-7252

WYOMING

Anderson, Dean	2527 Hwy. 215, Pine Bluffs, WY 82082	
Clouds Seed Co.	P.O. Box 937, Sheridan, WY 82801	
Etheridge Seed Farms	2028 Lane 11, Powell, WY 82435	(307) 754-2366
Faxon Farms	598 Rd. 11, Powell, WY 82435	
Little Goose Native Plants	PO Box 445, Big Horn, WY 82833	(307) 672-5340
Meadow Acres Greenhouse & Nursery	M13770 Meadow Lane Box 3, Evansville, WY 82636	(307) 235-1770
Parko Farms	Star Route, Box 162A, Powell, WY 82435	(307) 754-3080
Spiering Farms	1170 Road 19, Powell, WY 82435	(307) 754-4349
Super Seeds	15 Riggs road, Shoshoni, WY 82649	(307) 856-0500

Wind River Seed Co.	3075 Lane 51 1/2 , Manderson, WY 82432	(307) 568-3361 www.windriverseed.com wrsales@windriverseed.com
Yoder Grain and Lumber Co.	Torrington, WY 82240	(307) 532-2355

Plant Guide

NEEDLE-AND-THREAD
Hesperostipa comata (Trin. & Rupr.) Barkworth
Plant Symbol = HECO26

Contributed by: USDA NRCS Idaho State Office

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Alternate Names
Stipa comata; spear-grass

Uses
Grazing/Livestock- Needle-and-Thread begins growth early in the spring, goes dormant in early to mid-summer and may green-up in fall if soil moisture is adequate. It is considered good forage in spring prior to awn development and again in fall after seed is dropped. When grazed while awned seeds are present, the sharp-pointed seed may injure livestock by working into tongue, throat, eyes and ears.

Wildlife- It is desirable forage for elk in winter and spring and considered desirable forage for deer in spring.

Erosion Control/Reclamation- It is a very effective grass in preventing wind erosion on sandy soils. It is one of the first grasses to naturally establish in disturbed sandy sites. It can be used in seeding mixtures for revegetation of sandy sites and sites disturbed by mining activities.

Status
Consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g. threatened or endangered species).

Description
Genera*l*: Needle-and-Thread is a native, tufted, cool-season grass common to the prairies, plains and foothills of the western United States. It is a perennial bunchgrass, 1- 4 feet tall with erect, smooth culms and long, flat leaves 8- 12 inches long. The inflorescence is a contracted panicle that remains partially in the sheath. The source of its name is the 4- 5 inch long twisted awn which arises from the lemma. It detaches from the inflorescence with the seed and gives the appearance of a short needle and long thread. The ligule, an identifying characteristic, is membranous and split.

Intermountain Flora - drawn by Jeanne R. Janish. University of Washington Press.

Distribution: This grass is found from British Columbia and the Yukon to Ontario, south to California, New Mexico and Texas.

Habitat: Needle-and-Thread is an important plant in a wide variety of plant communities throughout western Canada and the United States. It can be found in the Palouse region of Idaho, Oregon and Washington and mountain foothills of British Columbia, Alberta, Idaho, Montana, Oregon and Washington associated with bluebunch wheatgrass, Idaho fescue, and bluegrass plant communities. In the northern Great Plains it is found in association with western wheatgrass, blue grama and bluebunch wheatgrass plant communities. In the central Great Plains it can be found in bluestem, gramagrass and prairie sandreed plant communities. In the arid regions of Idaho, Nevada, Oregon, Utah, and Wyoming it is found in association with sagebrush, saltbush, horsebrush, bitterbrush, winterfat, Sandberg bluegrass, Indian ricegrass, and thickspike wheatgrass plant communities. This species is a fairly early vegetative component on sand dunes in the intermountain region. On sand dune soils in southern Idaho, it follows the establishment of yellow wildrye and scurf pea and establishes before Indian ricegrass and thickspike wheatgrass.

Adaptation

Needle-and-Thread is very drought tolerant and prefers excessively drained sands to fine sandy loams to coarse gravelly loam soils, but is also found on loam to clay loam soils in some habitats. It is most commonly found in 7- 16 inch precipitation zones, but occasionally is found in areas receiving as low as 5- inches to as much as 24- inches mean annual precipitation.

Its elevation range is most common from 3500 to 8500 feet, but it has been found at elevations as low as 1000 feet.

Establishment

This species has fairly high levels of seed dormancy. If seed is less than 2- years old, it should be planted in late fall as a dormant planting to assist with breaking the seed dormancy. Older seed can be planted in early spring. Seed should be planted about ¾- inch deep on loamy soils, about ½- inch deep on clay soils and up to 1- inch deep on sandy soils.

Short prechill treatments (30 to 60 days) can induce a secondary dormancy, reducing seed germination (Scianna 2005). Tests show that seed with no prechill or 120 days prechill readily germinate, but seed prechilled 30 to 60 days had reduced germination of 37 and 68% respectively. Based on this study dormant fall planting or late spring planting will produce the best stands.

Because of its broad range of adaptation, native seed mixtures should specify "Source Identified" seed from locations within 500 miles of the planting site. Great Plains collections and Intermountain West collections do best within their own ecoregions.

There is an average of 115,000 seeds per pound. The recommend full seeding rate is 6 pounds PLS per acre. Seeding mixtures should specify a percentage of this rate.

Management

Needle-and-Thread begins growth in early spring, flowers in June and matures seed in July, goes dormant in early to mid-summer and may green-up in fall if soil moisture is adequate.

It is considered good forage in spring prior to awn development and again in fall after seed is dropped. When grazed while awned seeds are present, the sharp-pointed seed may injure livestock by working into tongue, throat, eyes, ears and hide. It cures well and provides fair to good winter forage.

It generally increases under grazing except in sandy soils and the central Great Plains where it decreases under grazing pressure. It needs to set seed in order to establish new plants, thus deferred rotation grazing systems are recommended.

Pests and Potential Problems

It is not known to be vulnerable to insects or other pests.

Environmental Concerns

Needle-and-Thread is a native species which spreads via seed. It is not considered to be "weedy" or an invasive species, but it can spread into adjoining vegetative communities under ideal climatic and environmental conditions. Its rate of spread is slow.

Needle-and-Thread is known to hybridize with closely related species, Indian ricegrass. These hybrids are sterile.

Seed Production

Seed production of Needle-and-Thread has been somewhat successful under cultivated conditions.

Row spacing of 24- 36 inches under irrigation or high precipitation (>16 inches annual precipitation) to 36-48 inches under dryland conditions are recommended. Seeding rates for seed production range from 2.9- 4.3 (48- 36 inch rows) pound PLS per acre on dryland to 4.3- 5.7 (36- 24 inch rows) pound PLS per acre under irrigated conditions.

It should be seeded in locations where weeds are well controlled. Needle-and-Thread seedlings are slow to establish and are therefore vulnerable to mechanical (wheel and foot traffic) and chemical damage. Wait until the 3- 5 leaf stage before applying herbicides at a low rate (bromoxynil according to label) or clipping for weed control. Cultivation between rows will be needed for weed control and to maintain row culture.

Seed fields are productive for about 3- 4 years. Field moisture during the fall, soil fertility, and plant re-growth determine the yield the succeeding year.

Average production of 100 pounds per acre can be expected under dryland conditions in 16- inch plus rainfall areas. Average production of 150 pounds per acre can be expected under irrigated conditions.

Harvesting can be completed by direct combining in the hard-dough stage (seed turning brown) or by windrowing followed by combining. Windrowing may help ensure a more complete threshing. Windrowing also reduces the risk of loss of seed from wind. Seed is generally harvested from late July to late August. Seed must be dried immediately after combining (moisture content should be 12 percent in bins/15 percent in sacks). Brush-type seed strippers work well in harvesting seed of this species, as the long twisted awns of the mature seed are readily pulled into the hopper, leaving the immature straight awned seed in the inflorescence. Stripping seed must be immediately dried.

Seed should be stored in plastic woven sacks – not cotton or burlap sacks. Sharp seeds will become caught in cotton and burlap fabric. Awn should be removed as soon after harvest as possible or it becomes intertwined with other seed making seed processing very difficult.

Because of the difficulty in harvesting and conditioning, the forage can be harvested at time of seed maturity and the baled forage used as mulch on planting sites. Shattered seed will naturally plant itself when changes in relative humidity cause the awn to twist, driving the seed into the soil surface.

Cultivars, Improved, and Selected Materials
No releases are presently available.

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Edited: 05oct06dgo; 09maydjt; 11may06ls; 05june06mm; 05june06taj

For more information about this and other plants, 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>

Plant Guide

THURBER'S NEEDLEGRASS
Achnatherum thurberianum (Piper) Barkworth
Plant Symbol = ACTH7

Contributed by: USDA NRCS Idaho State Office

Range Plant Leaflet 69. Oregon State University. Cooperative Extension Service. Prepared by: J. Powell.

Alternate Names
Stipa thurberiana; Stipa occidentalis

Uses
Grazing/Livestock- Thurber's needlegrass begins growth early in the spring, goes dormant in early summer and may green-up in fall if soil moisture is adequate. It is considered preferred forage in spring prior to seed-awn development for cattle and horses. It is considered acceptable forage for all classes of livestock throughout the rest of the year following seed drop.

Wildlife- It is preferred forage for elk in spring and considered desirable forage for elk the rest of the year. It is desirable forage for deer and antelope in spring.

Erosion Control/Reclamation- It is an effective grass in preventing wind and water erosion on sandy to loamy soils. It can be used in seeding mixtures for revegetation of sites disturbed by mining activities.

Status
Consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g. threatened or endangered species).

Description
General: Thurber's needlegrass is a native, cool-season grass common to the semiarid regions of the Intermountain West. It is a perennial bunchgrass, 1- 2 feet tall with fine, narrow in rolled leaves about 6-10 inches long. The inflorescence is 3- 4 inches long, narrow and somewhat purplish in color. The seed is about ¼- inch long, sharp pointed with a twice bent, 2- inch long awn. Tiny hairs cover the seed and lower segments of the awn.

Intermountain Flora - drawn by Jeanne R. Janish. University of Washington Press.

Distribution: This grass is found in the semiarid Intermountain West from southern Idaho to Washington Columbia Basin and south to eastern California and northern Nevada and Utah.
Habitat: Thurber's needlegrass is an important plant in semiarid locations in the northern Intermountain West. In the semiarid regions of Idaho, Nevada, Oregon, Washington, Wyoming and Utah it is found in association with sagebrush, saltbush, horsebrush, bitterbrush, winterfat, Sandberg bluegrass, Indian ricegrass, bluebunch wheatgrass and thickspike wheatgrass plant communities.

Adaptation
Thurber's needlegrass is very drought and cold tolerant and prefers well drained fine sandy loams to coarse gravelly loam to silt loam soils. It is not tolerant of shade and saline or sodic soil conditions. It is less resistant to fire than many other bunchgrasses.

It is most commonly found in 7- 16 inch precipitation zones and is often the dominant grass in areas receiving 10- inches or less mean annual precipitation.

Its elevation range is most common from 3500 to 6500 feet, but it has been found at lower elevations.

Establishment
This species has been found to have low levels of seed dormancy as compared to close relatives such as needle-and-thread and Indian ricegrass. This species has low seedling vigor and competes poorly against annual and more vigorous perennial grass species. Seed should be planted into firm weed-free seedbeds in late fall as a dormant planting or in very early spring. Seed should be planted about ¼- ½- inch deep.

Native seed mixtures should specify "Source Identified" seed from locations within 500 miles of the planting site.

There is an average of 3 seeds per foot squared at a 1 pound seeding rate. The recommend full seeding rate is 7 pounds per acre. Seed mixtures should specify a percentage of this rate.

Management
Thurber's needlegrass begins growth in early spring, flowers in late May to early June and matures seed in July. Plants go dormant in early to mid-summer and may green-up in fall if soil moisture is adequate.

It is considered preferred forage in spring prior to seed-awn development and acceptable forage the rest of the year following seed drop. Animals avoid grazing Thurber's needlegrass as seed matures. The sharp pointed callus and awns can be injurious to eyes, ears, nose, tongue and throat. Otherwise, it cures well and provides fair to good winter forage.

It generally decreases under grazing pressure. It needs to set seed in order to establish new plants and deferred rotation grazing systems are recommended.

Pests and Potential Problems
It is not known to be vulnerable to insects or other pests.

Environmental Concerns
Thurber's needlegrass spreads via seed. It is not considered to be "weedy" or an invasive species, but it can spread into adjoining vegetative communities under ideal climatic and environmental conditions. Its rate of spread is slow.

It may hybridize with closely related species, Indian ricegrass creating the hybrid *Stipa bloomeri*.

Seed Production
Seed production of Thurber's needlegrass has been difficult under cultivated conditions.

Row spacing of 24- 36 inches under irrigation or high precipitation (>16 inches annual precipitation) to 36 inches under dryland conditions are recommended. Seeding rates for seed production range from 2.9- 4.3 (48- 36 inch rows) pound PLS per acre on dryland to 4.3 (36 inch rows) pound PLS per acre under irrigated conditions.

It should be seeded in locations where weeds are well controlled. Thurber's needlegrass seedlings are slow to establish and are therefore vulnerable to mechanical (wheel and foot traffic) and chemical damage. Wait until the 3- 5 leaf stage before applying herbicides at a low rate (bromoxynil according to label) or clipping for weed control. Cultivation between rows will be needed for weed control and to maintain row culture.

Seed fields are productive for about 3- 5 years. Field moisture during the fall, soil fertility, and plant re-growth determine the yield the succeeding year.

Estimated average production of 50- 75 pounds per acre can be expected under dryland conditions in 16-inch plus rainfall areas. Estimated average production of 100- 150 pounds per acre can be expected under irrigated conditions.

Harvesting can be accomplished by direct combining in the hard-dough stage or by windrowing followed by combining. Windrowing may help ensure a more complete threshing. Windrowing also reduces the risk of loss of seed from wind. Seed is generally harvested from mid July to mid August. Seed must be dried immediately after combining (moisture content should be 12 percent in bins/15 percent in sacks).

Seed should be stored in plastic woven sacks – not cotton or burlap sacks. Sharp seeds will become caught in cotton and burlap fabric.

Cultivars, Improved, and Selected Materials
No releases are presently available.

The USDA Forest Service is currently working on a selection of this species.

References
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United States Department of Agriculture
Natural Resources Conservation Service

Plant Guide

MUTTONGRASS

Poa fendleriana (Steud.) Vasey

Plant Symbol = POFE

Contributed by: USDA NRCS Idaho State Office

Photo by Derek J. Tilley

Alternate Names

Early bluegrass, mutton bluegrass, *Eragrostis fendleriana*, *Poa eatoni*, *P. montana*, *P. longiligula*

Uses

Forage: Muttongrass is a good source of forage and has been rated as excellent forage for cattle and horses, and good for sheep, elk and deer (USDA 1937). During the winter, seedheads are eaten by pronghorn antelope. Seeds and leaves are also utilized by birds.

Erosion control: The fibrous root system of this species reaches a depth of approximately 10 inches providing good surface erosion control in arid sites.

Native species restoration: Muttongrass has been used sparingly to improve diversity in sagebrush and piñon-juniper communities. It can be used to restore areas where juniper encroachment has depleted the herbaceous understory following juniper removal. The species is drought tolerant and has potential for use in restoration and native diversification projects throughout the West.

Status

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

Description

General: Muttongrass is a perennial bunchgrass growing 0.7 to 2.5 feet tall with narrow leaves (1 to 3mm wide). The species is generally considered apomictic (not requiring fertilization for seed production). The flowers are typically pistillate (only female), but occasional staminate (male) flowers arise giving the species the ability to hybridize with other bluegrasses (Welsh and others 2003). Some plants may also reproduce sexually from pollen received from male plants of other bluegrass species (Cronquist and others 1977).

Distribution: For current distribution, consult the Plant Profile page for this species on the PLANTS Web site. Historic records show muttongrass ranges from southern Canada to Texas and east to the Dakotas.

Habitat: Muttongrass is an important late successional understory component in juniper and piñon-juniper communities. Plants can also be found throughout ponderosa pine and into aspen forests and Engelmann spruce-lodgepole pine zones.

Adaptation

Muttongrass is among the most drought tolerant bluegrasses and should be considered for restoration and native diversification projects in western states. It is limited in its use however due to its low seed viability.

This species performs best on well-drained clay loams but is also found in drier, less fertile, gravelley and sandy soils (USDA 1937). Muttongrass is adapted to sites receiving 10 to 22 inches annual precipitation. In the northern extent of its range, muttongrass occupies lower elevation plant communities while it is found at higher elevations to the south.

Muttongrass has shown limited tolerance to fire. Some evidence indicates that muttongrass stands have responded well following fires (Gartner and others 1978) while others have observed stands being damaged.

Establishment
Plant in late fall (dormant) with a pure seeding rate of 2 lb PLS/acre. If seeding as part of a mix, adjust seeding rate to the desired percentage of the mixture. Seed should be planted with a drill ¼ inch deep, into a firm, weed-free seedbed or seed can be broadcast followed with a cultipacker or harrow operation to provide a shallow covering of soil.

Management
Weed control in seed production fields can be achieved by between-row cultivation but may require some hand weeding during the first growing season because seedlings are very small. After plants reach the 3 to 5 leaf stage, broadleaf herbicides can be applied at low rates.

Pests and Potential Problems
There are no known pests of muttongrass; however, plants may, like other bluegrass species, be susceptible to stem rust.

Environmental Concerns
Muttongrass is a species native to the western United States and is not considered a weedy or invasive species, but it can spread to adjoining vegetative communities under ideal environmental conditions.

Seed and Plant Production
Plant in early spring into a firm, weed-free seedbed at 24 to 36" spacing. Plants require 30 lb/ac available nitrogen during the establishment year and 45 lb/ac available nitrogen on established fields. Apply phosphorus according to soil test recommendations. For establishment, irrigate to maintain a moist soil surface and to avoid soil crusting. On established fields irrigate in early spring through boot stage. Do not irrigate during pollination or seed ripening. Irrigate after harvest to promote growth.

Harvest by direct combining in late May through mid-June. Muttongrass is very susceptible to seed shatter and timing of harvest is critical. Seed should be dried to approximately 10% moisture before cleaning and storage. Seed can be cleaned by lightly hammer milling followed with a clipper or air screen cleaner.

Yields for irrigated production fields average about 35 lb/acre but vary widely from year to year. Stands produce seed for up to 8 years. Low viability in seed prevents muttongrass from being more widely used. There are approximately 890,000 seeds/pound.

Cultivars, Improved, and Selected Materials (and area of origin)
There are no releases currently available. Wildland collected seed can be obtained through commercial vendors.

The Aberdeen, Idaho Plant Materials Center is currently evaluating accessions for potential release. Contact your local Natural Resources Conservation Service (formerly Soil Conservation Service) office for more information. Look in the phone book under "United States Government." The Natural Resources Conservation Service will be listed under the subheading "Department of Agriculture."

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Edited: djt101906; lstj102006; dgo111706; 111606 jsp

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Plant Guide

SANDBERG BLUEGRASS

Poa secunda Presl including:

P. ampla **Merr. (POAM)**
P. canbyi **(Scribn.) Howell (POCA)**
P. gracillima **Vasey (POGR)**
P. juncifolia **Scribn. (POJU)**
P. nevadensis **Vasey (PONE3)**
P. sandbergii **Vasey (POSA12)**
P. scabrella **(Thurb.) Benth (POSC)**

Plant Symbol = POSE

Contributed by: USDA – NRCS, Boise, Idaho

Photo by Mark Majerus. Bridger, MT Plant Materials Center

Alternate Names

P. ampla = Big bluegrass
P. canbyi = Canby's bluegrass
P. gracillima = Pacific or Slender bluegrass
P. juncifolia = Alkali bluegrass
P. nevadensis = Nevada bluegrass
P. sandbergii = Sandberg bluegrass
P. scabrella = Pine bluegrass

Description

General: The Sandberg bluegrass complex is composed of cool-season (with some summer active ecotypes) perennial bunchgrasses that mature early in the growing season. This grass is one of the first to green up in the spring, but is cured and dormant by early summer. The plant usually occurs as small tufts, with soft basal leaves and few to many flowering stalks that are naked except for one or two small leaves. The leaves have the typical bluegrass characteristics of prow-shaped tip and double groove down the center of the leaf surface. Sandberg bluegrass has a prominent membranaceous, acute ligule. The seeds are glabrous except for short crisp hairs on the lower portion of the lemmas. The flowers are in narrow panicles that are somewhat spreading during anthesis. Plants seldom exceed 60 cm (24 in) in height. Plants of the Sandberg bluegrass complex have extensive, deep penetrating, coarse, fibrous roots that make them quite drought tolerant and resistant to grazing and trampling. Species within the complex have approximately 2,000,000 seeds per kilogram (925,000 seeds per pound).

Distribution: Plants occur throughout Western North America with disjunct populations in Quebec and Chile. For current distribution, consult the Plant Profile page for this species on the PLANTS Web site.

Taxonomy

The type specimen for *Poa secunda* was collected between 1790 and 1794 in "cordilleras Chilensibus" by Thaddeus Haenke and was described by Presl in 1830. In 1892, Sandberg collected a plant near Lewiston, Idaho which was described the following year by Vasey as *Poa sandbergii*. Presl's work is recognized as having taxonomic priority due to its earlier date (Arnow 1981).

The Sandberg bluegrass complex has included up to 45 named species including eight species recognized by Hitchcock (1935): Canby's bluegrass (*P. canbyi)*, big bluegrass (*P. ampla*), little mountain bluegrass (*P. curtifolia*), Pacific bluegrass (*P. gracillima*), alkali bluegrass (*P. juncifolia*), Nevada bluegrass (*P. nevadensis*), Pine bluegrass (*P. scabrella)* and the traditional Sandberg bluegrass (*P. sandbergii*) (Arnow 1981). Kellogg (1985a, 1985b) however, demonstrated that for all species except *P. curtifolia*, the characters used to separate the species were unreliable. Many were often environmentally determined, for example plants turning red when dry, leaf rolling and leaf glaucusness. Research has shown that under garden and greenhouse conditions these characters don't exhibit themselves as in field conditions (Kellogg 1985b). Other characters vary so widely within a population that they are also unusable to delineate groups within the complex.

Based on these findings, Kellogg (1985a) synonomized the entire complex with the exception of *P. curtifolia*, a well-defined species endemic to serpentine outcrops in the Wenatchee Mountains in Kittitas and Chelan Counties, Washington (Hitchcock and others 1971).


Variation in Sandberg bluegrass releases; left to right: Sherman big bluegrass, High Plains and Mountain Home Sandberg bluegrass. Photo by Derek J. Tilley, Aberdeen, ID Plant Materials Center.

Although evidence currently points to a large, highly variable suite of forms making up the Sandberg bluegrass complex, the authors of this paper believe that unique phenotypes exist and the separation of these forms is still useful in describing ecological sites, predicting revegetation performance and in making land management decisions. In this light, the authors have decided to provide descriptions here of the seven separate forms of Sandberg bluegrass recognized by Hitchcock (1935), minus *P. curtifolia*, as an aid to land managers.

The following taxonomic key taken from Cronquist and others (1977) should be useful in separating the seven species of the Sandberg bluegrass complex.

1. Lemmas crisp puberulent to nearly glabrous, the pubescence sometimes confined to the very base.
  2. Panicles open, the lower branches nearly at right angles to the axis; culms often decumbent at the base; plants summer flowering ……………………………………*P. gracillima*
  2. Panicles contracted or somewhat open; culms usually erect.
    3. Plants relatively small, culms mostly less than 30 cm tall; basal leaves forming a short dense tuft, 3-10 cm high; panicles 2-7 cm long; mostly spring flowering...*P. sandbergii*
    3. Plants larger, mostly more than 30 cm tall; basal leaves looser, the tuft 5-30 cm high; panicles 6-16 cm long; mostly summer flowering
      4. Basal tuft of leaves 3-15 cm high; panicles 4-12 cm long…........*P. scabrella*
      4. Basal tuft of leaves 15-30 cm high; panicles 9-16 cm long………...*P. canbyi*
1. Lemmas usually glabrous, sometimes minutely scaberulous
  5. Ligules decurrent, long, 1.5-6.5 mm long, acuminate or sharply acute…….*P. nevadensis*
  5. Ligules not obviously decurrent, short, 1-2 mm long, rounded or obtuse to truncate.
    6. Blades involute, mostly less than 1.5 mm broad, greenish; plants 20-70 cm tall; usually growing in alkaline soils ....*P. juncifolia*
    6. Blades mostly flat, 1.5-3.5 mm broad, often glaucous; plants robust, 60-180 cm tall; growing in non-alkaline soils……...*P. ampla*


'Sherman' big bluegrass. Photo from USDA-NRCS.

Big bluegrass (*Poa ampla*)
This is the most robust species within the Sandberg bluegrass complex. Culms reach 60 to 130 cm (24 to 48 in) tall, with basal leaves growing to 40 cm (16 in) long and 1.5 to 3.5 mm (1/16 to 1/8 in) wide. The leaves are typically bluish-green and somewhat glaucus. Panicles range from 10 to 18 cm (4 to 7 in) long and are narrow with densely arranged spikelets.

This species occupies sagebrush slopes, mid-elevation meadows and openings in aspen stands. Big bluegrass is notable for early green-up, greater forage production and its importance to range management.

Canby's bluegrass (*Poa canbyi*)
Canby's bluegrass bears green to glaucus leaves with culms to 80 cm (31 in) tall. The basal leaves are typically 15 to 30 cm (6 to 12 in) long and 1 to 3 mm (1/16 to 3/32 in) wide. The panicles are loose to compact with erect branches growing to a length of 16 cm (6 ¼ in). Plants of Canby's bluegrass grow on open grassy or sagebrush slopes at middle elevations. In its native habitat this species actively grows during the late spring and matures by early July as opposed to *P. sandbergii* (Cronquist and others 1977)

Pacific or Slender bluegrass (*Poa gracillima*)
This is another summer active species. Culms range from 20 to 50 cm (8 to 20 in) tall. Leaf blades are flat and lax from 5 to 15 cm (2 to 5 in) long and 0.7 to 2 mm (1/32 to 1/16 in) wide. The panicles are open and pyramidal. Lemmas of Pacific bluegrass have longer hairs on the keel than *P. sandbergii*. This species can be found in meadows, stream banks and rocky slopes from British Columbia to the California Sierras, with populations also in northern Nevada, northern Utah and Colorado.

Nevada bluegrass (*Poa nevadensis*)
This species is a perennial bunchgrass with culms as much as 100 cm (39 in) tall. Basal leaves typically reach a length of 25 cm (10 in) with a width of 1 to 3 mm (1/16 to 3/32 in). Nevada bluegrass has distinctive long acuminate ligules from 1.5 to as much as 6 mm (1/16 to ¼ in) long. The narrow panicles are 10 to 18 cm (4 to 7 in) long with yellowish-green to purplish-tinged spikelets. Nevada bluegrass can be found in relatively moist areas in sagebrush communities including mountain foothills and meadows from Alaska to southern California, through Nevada to Arizona and Colorado.

Alkali bluegrass (*Poa juncifolia*)
This species is regarded as being closely related to *P. ampla* (Cronquist and others 1977) and it has been shown that when grown under garden conditions the differences between the two species are lost (Hitchcock and others 1969). Typically the plants are smaller with culms growing 30 to 70 cm (12 to 26 in) tall. Leaf blades are tightly rolled and less than 2 mm (1/16 in) wide. Panicles are narrow, 7 to 15 cm (2 ¾ to 6 in) long with short, ascending branches. This species prefers moist or dry alkaline meadows from the sagebrush zone to mountain communities from British Columbia to South Dakota and south to Nevada, Utah and New Mexico.

Sandberg bluegrass (*Poa sandbergii*)
This is probably the most common bluegrass species in the Intermountain West, at least in the drier portions of the region, and is an important forage species for small animals in spring and fall (Cronquist and others 1977). Plants are relatively small with culms reaching 20 to 35 cm (8 to 14 in) tall and basal leaves 3 to 5 cm (1 to 2 in) long. Plants occur in dry areas in sagebrush and mountain shrub communities, and occasionally in alpine sites.

Pine bluegrass (*Poa scabrella*)
This species can be tentatively separated from Canby's bluegrass by its being a spring flowering species as opposed to summer, and from Sandberg bluegrass by its smaller size. However; it is admittedly very closely related to both and extremely difficult to separate when the species are found in close proximity to one another. Typically this species is found on relatively dry sites on sagebrush hills and woodlands at low to mid-elevations from British Columbia to Baja California, Nevada Utah and Colorado, and east to Minnesota.

Pine bluegrass. http://www.tarleton.edu/~range/Home/home.htm

Uses
Sandberg bluegrass and the other spring ecotypes are palatable to livestock early in the growing season, becoming less preferred during the summer when cured. Summer growing ecotypes are palatable longer into the season. By autumn Sandberg

bluegrass is frequently selected again as available alternatives diminish. Deer, pronghorn antelope, and bighorn sheep utilize Sandberg bluegrass forage and birds and small mammals utilize the seed (Johnson and Larson 1999).

Because of the small stature and early maturity, most of the species of Sandberg bluegrass do not provide much usable forage; however, big bluegrass and Nevada bluegrass can be important forage producers for larger animals. Sandberg bluegrass is usually a minor component of many grassland communities, but is still considered one of the six most important rangeland grasses of the Intermountain and Pacific Northwest regions (USDA Forest Service 1937).

The anticipated use of commercially available Sandberg bluegrass seed is for inclusion in native mixtures for wildlife habitat, reclamation of disturbed sites, restoration of native rangeland, and conservation plantings.

Status

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

Adaptation

Sandberg bluegrass is considered an increaser in mid and short-grass prairies, mountain meadows, and foothills of south-central Canada and western United States (Dakotas west to Washington), south to Mexico (Hitchcock 1935) (Hitchcock & Cronquist 1976). It is found at elevations ranging from 100 to 3,650 meters (300 to 12,000 ft). It grows well on medium texture soils but is also common on badlands, ridge tops, and dry, stony, or sandy soils. It is a pioneer species, one of the first grasses to colonize on disturbed sites. Plants of the Sandberg bluegrass complex occupy a niche in bunchgrass plant communities. The primary area of use would include the northern Great Plains (Montana, Wyoming, North Dakota, South Dakota, Colorado), the Intermountain West including the Great Basin (Idaho, Nevada, Oregon, Washington, Utah), and the Palouse country (Idaho, Oregon, Washington).

Sandberg bluegrass is considered to be a facultative apomyct, reproducing primarily (but not limited to) agamospermy, or asexual seed production (Kellogg 1987). Larson and others (2001) showed that genetic diversity within natural populations of Sandberg bluegrass was much greater than that in the releases Sherman or Canbar. Accordingly, releases, such as Reliable Sandberg bluegrass germplasm, have been developed from multiple plant populations to ensure higher amounts of genetic diversity and greater adaptation (Waldron and others 2006).

Establishment

For best results, seed should be planted into a firm, weed-free seedbed, preferably with a drill that will ensure a uniform seed placement of about 6 mm (1/8 to 1/4 inch). The small seed can be broadcast seeded, harrowed, and packed for good seed-soil contact; however, in dryland situations good precipitation at the time of germination is critical for emergence and survival. The full seeding rate is 1.7 kg/ha PLS (2.0 lb/ac PLS), but this species would seldom be seeded in a pure stand. This species would normally be included in native seed mixtures at a rate of 0.3 to 0.6 kg/ha PLS (1/4 to 1/2 lb/ac PLS). Seeding in early spring is favored in areas that have summer moisture patterns such as the Northern Great Plains, while fall dormant seedings are preferred in winter rainfall areas such as the Columbia Basin and most of the Intermountain West. Sandberg bluegrass is considered a pioneer species and is often one of the first grasses to respond to surface manipulation of deteriorated rangeland. Sandberg bluegrass is a relatively short-lived grass, but often perpetuates itself through prolific seed set and shatter**.**

Management

Sandberg bluegrass will withstand heavy grazing and trampling, in part, because of its early maturity and apparent dormancy during the summer and fall grazing period. When planted in a native reclamation mix, it will be a minor component of the establishing plant community; therefore management should be based on other key species in the mixture. Any new planting should be deferred from livestock grazing until it is well established which may require 1 to 3 years (Schwendiman 1971).

Pests and Potential Problems

Sandberg bluegrass is susceptible to stem and leaf rusts which can significantly decrease seed production (Mosman 2005). Rust outbreaks can be prevented and controlled by applying a 14 oz rate of systemic fungicides such as Propiconazole and Azoxystrobin ('Quilt' ^{tm}). Always follow the label in any pesticide application.

Environmental Concerns

Sandberg bluegrass is a native perennial grass that is considered an increaser under heavy grazing conditions and is a pioneer (early colonizing species) on rangeland disturbances or surface manipulated sites. This species is a bunchgrass and seed shatter does not travel far from the parent plant. It occupies space in bunchgrass plant communities and assists with deterring invasive species encroachment due to its extensive root system.

It is recommended in mixtures on sites needing an early spring perennial grass to compete against annual weeds. Sandberg bluegrass is known to fill in interspaces between larger bunchgrasses and effectively impedes the spreading of cheatgrass (Monsen and others 2004). Seed may be consumed by songbirds, upland game birds, and small mammals and spread through feces. Sandberg bluegrass is not aggressive, and therefore is not considered to be invasive.

Seed Production

Seed should be planted in rows using a drill that will ensure a uniform 6 mm (1/4 inch) planting depth. Seeding is best in early spring (April 1 to May 15). Seed in rows with at least 45-60 cm (18-24 in) spacing on irrigated sites and 75-90 cm (30-36 in) on dryland sites.

Seed production should not be attempted on dryland sites receiving less than 380 mm (15 inches) of annual precipitation. Seed of this species matures early, so a long growing season is not necessary. However, seed production should not be attempted in areas that have a high probability of a killing frost past May 15th. Commercial seed production fields of Sandberg bluegrass will not produce seed the first (establishment) year. Seed production fields should be established using a rate of 150 to 250 seeds per linear meter of row (50-80 PLS/ linear foot). This will equate to 0.6 to 1.2 kg/ha (0.5 to 1 lb/ac) of pure live seed. Because of the extremely small seed size, seeding rates are often in the neighborhood of 2.2 kg/ha (2 lb/ac) because of the difficulty in metering such a small volume of seed through a drill.

Seeding in wide-spaced rows facilitates weed control and allows for more robust plant development resulting in optimum seed production. Close cultivation should occur only during the establishment year. As the stand matures, cultivation should be further away from the row, allowing tillering from the edges and preventing damage to surface roots. There are several broadleaf herbicides that are registered for use in grass seed production fields, however, options are limited for chemical control of annual grassy weeds.

The average harvest date in south-central Montana ranges from June 24 to August 19; the harvest date varying with spring and early summer climatic conditions. Good seed production can be expected during the second and third year of production with seed production dropping off drastically the fourth year. Expected seed production is 85-175 kg/ha (75-150 lbs/ac) on dryland and 110-445 kg/ha (100-400 lbs/ac) on irrigated sites. Seed ripening is uniform enough that seed can be direct combined, but swathing and combining from a cured windrow is the preferred method of harvest.

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

Various "ecotypes" should be utilized within a reasonable geographic range from the original source, since available releases are primarily source identified or selected germplasm releases and have not been progeny tested to determine their range of adaptation and performance.

Seed production field of High Plains Sandberg bluegrass at the Bridger, MT PMC. Photo by Susan Winslow.

High Plains Selected Class Germplasm of Sandberg bluegrass *(Poa sandbergii)* was released in 2000 from the Bridger Plant Materials Center. This is the first release of the *Poa sandbergii* type to the commercial seed industry. This release is a composite of three accessions originating from the high plains of Wyoming; one each from Natrona (300-350 mm precip., elev. 1,590 m), Campbell (250-300 mm precip., elev. 1,430 m), and Uinta (175-225 mm precip., elev. 1,920 m) counties. G_1 (equivalent to Foundation) seed is available to commercial growers through the Foundation Seed Program at Montana State University and the University of Wyoming. The Montana and Wyoming Seed Certification Programs will recognize G_2 (equivalent to Registered) and G_3 (equivalent to Certified) classes of germplasm.

Mountain Home Germplasm (*Poa sandbergii)* is test material from the USDA Forest Service Rocky Mountain Research Station in Boise, ID. Mountain

Home Germplasm is not a release at this point, but is under commercial production and being utilized in seed mixes in the Intermountain West.

Hanford Source Sandberg bluegrass (*Poa sandbergii*) is a source identified release from L&H Seeds in Connell, Washington. The original material was collected from Hanford, Washington from an area receiving an average 6 inches of annual precipitation. It is adapted to droughty regions in the west and/or locations with well drained sandy soils.

Duffy Creek and Wallowa (*Poa sandbergii)* are source identified releases from Benson Farms Inc. Both are intended for use in arid sites throughout the western states.

Reliable Sandberg bluegrass (*Poa sandbergii)* was released by the USDA-ARS and the Utah Agricultural Experiment Station in 2004 as a Selected Class germplasm. This is a multi-origin germplasm stemming from 28 collections representing seven USDA-NRCS ecological sites. Reliable was developed for its high genetic diversity and to provide adaptation over a broad ecological range (Waldron and others 2006). G_1 and G_2 seed is maintained by the USDA-ARS Forage and Range Research Laboratory, Logan, UT. G_3 seed is available through the Utah Crop Improvement Association. Seed through the G_5 generation will be eligible for certification as Selected Class germplasm.

Canbar canby's bluegrass (*Poa canbyi)* is a cultivar release and was selected from a single collection made in the Blue Mountains, Columbia County, Washington. It is adapted to sites receiving 8 to 24 inches annual precipitation and is intended for use in basin, Wyoming and mountain big sagebrush plant communities in western states. Canbar should be used in a mixture on sites needing an early spring perennial grass to compete against annual weeds. Canbar is known to fill in interspaces between larger bunchgrasses and effectively impedes the spreading of cheatgrass (Monsen and others 2004). Foundation seed is available through the Washington State Crop Improvement Association. Breeder seed is maintained by the Pullman, Washington Plant Materials Center.

Service Sandberg bluegrass (*Poa ampla)* comes from a collection made east of Whitehorse, Yukon Territory, Canada. It is intended for use in reclamation, native habitat restoration and erosion control throughout most of Alaska (Alderson and Sharp 1994). Breeder seed is available through the Alaska Plant Materials Center, Palmer, Alaska.

Sherman big bluegrass was collected from a native population near Moro, Sherman County, Oregon in 1932 and this cultivar was released in 1945 by the Washington, Idaho and Oregon Agricultural Experiment Stations and the Pullman Washington Plant Materials Center. This is a large stature bunchgrass growing to nearly 1 meter tall (Alderson and Sharp 1994). It is intended for use in range reseeding, cropland retirement plantings, and revegetation of disturbed lands in mountain brush communities and openings in aspen and conifer forests. It is best adapted to areas that receive 10-24 inches of annual precipitation. Plants of Sherman are readily eaten by livestock and large game. Foundation seed is available through Washington State Crop Improvement Association, and breeder seed is maintained by the Pullman, Washington Plant Materials Center.

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Plant Guide

BLACK GREASEWOOD

Sarcobatus vermiculatus (Hooker) Torrey

Plant Symbol = SAVE4

Contributed by: USDA – NRCS, Boise, Idaho

Black Greasewood. Photo by Brock Benson, NRCS, UT

Uses

Wildlife habitat/forage: Although often considered poor browse, black greasewood provides important cover for wildlife and livestock, especially during the winter. Plants are low to low fair in protein levels depending on soil and growing conditions.

Caution: Black greasewood plants contain sodium and potassium oxalates and are toxic to livestock. Browsing black greasewood can be fatal if even low to moderate quantities are consumed without large quantities of other forage in the diet. Black greasewood is poisonous year round, but plants can be consumed safely in light to very moderate amounts in the spring while the leaves are growing, as long as there is a substantial amount of other preferable forage available. As the season progresses, toxins accumulate and the plant becomes the most toxic in the fall. Animals can also be poisoned in fall and winter by eating the leaves from the ground.

Signs of poisoning develop 4 to 6 hours after an animal has eaten a toxic amount, approximately 2 pounds for sheep and 3 pounds for cattle (James et al 1980; Weathers 1998). James et al (1988) state that grazing black greasewood properly and with a great deal of caution can be beneficial to the grazing animal.

Ethnobotanical: The tough wood from *Sarcobatus* was used by Native American Indians for tools and firewood (Welsh et al 2003).

Status

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

Description

General: Goosefoot Family (Chenopodiaceae): Black greasewood is a rapidly growing, tall (3 to 10 ft), erect spiny deciduous to semi-evergreen shrub (it is more deciduous in northern reaches and less so in the southern reaches of its range). Black greasewood has a long lifespan with very good seedling vigor. Leaves are bright green to light olive green in color, round, narrow and fleshy.

Black greasewood plants are generally monoecious (having separate male and female flowers on the same plant) but can also be dioecious (having separate male and female plants) [Hickman 1993]. The male (staminate) flowers are small and clustered in pine cone shaped spikes that are 1/2 to 1 inch long. Male flowers lack both sepals and petals. Flowers are found at the ends of the top most branches on the plant. The female (pistillate) flowers are green, small in size (about 3/16 in), very inconspicuous with a wing-like membrane that becomes enlarged as the fruit matures. The fruit reaches approximately 1/2 inch at maturity. Fruit are green while growing, turning reddish nearing the end of development and tan when fully mature. Black greasewood plants flower in May through July with the fruit maturing in July through September. Both male flowers and female flowers can be found on plants from May through July. The male flowers persist on the plant through the end of the growing season, while the female flowers are found on the plant from mid July through November.

Bark is white on young plants and new growth, but turns gray to black on old growth. Spines are found along the branches and at the tips of the branches (spines are not considered to be true spines, but the ends of branches which grow out at about a 90 degree angle). These serve as mechanical protection from grazing.

Mature Seed. Photo courtesy of the PLANTS database.

Distribution:
Black greasewood can be found in saline seeps as well as dry upland communities in arid to semi-arid habitats in all western states east to Texas and North Dakota. For current distribution, consult the Plant Profile page for this species on the PLANTS Web site.

Habitat:
Black greasewood plants inhabit a wide range of plant communities in the lowlands of the western deserts. Plants are typically found growing in saline soils that can be quite moist (wet saline meadows) to dry uplands. Black greasewood is often the dominant species in the plant community, but plants are also found associated with seepweed, saltbush, saltgrass, shadscale, basin big sagebrush and Wyoming big sagebrush communities. Some ecological sites may only have a minor component of black greasewood, but black greasewood will often increase to become dominant under certain circumstances giving the impression that it is a "greasewood site".

Adaptation
Black greasewood tolerates mildly to strongly sodic soil as well as non-saline to strongly saline soils. It is normally found on soils that are primarily fine-textured and saline and/or sodic, but this plant will grow on a wide variety of soils from very heavy clays to cobbly loams. It has very high tolerance to sodic to saline affected soils. Plants are highly drought tolerant but can also tolerate high water tables and can survive prolonged flooding (up to approximately 40 days).

Black greasewood plants can have an extremely long root system (reported from 1.5 meters (5 ft) to 6.1 meters (20 ft) long) with lateral roots 0.9 meters (3 ft) to 3.7 meters (12 ft) in length. Adventitious buds are found all along the lateral root system which initiate sprouting when the main plant or the root system is damaged. Plants have the ability to crown sprout whenever the crown is damaged.

Management
Although black greasewood is not usually considered to be a weedy species, sites containing the plant are often in poor ecological condition due to the combination of past management coupled with the harsh environment in which the plant normally occurs. Recovering the health of sites that are in poor condition can be very challenging and may take years to achieve.

Characteristics of greasewood, such as adventitious buds and crown sprouting, make it relatively difficult to manage. Unlike black greasewood, big sagebrush species do not tolerate high levels of salinity or sodicity. In general, the more big sagebrush that is found on the site the better the chance of being able to successfully treat the site. **Where there is very little to no big sagebrush, the treatment of the site will most likely fail or be a very poor investment of capital.** Other criteria that should be considered are climate, available water holding capacity of the soil, depth of soil, soil surface texture, surface rock fragments and slope.

Control of black greasewood is not easily accomplished. 2, 4-D and 2, 4-D + dicamba (Banvel®) are the most common control methods, but these rarely work with a single application. Normally two applications on subsequent years are needed. Occasionally three applications are required to gain acceptable control. Picloram (Tordon®) works fairly well. Metsulfuron (Ally®, Cimmaron®, or Escort®) have produced mixed results. Metsulfuron, when it works, will work very well, but apparently there are some environmental factors that contribute to its effectiveness. These factors do not appear to be clearly defined at this time. Other mixes that have been successfully applied are 2, 4-D + Tordon and 2, 4-D + Metsulfuron. Adding a surfactant to any chemical application seems to improve the success of the control project. Spraying should be completed in the spring when plants are actively growing and the new leaves are about 1/2 to

3/4 inches long. Be sure to read and follow pesticide label instructions.

Deep plowing to a depth of 10 inches or deeper and plowing in two directions is often the most effective treatment where soil conditions are favorable. After the first plowing, wait until the plants start growing again and then make the second pass at a 45 degree angle to the previous pass. Regrowth normally occurs in the next growing season but can happen in the year of the first plowing.

Where the site is not conducive to brush removal, but improving the understory is needed, broadcast seeding around the plants without disturbing them is an option. The likelihood of success for this type of seeding is low; however, some of the seed may grow and improve the opportunity for livestock and wildlife use.

One way of seeding areas where a drill can not be used, due to soils being too fluffy or where there are shrubs or plant stumps in the way, is to broadcast or aerially apply seed and then put a large number of animals in the area for a short period of time to work the seed into the soil surface. Seed trampling works best where the soil surface is too soft to be drilled at the right depth, or where you are trying to seed around and/or through an existing stand of black greasewood that needs understory improvement.

Areas of black greasewood that are burned, crowned, brush beat, or shallow plowed and/or shallow disked will often result in a much higher density of black greasewood. Over-grazing of the understory vegetation also gives greasewood the chance to increase on the site to the point of site domination.

Not all of the ecological sites where black greasewood is found are suitable for manipulation. Thus, extreme caution should be exercised when selecting which sites have the best potential for improvement.

The following points should be kept in mind when managing black greasewood sites:

- Proper grazing management of understory vegetation is critical to maintaining healthy greasewood sites.

- If proper grazing practices are not followed after improvements are made, the site will quickly revert back to their former state.

- Conditions such as low precipitation, high sodicity and high salinity can reduce the success of improvements.

- Black greasewood is a sprouting plant and will come back vigorously if only the plant crown is disturbed and the root system is not destroyed.

Environmental Concerns
Black greasewood is a species native to the western United States. The species is not considered weedy or invasive, but plants can spread to adjoining vegetative communities under ideal environmental conditions.

Seed and Plant Production
Seed can be wildland collected by hand in late fall when the fruit has turned a light brown color. Containerized seedlings can be propagated after placing seed in cold stratification. Germination occurs best at 10º C and 30D/20N C alternating temperature cycle (Baskin and Baskin 2002).

Cultivars, Improved, and Selected Materials (and area of origin)
There are currently no commercial releases of black greasewood.

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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>

Plant Guide

PARSNIPFLOWER BUCKWHEAT

Eriogonum heracleoides Nutt.

Plant Symbol = ERHE2

Contributed by: USDA – NRCS, Boise, Idaho

Parsnipflower buckwheat. Photo by Derek J. Tilley

Alternate Names

Whorled buckwheat, Wyeth buckwheat

Uses

Restoration/low water use landscaping: Parsnipflower buckwheat produces large splays of small, cream to yellow colored flowers and has tremendous potential for use in native landscaping and drought tolerant plantings in the semi-arid regions of western North America (Young 1989). Parsnipflower buckwheat can be used in seeding mixtures to increase the forb- sub-shrub component in native species diversification and site restoration planting projects in the sagebrush steppe and mountain foothills of the Intermountain West. Flowers of buckwheat species are known to attract insects which are an important part of the diets of insect loving species such as sage grouse (*Centrocercus urophasianus*). Parsnipflower buckwheat has little or no forage value for livestock (USDA, 1937).

Ethnobotanical: A decoction of roots and stems are said to have been used to treat colds and tuberculosis and to treat cuts and sores (Turner and others 1980). Root decoctions have also been reported to have been used for diarrhea, stomachaches and other ailments (Steedman 1930).

Status

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

Description

General: Buckwheat family (Polygonaceae). Parsnipflower buckwheat is a perennial forb to sub-shrub with a branching woody stem. Leaves are covered with dense white hairs making the herbage appear a light green to blue-grayish color. The flowers are a creamy-yellow color and have six petals which are borne in simple or compound umbels. Plants of parsnipflower buckwheat can be distinguished from other closely related members of the genus by having a whorl of 5 to 10 leaves at midpoint of flowering stem; however in some subspecies this is not apparent (Freeman and Reveal 2005). The seeds, or achenes, are light to dark brown from 3 to 5 mm long. There are approximately 374,000 seeds/kg (170,000 seeds/lb).

Distribution: The species range includes the Rocky Mountain and Intermountain western states from British Columbia and Alberta south to Utah and Nevada. For current distribution, please consult the Plant Profile page for this species on the PLANTS Web site.

Habitat: Plants of parsnipflower buckwheat can be found growing in rocky soils, often on slopes and dry canyons. This species is frequently found growing in association with mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and antelope bitterbrush (*Purshia tridentata*).

Adaptation

Plants are found growing naturally in areas receiving 12 inches to about 25 inches annual precipitation. Parsnipflower buckwheat grows in mountain foothills at the upper end of the Wyoming big sagebrush zone and into the mountainous coniferous and deciduous forest regions. Parsnipflower buckwheat typically occupies sites at lower elevation and precipitation than sulphurflower buckwheat (*E. umbellatum*), but the ranges of the two species do overlap. Plants grow in course, rocky, well-drained soils.

Establishment
Recently harvested seed is typically dormant and responds best to a 16 to 24 week chilling period at 2º C (36 º F) (Meyer and Paulsen 2000). Seed should be planted at or just below the soil surface, to no more than 3mm (0.25 in) depth. The full seeding rate is 3.4 kg/ha PLS (4.0 lb/ac PLS), but this species should not be seeded in a pure stand. This species would normally be included in native seed mixtures at a rate of 0.3 to 0.6 kg/ha PLS (1/4 to 1/2 lb/ac PLS).

Management
When planted in a native reclamation seed mix, parsnipflower buckwheat will be a minor component of the establishing plant community; therefore management should be based on other key species in the mixture. Any new planting should be deferred from livestock grazing until it is well established which may require 1 to 3 years.

Pests and Potential Problems
Seed collections often contain insect larvae in the seeds. Placing seeds in a freezer (0 to 10º F) for 7 to 10 days prior to long term storage effectively kills insect pathogens.

Environmental Concerns
Parsnipflower buckwheat is a species native to the Intermountain and Rocky Mountain West. The species is not considered weedy or invasive, but plants can spread to adjoining vegetative communities under ideal environmental conditions.

Seed and Plant Production

Parsnipflower buckwheat seed. Photo by Derek J. Tilley

Seed should be planted in late fall as a dormant planting to allow proper stratification of the seed over winter. For best results the seedbed should be weed free, moist and firmly packed. The use of weed barrier fabric is very effective at controlling weeds. Additionally, preliminary herbicide tolerance trials conducted at the University of Oregon, Malheur Experiment Station on sulphurflower buckwheat indicated Prowl® (pendimethalin) Treflan® (trifluralin) and Balan® (benefin) look promising for use in seed production fields (Shock and others 2006). J. Herbert Stone Nursery in Oregon recommends soil fumigation prior to planting forb seed production fields to eliminate soil borne pathogens and to reduce weed competition (Archibald 2006). Buckwheat seed should be planted to a depth of no more than 3 to 6 mm (0.125 to 0.25 in). When planting in weed barrier fabric, plant at 9 to 18 in spacing. When drill seeding, use a seeding rate of 20 to 30 pure live seeds (PLS) per linear foot (Ogle and others 2006).

Seed can be harvested by hand or direct combined in mid to late July. Due to the wide window of seed ripening it may be beneficial to harvest multiple times by hand to obtain the greatest amount of viable seed.

For seed cleaning, run harvested material through a hammermill followed by an air screen cleaner. Check cleaned seed for holes or other insect damage which may indicate the absence or damage of the seed within the achene. It may be necessary to reclean using the air screen cleaner with the blower on a higher setting to remove empty achenes.

Cultivars, Improved, and Selected Materials (and area of origin)
There are currently no commercial releases of parsnipflower buckwheat; however wildland collected seed is available. The Aberdeen, Idaho Plant Materials Center is currently conducting a common garden study to evaluate accessions for potential release. Contact your local Natural Resources Conservation Service office for more information. Look in the phone book under "United States Government." The Natural Resources Conservation Service will be listed under the subheading "Department of Agriculture."

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Plants for Solving Resource Problems

ABERDEEN SELECTION of LAUREL WILLOW

Species: ***Salix pentandra***
Common Name: **Laurel Willow**

Plant Symbol: **SAPE**
Accession Number: **9005049**

Source: The USDA Natural Resources Conservation Service, Plant Materials Center at Aberdeen, Idaho received the original plant material from the Plant Materials Center in Rose Lake, Michigan. It was collected in the upper Midwest from naturalized stands of European lineage.

Site Information: This plant is native to central and western Europe where it has been cultivated for many centuries. Another common name is Bay Willow. Both common names refer to the similarity of the leaf to that of the Bay Laurel tree.

Method of Selection: Selected from a collection of potential windbreak plants assembled and evaluated at the Plant Materials Center from 1981 through 1996. Laurel willow has been tested at off-center locations near Mountain Home, Idaho and Winnemucca, Nevada. This accession was selected for its beauty, hardiness, appropriate growth form for windbreaks, and natural range of adaptability. This accession shows great promise for use throughout the Intermountain West when used in irrigated windbreaks and for landscaping.

Laurel Willow

Description: Introduced from Europe during the past three centuries, Laurel willow has lustrous dark green foliage. The dark green, shiny leaves are 2 to 5 inches long and very attractive. The bark on the fine twigs and the stems is green to yellow green and gray on the older trunks. It requires deep, moist soils or supplemental irrigation. It is a medium to tall shrub with a dense round top, symmetrical crown and multiple trunks. Laurel willow grows to heights of 20-40 feet (6-12 meters) with average canopy coverage of 15-25 feet (4-8 meters).

Use: The potential uses of Laurel willow are for wind erosion control, diversity and beautification. Its fibrous root system and wide canopy cover make it an excellent plant for soil stabilization. The moderately dense stem and leaf pattern makes this an excellent plant for windbreaks. It is recommended for use in interior rows of multiple-row windbreaks, in a single row or twin-row windbreaks where an evergreen is not needed or desired, for landscaping, and to provide nesting and roosting habitat for birds.

Insect and Disease Problems: No problems have been observed with insects or diseases which could affect the survival or appearance of this plant.

Environmental Considerations: Laurel willow is not intended for use in natural wetlands or riparian areas. Since it is an introduced plant from Europe, it is not an appropriate component in native plant communities. In riparian areas, stems cut by beaver and broken stems may spread this plant to areas beyond the landowner's control. The released material is all from female plants.

Potential Area of Adaptation: The range of adaptation is very broad because the plant is expected to be used under managed conditions where annual rainfall is high (at least 22 inches per year) or where irrigation water is available. It is tolerant of very cold weather and adapted for use in windbreaks and landscaping throughout the Intermountain West. It also should perform well in the northern Great Plains and upper Midwest.

Potential Soil Adaptation: Deep or moderately deep loams, sandy loams, gravelly loams, well-drained to somewhat poorly drained soils.

Harvesting and Planting: This plant is reproduced using cuttings. Cuttings should be made during the period from late fall to early spring when the plants are dormant and have no leaves. Branches from 0.5 to 2 inches in diameter make excellent cuttings. All of the small side branches should be removed, as well as the upper part that is less than 0.25 inches in diameter. Cuttings can be from 3 to 6 feet long. Cuttings should be stored under refrigeration until spring, or they can be planted immediately. The key to successful planting is to get the bottom of the cutting as deep into the soil as possible. A good rule of thumb is to place at least 2/3 of the cutting in the ground and more if possible. Where irrigation water is provided, planting deep and watering deep are essential to long term survival. If the cuttings have been stored for a long period prior to planting, soaking the lower ends (all that will be in the ground) in water 1 to 4 days will speed up the rooting process. The use of root promoting hormones is not required. The scarring or cutting of the planted portion is not recommended and may hurt the plant.

Parent Plant Maintenance: Parent plants are maintained at:

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

Cuttings from Laurel willow will be made available to nurseries. Nurseries may establish their own parent plants for long-term production of cuttings.

November 2006

Plants for Solving Resource Problems

Alkali Bulrush

Species: ***Schoenoplectus maritimus***

Common Name: Alkali Bulrush
Plant Symbol: SCMA8

Accession Numbers: Bear Lake Selection (9067380), Bear River Selection (9067374), Fort Boise Selection (9057579) and Stillwater Selection (9067428)

Source: The Aberdeen PMC has released four performance tested ecotypes of alkali bulrush from the PMC service area. The Bear Lake Selection was collected from the Bear Lake National Wildlife Refuge (NWR), south of Montpelier, ID. It was selected for use in Land Resource Region (LRR) B East. The Bear River Selection was selected for use in LRR D South. It was collected from the Bear River Migratory Bird Refuge west of Brigham City, UT. The Fort Boise Selection comes from the Fort Boise Wildlife Management Area, near Apple Valley, ID and was selected for use in LRR B West. The Stillwater Selection was selected for use in LRR D North. The collection site was at the Stillwater National Wildlife Refuge northwest of Fallon, NV.

Site Information: Alkali bulrush is a commonly occurring wetland species found throughout western North America.

Method of Selection: Fourteen alkali bulrush collections from the Aberdeen PMC Service Area were evaluated from 1991 to 1995. All collections were evaluated for survival, overall growth and spread, vigor, and stability of land ownership. The PMC

Alkali Bulrush

released one selection from each LRR in the PMC service area. The released selections are the accessions with the best overall rating against others from within its respective LRR.

Description: Alkali Bulrush is a perennial, rhizomatous, wetland obligate. Stems are upright, triangular, and grow up to 1.5 meters (5 ft) tall. The leaves are several, 1 cm (0.4 in) wide, well developed, elongate, flat and distributed along the stem below the middle. Inflorescences consist of 3 to 20 or more blunt spikes, 1.2 to 2 cm (0.5 to 0.75 in) long and 6 to 10 mm thick, all sessile in a compact terminal cluster. The fruit is a brown lenticular achene from 2 to 4 mm long.

Use: Alkali bulrush is suitable for erosion control, constructed wetland system applications, wildlife food and cover, wetland restoration and creation and improvement of plant diversity in wetland and riparian communities. Dense roots make this a good choice for soil stabilization, and the above ground biomass provides protection from erosive wave action and stream currents. Waterfowl feed on the seed and use the stands for nesting. Muskrat and beaver will eat the rootstocks and young shoots. The rhizomes also form a matrix for many beneficial bacteria, making this an excellent choice for wastewater treatment.

Insect and Disease Problems: There are no known problems with insects or diseases. If an insect or disease problem is encountered in the greenhouse, treat as you would for any other plant species.

Environmental Considerations: These selected class releases are from a species native to the Intermountain West and have no known negative impacts on wild or domestic animals.

Area of Adaptation: Alkali bulrush can be found at low to mid elevations in marshes, pond margins, backwaters and transient wet areas. It can survive short periods of total inundation of up to 1 m (3 ft) deep. Alkali bulrush can occur on freshwater sites, but is usually a pioneering species that will be replaced over time with longer lived species. Plants spread by seed and rhizomes.

Soil Adaptation: Plants form large dense stands in alkaline or saline sites. Alkali bulrush can grow in soils with a pH of up to 9.0 and soil textures from fine clays to silt loams to sands. It will tolerate high levels of saline conditions (EC<19).

Planting and Harvesting: Germination can be enhanced by wet prechilling the seeds in a mixture of water and sphagnum moss at 2º C (35º F) for 30 days. Seed requires light, moisture and heat for germination. For greenhouse propagation, place seeds on soil surface and press in lightly to assure good soil contact. Do not cover seed. Soil should be kept moist, and the greenhouse should be kept hot, 32 to 38ºC (90 to 100º F). Germination should begin within one to two weeks. Maintain soil moisture until transplanting. Plugs should be transplanted at 30 to 45 cm (12 to 18 in) spacing. This allows plants to fill in interspaces within one growing season. Soils should be kept saturated with no more than 5 to 8 cm (2 to 3 in) of standing water during the first growing season. Fluctuating water levels during the establishment year will facilitate spreading. Seed can be collected by hand stripping, clipping with hand shears or by using a gas powered seed stripper.

Seed Maintenance: Generation 0 (G0) seed is maintained at Aberdeen PMC. Later generation seed (ie G1) is not produced, maintained or available through the USDA-NRCS Plant Materials Center. To make collections of these alkali bulrush releases, contact the appropriate managing agency to collect from the original collection site.

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

November 2006

Plants for Solving Resource Problems

'APPAR' BLUE FLAX

Species: ***Linum perenne***
Common Name: **Blue Flax**
Plant Symbol: LIPE2
Accession Number: PI-445972

Source: 'Appar' is a selection from a non-native plant collection made in the badlands of the Black Hills region of South Dakota in 1955. It is named for its collector, A. Perry Plummer, at that time a Range Scientist with the USDA Forest Service Intermountain Forest and Range Experiment Station in Ephraim, Utah.

Native Site Information: Once thought to be the native species Lewis flax, Appar has since been identified as blue flax, an introduced species from Europe.

Method of Selection: Appar was selected after several years of testing at the Utah Division of Wildlife Resources Research Nursery at Ephraim, Utah and at the NRCS Plant Materials Center in Aberdeen, Idaho. Appar was chosen based on superior beauty, vigor, seed production and competitiveness with understory grasses at the original collection site.

Description: Appar blue flax is a tap-rooted, medium-lived perennial forb arising from a woody caudex or root crown. Numerous stems bear small, alternate, linear leaves which range from one to three mm long. Plant height varies from 12 inches in arid sites to 36 inches when irrigated. Flowers are 1 to 1.5 inches across and have five deep blue petals with a yellow hint at the throat. Flowers are produced from mid-May to late June. Individual flowers bloom from morning to mid-day after which petals are shed.

'Appar' Blue Flax

Use: Appar is consumed readily by big game animals and livestock, especially in the spring when they are changing diets from shrubs to forbs and grasses. Because of its beautiful deep blue color as compared to the paler native flax plants, Appar is often used in horticultural settings such as road-side improvement applications and as an ornamental in home gardens.

Insect and Disease Problems: No detrimental disease symptoms or insect problems have been observed in plantings of Appar.

Environmental Considerations: Because Appar is an introduced plant from Europe, it is not an appropriate component in native plant community restoration. It has no known negative impacts on wild or domestic animals and does not cross with native flax species. It is not considered a weedy or invasive species but can spread to adjoining vegetative communities under ideal conditions. It coexists with other plant species and adds biodiversity to those plant communities.

Area of Adaptation: Appar is adapted to many areas of the Intermountain West on sites receiving 10 to 23 inches mean annual precipitation. It is well suited to live in a variety of plant communities from big sagebrush to mountain brush sites. It prefers full sun and does not perform well as an understory species.

Soil Adaptation: Appar is best suited to sites with well-drained to moderately well-drained soils that are moderately basic to weakly acidic. It is also well adapted for use in mixtures for seeding mine spoils and highway rights-of-way.

Planting and Harvesting: Appar should be seeded with a drill at a depth of ¼ to ½ inch in a firm, weed-free seedbed. The full seeding rate is 4 pounds Pure Live Seed (PLS) per acre. Adjust for desired percentage when used as a component of a seed mix.

For seed production, plant in 36 inch rows at a rate of 1.6 pounds PLS per acre to allow mechanical weed control and to maintain rows.

Appar must be swathed before harvest. Seed is typically harvested in early-August. Seed yields range from 300 pounds per acre (dryland) to 700 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 University of Idaho Foundation Seed Program and Utah Crop Improvement Association 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).

November 2006

Plants for Solving Resource Problem

Baltic Rush

Species: ***Juncus balticus***

Common Name: Baltic Rush

Plant Symbol: JUBA
Accession Numbers: Railroad Valley Selection (9057641), Roswell Selection (9057580), Sterling Selection (9067411) and Stillwater Selection (9057632)

Source: The Aberdeen PMC has released four performance tested ecotypes of Baltic rush from the PMC service area. Railroad Valley Selection was collected from the Railroad Valley Wildlife Management Area (WMA) in Nye County, NV. It was selected for use in Land Resource Region (LRR) D South. The Roswell Selection was selected for use in LRR B West. It was collected from the Roswell WMA near Roswell, ID. The Sterling Selection comes from the Sterling WMA, north of Aberdeen, ID and was selected for use in LRR B East. The Stillwater Selection was selected for use in LRR D North. The collection site was the Stillwater National Wildlife Refuge near Fallon, NV.

Method of Selection: Fourteen Baltic rush collections from the Aberdeen PMC Service Area were evaluated from 1991 to 1995. All collections were evaluated for survival, overall growth and spread, vigor, and stability of land ownership. The PMC released one selection from each LRR in the PMC service area. The released selections are the accessions with the best overall rating against others from within its respective LRR.

Baltic Rush

Description: Baltic rush is a perennial, rhizomatous wetland plant. It is the most widespread and common rush found the Great Basin and arid Intermountain regions. Plants form dense stands of dark green, round, upright stems from 30 to 90 cm (12 to 35 in) tall. Most leaves are basal and bladeless. A single, leaf-like bract subtends the inflorescence and appears to be an extension of the stem. 10 to 50 flowers are born in a loosely arranged panicle. The six tepals are 3.5 to 5 mm long. The fruit is a capsule which bears numerous tiny brown seeds (0.6 to 0.8 mm long).

Use: Baltic rush is suitable for erosion control, constructed wetland system applications, wildlife food and cover, wetland restoration and creation and improvement of plant diversity in wetland and riparian communities. Plants provide good cover and food for waterfowl, songbirds and small mammals. The rhizomes also host many beneficial bacteria making this plant an excellent choice for wastewater management applications. Baltic rush is also traditionally used by Native American cultures in basketry as well as for food.

Insect and Disease Problems: There are no known problems with insects or diseases. If an insect or disease problem is encountered in the greenhouse, treat similar to any other plant species.

Environmental Considerations: These selected class releases are from a species native to the Intermountain West and have no known negative impacts on wild or domestic animals.

Area of Adaptation: Baltic rush is found at low to mid elevations and occasionally in subalpine and alpine sites. It grows in wet depressions, swales, meadows, sloughs and springs. Plants are both flood tolerant and drought tolerant. They are most often found in areas that are flooded in the spring and dry in the summer and fall.

Soil Adaptation: Soils range from silt and clay loams to coarse substrates and peat soils. Plants have been documented growing on soils that are acidic to neutral to saline and sodic (pH 6 to 9 and EC<14).

Planting and Harvesting: Seed does not require any pretreatment. Seed requires light, moisture and heat for germination. For greenhouse propagation, place seeds on soil surface and press lightly to assure good soil to seed contact. Do not cover seed. Soil should be kept moist, and the greenhouse should be kept hot, 32 to 38º C (90 to 100º F). Germination should begin within one week. Maintain soil moisture until transplanting. Plugs should be transplanted at 25 to 30 cm (10 to 12 in) spacing. This allows plants to fill in interspaces within one growing season. Soils should be kept saturated with no more than 8 cm (3 in) of standing water at any time during the first growing season. Fluctuating water levels during the establishment year will facilitate spreading. Seed can be collected by hand stripping or clipping with hand shears. Seed is very small and plants should be handled carefully to prevent seed loss.

Hydrology is very important to the establishment and management of *Juncus* species. Standing water should fluctuate throughout the growing season and should be kept no deeper than 2.5 to 8 cm. Baltic rush can tolerate long periods of drought as well as total inundation. Water levels can be managed to control terrestrial weeds and to facilitate spreading of Baltic rush.

Seed Maintenance: Generation 0 (G0) seed is maintained at Aberdeen PMC. Later generation seed (ie G1) is not produced, maintained or available through the USDA-NRCS Plant Materials Center. To make collections of these alkali bulrush releases, contact the appropriate managing agency for the original collection site.

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1691A S. 2700 W.
Aberdeen, ID 83210
Phone: (208) 397-4133

November 2006

Plants for Solving Resource Problems

'BANNOCK' THICKSPIKE WHEATGRASS

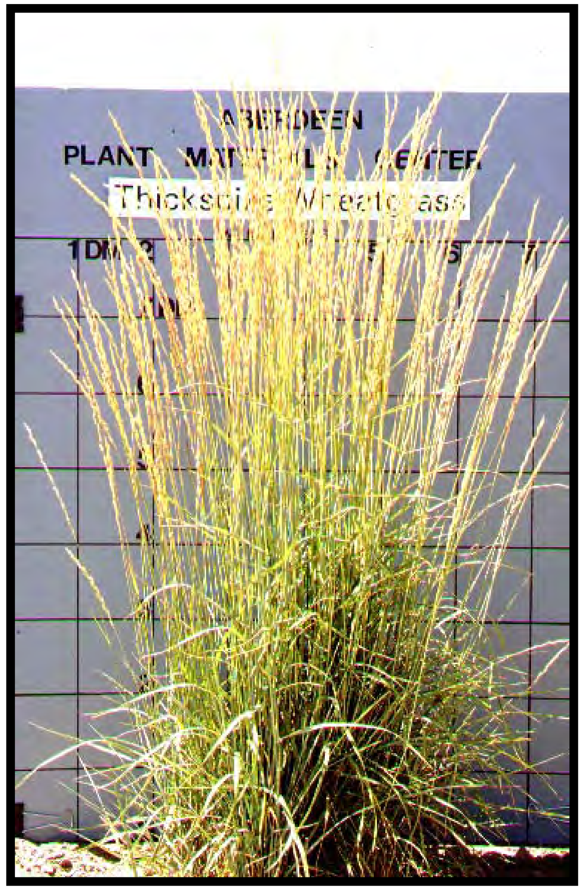
Species: *Elymus lanceolatus* ssp.*lanceolatus*
Common Name: **Thickspike Wheatgrass**
Plant Symbol: **ELLAL**
Accession Number: **9021076**

Source: Bannock is a composite of 6 seed collections of thickspike wheatgrass from Pocatello, Idaho; The Dalles, Oregon; and Quincy, Washington that were collected prior to 1948. Specific collection site information is not available.

Native Site Information: Thickspike wheatgrass is native to the western United States and is adapted to areas where annual precipitation averages 8 inches or more.

Method of Selection: The original seed collections were planted in 1948. In the late 1950's, six individual plants that were more vigorous and productive were selected, increased under isolation and seed was bulked. The first generation seed was planted at Tetonia, Idaho and seed from Tetonia was planted at Knoll Creek, Nevada. Seed from Knoll Creek was then brought back to the Aberdeen Plant Materials Center for seed increase. Bannock has been compared to other thickspike wheatgrass cultivars at sites throughout the western United States and is taller, leafier and more productive.

Description: Bannock is a long-lived, leafy, cool season perennial grass. It is moderately rhizomatous, with good sod-producing qualities. The stems are erect, 15 to 24 inches tall (up to 40 inches irrigated). The leaves, stems, and seedheads have little or no pubescence. Leaves are abundant with a pale green to bluish cast. Seedheads often turn reddish at maturity. There are no awns.



'Bannock' Thickspike Wheatgrass

Anticipated Use: The potential uses of Bannock thickspike wheatgrass are as a component of a seed mix for rangeland, erosion control, forage and cover seedings in 8 to 16 inch rainfall zones; mine spoil reclamation; critical area stabilization where a sod-forming perennial is needed; filter strips to trap sediment; and competition with aggressive annuals such as cheatgrass and medusahead because of its ability to establish sod.

Insect and Disease Problems: No highly detrimental disease symptoms or insect problems have been observed in plantings of Bannock.

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. Bannock is not considered a weedy or invasive species but can spread to adjoining vegetative communities under ideal environmental conditions.

Potential Area of Adaptation: Bannock is adapted to the Northwest and Intermountain regions of the United States where annual precipitation averages above 8 inches. It may be adapted to the northern Great Plains.

Potential Soil Adaptation: Bannock prefers moderately deep, loamy to silt loam soils, but can grow on sandy and clayey soils.

Planting and Harvesting: Bannock should be seeded with a drill to a depth of 1/4 to 1/2 inches on a firm, weed-free seedbed. The full seeding rate is 6 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, Bannock should be seeded in 36 inch rows to allow mechanical weed control and to maintain rows. Bannock may be seeded during the spring, late summer (irrigated), or fall (dormant).

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 mid-July to mid-August. Seed yields range from 100 pounds per acre (dryland) to 400 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 Crop Improvement Association and Soil Conservation Districts in Idaho, Utah and Nevada. Certification of seed shall be limited to not more than two generations from Foundation seed. Variety protection has been granted under the Plant Variety Protection Act of 1970. Conditions of this license specify that Bannock seed can be marketed only as a class of certified seed.

November 2006

Plants for Solving Resource Problems

CLEARWATER SELECTION VENUS PENSTEMON

Species: ***Penstemon venustus***
Common Name: **Venus Penstemon**
Plant Symbol: **PEVE2**
Accession Number: **9008487**

Source: Seed was collected near Dworshak Reservoir on the Clearwater River, Idaho. No detailed site information is available. The area ranges from 1,600 to 2,800 feet elevation. The soils are mostly granite in origin and annual precipitation ranges from 23 to 38 inches.

Native Site Information: This plant is native to the western United States and is adapted to rangeland areas of 1,000 to 6,000 feet elevation in 20 to 35 inch rainfall areas.

Method of Selection: Selected from a collection of 119 penstemon accessions assembled and evaluated at the Aberdeen Plant Materials Center from 1981 to 1985. There were 3 Venus penstemon accessions in the assembly. The Clearwater Selection was selected for its beauty, hardiness, seed production and natural range of adaptability. Seed from this accession does not appear to need a long stratification period to germinate and the plants are long lived.

Description: *Penstemon venustus* is a perennial, cool season forb. It is 12 to 24 inches tall with a strong taproot and woody base. The leaves are oblong and sharply serrate. The flowers appear in one or more narrow terminal panicles, 12 to 20 inches long. The flowers are bright lavender to purple blooming in mid-summer through early fall.

Venus Penstemon

Use: The potential uses of the Clearwater Selection of Venus penstemon are erosion control, diversity and beautification. The heavy taproot and woody base make it an excellent plant for soil stabilization. The heavy basal leaf mass and showy purple flowers also make it a desirable forb for beautification.

Insect and Disease Problems: Venus penstemon is susceptible to soil-borne fusarium and rhizoctonia root rot, which can be severe in poorly drained loam and clay textured soils. There are no known insect problems.

Environmental Considerations: This selected release is from a species native to the Intermountain West and has no known negative impacts on wild or domestic animals. Venus penstemon is not considered a weedy or invasive species but can spread to adjoining vegetative communities under ideal environmental conditions. It co-exists with other native species and adds biodiversity to those plant communities.

Potential Area of Adaptation: The natural habitat of Venus penstemon is at elevations from 1,000 to 6,000 feet in 20 to 35 inch rainfall areas. Venus penstemon can survive in full sunlight and on open rocky slopes. It does not do well in areas with poor drainage.

Potential Soil Adaptation: Shallow rocky, loams, sandy loams, gravelly loams, well-drained to moderately well-drained soils.

Planting and Harvesting: Venus penstemon may be seeded with a drill or broadcast planted and then covered to a depth of 1/8 to 1/4 inches into a firm seedbed in late fall. The full seeding rate is 2 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, Venus penstemon should be seeded in 36 inch rows at a rate of 0.7 pounds PLS per acre. The use of weed barrier fabric is an alternative to allow closer spacing and facilitate weed control. Venus penstemon should be seeded in late fall or early winter to allow the seed to stratify. Germination can occur over several growing seasons.

Seed is harvested by hand stripping or combine. Flowering is indeterminate with mature capsules and flowers present at harvest period. Seed is mature when capsules are dry and seed is hard. Multiple harvest periods by hand may be necessary to maximize seed collection. Some seed will shatter as capsules dry and open. Seed can be separated from the capsule with a hammermill or barley debearder followed by air-screening. Seed should be stored in a cool, dry area to maintain viability. Seed yields range from 100 to 200 pounds per acre.

Seed Maintenance: G0 and G1 seed is maintained at:

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

G1 seed is available through the University of Idaho Foundation Seed Program, Utah Crop Improvement Association and Soil Conservation Districts in Idaho, Utah and Nevada. Growers may produce one generation each of G2 and G3 seed.

November 2006

Plants for Solving Resource Problems

Common Threesquare

Species: ***Schoenoplectus pungens***

Common Name: **Common threesquare**
Plant Symbol: **SCPU10**

Accession Numbers: Fort Boise Selection (9057578), Wayne Kirch Selection (9067642), Malheur Selection (9057610) and Market Lake Selection (9057648)

Source: The Aberdeen PMC has released four performance tested ecotypes of common threesquare from the PMC service area. The Fort Boise Selection was collected from the Fort Boise Wildlife Management Area (WMA) west of Apple Valley, ID. It was selected for use in Land Resource Region (LRR) B West. The Wayne Kirch Selection was selected for use in LRR D South. It was collected from the Kirch WMA in Nye County, NV. The Market Lake Selection comes from the Market Lake WMA, north of Roberts, ID and was selected for use in LRR B East. The Malheur Selection was selected for use in LRR D North. The collection site was at the Malheur National Wildlife Refuge near Burns, OR.

Site Information: Common threesquare is a commonly occurring wetland species found throughout temperate North America.

Method of Selection: Twelve common threesquare collections from the Aberdeen PMC Service Area were evaluated from 1991 to 1995. All collections were evaluated for survival, overall growth and spread, vigor, and potential seed production. The PMC released one selection from each LRR in the PMC service area. The released selections are the accessions with the best overall rating against others from within its respective LRR.

Common threesquare

Description: Common threesquare is a perennial, rhizomatous wetland plant found at low to mid elevations in backwater areas of streams, ponds, reservoirs and lake fringes. Plants are generally found in mixed stands, often with Nebraska sedge, creeping spikerush and Baltic rush. Stems are erect and triangular and may reach over 1 m (3 ft) tall. Leaves occur on the lower third of the stem, are elongated and 2 to 4 mm wide. The inflorescence is a lateral cluster of 1 to 7 sessile spikelets subtended by an involucral bract that appears to be a continuation of the stem. Scales are yellowish to reddish brown. The fruit is a brown lenticular achene 2.2 to 3.3 mm long with a slender beak.

Use: Common threesquare is suitable for erosion control, constructed wetland system applications, wildlife food and cover, wetland restoration and creation and improvement of plant diversity in wetland and riparian communities. Dense roots make this an excellent choice for soil stabilization, and the above ground biomass provides protection from erosive wave action and stream currents. Waterfowl feed on the seed and use the stands for nesting. Muskrat and beaver will eat the rootstocks and young shoots.

Insect and Disease Problems: There are no known problems with insects or diseases. Aphids will feed on the stems, but rarely cause significant damage.

Environmental Considerations: These selected class releases are from a species native to the Intermountain West and have no known negative impacts on wild or domestic animals.

Area of Adaptation: Common threesquare is found in wet meadows, marshes, streams, ditches, seeps ponds and lakes throughout the western U.S. Plants are generally found in areas of standing water ranging from 10 to 15 cm (4 to 6 in) in depth. Plants can survive periods when the water table is more than 1 m (3 ft) below the surface.

Soil Adaptation: This species grows on fine silty clay loam to sandy loam soils generally in fresh water areas. It will tolerate moderate levels of saline conditions (EC<14).

Planting and Harvesting: Germination can be enhanced by wet prechilling the seeds in a mixture of water and sphagnum moss at 2º C (35º F) for 30 days. Seeds require light, moisture and heat for germination. For greenhouse propagation, place seeds on soil surface and press in lightly to assure good soil contact. Do not cover seed. Soil should be kept moist, and the greenhouse should be kept hot, 32 to 38º C (90 to 100º F). Germination should begin within one to two weeks. Maintain soil moisture until transplanting. Plugs should be transplanted at 30 to 45 cm (12 to 18 in) spacing. This allows plants to fill in interspaces within one growing season. Soils should be kept saturated with no more than 5 to 8 cm (2 to 3 in) of standing water during the first growing season. Fluctuating water levels during the establishment year will facilitate spreading. Seed can be collected by hand stripping, clipping with hand shears or by using a gas powered seed stripper.

Seed Maintenance: Generation 0 (G0) seed is maintained at Aberdeen PMC. Later generation seed (i.e. G1) is not produced, maintained or available through the USDA-NRCS Plant Materials Center. To make collections of these common threesquare releases, contact the appropriate managing agency for the original collection site.

November 2006

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Plants for Solving Resource Problems

Creeping spikerush

Species: ***Eleocharis palustris***

Common Name: **Creeping spikerush**

Plant Symbol: **ELPA3**
Accession Numbers: **CJ Strike Selection (9057585), Malheur Selection (9057607), Mud Lake Selection (9067389) and Ruby Lake Selection (9067387)**

Source: The Aberdeen PMC has released four performance tested ecotypes of creeping spikerush from the PMC service area. The CJ Strike Selection was collected from the CJ Strike Wildlife Management Area (WMA) near Bruneau, Idaho. It was selected for use in Land Resource Region (LRR) B West. The Malheur Selection was selected for use in LRR D North. It was collected from the Malheur National Wildlife Refuge (NWR) near Burns, OR. The Mud Lake Selection comes from the Mud Lake WMA, north of Terreton, Idaho and was selected for use in LRR B East. The Ruby Lake Selection was selected for use in LRR D South. The collection site was the Ruby Lake NWR in Elko County, NV.

Method of Selection: Sixteen creeping spikerush collections from the Aberdeen PMC Service Area were evaluated from 1991 to 1995. All collections were evaluated for survival, vigor, overall growth and spread, potential seed production, and above ground biomass production. The PMC released one selection from each LRR in the PMC service area. The released selections are the accessions with the best overall rating against others from within its respective LRR.

Creeping spikerush

Description: Creeping spikerush is a perennial, strongly rhizomatous wetland plant naturally occurring in wet meadows, seeps, springs, lake margins and other wetland environments. Stems are upright and round and are typically 10 to 70 cm (4 to 27 in) tall. Stems are topped with a terminal spikelet bearing numerous flowers. The fruit is a yellow to brown lenticular achene from 1.5 to 2.5 mm long. Achenes are tipped with a tubercle and subtended by up to 8 bristles. Creeping spikerush is a native obligate wetland species found throughout the northern Hemisphere. It occurs in all U.S. states except Georgia, Florida and Hawaii.

Use: Creeping spikerush is suitable for erosion control, constructed wetland system applications, wildlife food and cover, wetland restoration and creation and improvement of plant diversity in wetland and riparian communities. Plants spread rapidly by rhizomes and will develop a thick root mass that is resistant to compaction and erosion. The rhizomes also form a matrix for many beneficial bacteria making this plant an excellent choice for wastewater management applications.

Insect and Disease Problems: There are no known problems with insects or diseases. Aphids will feed on the stems, but little or no damage has been noted, and the vigor of the plants has not been affected.

Environmental Considerations: These selected class releases are from a species native to the Intermountain West and have no known negative impacts on wild or domestic animals.

Area of Adaptation: Creeping spikerush grows on sites that are either permanently or seasonally flooded. The plants can grow and thrive in permanent water up to 1 m (3 ft) deep. They can also survive in areas where the water table drops to 30 cm (12 in) below the surface late in the growing season. Plants are commonly found growing in areas totally inundated for up to 4 months. Plants grow in saturated, fine textured soils in neutral to alkaline or saline conditions (pH 7 to 8 and EC <14).

Soil Adaptation: Plants grow in saturated, fine textured soils in neutral to alkaline or saline conditions (pH 7 to 8 and EC <14).

Planting and Harvesting: Germination rates can be enhanced by lightly scarifying the seed followed by wet prechilling in a mixture of water and sphagnum moss at 2°C (35° F) for 30 to 45 days. Seed requires light, moisture and heat for germination. For greenhouse propagation, place seed on soil surface and press in lightly to assure good soil contact. Do not cover seed. Soil should be kept moist, and the greenhouse should be kept hot, 32 to 38°C (90 to 100° F). Germination should begin within one to two weeks. Maintain soil moisture until transplanting. Plugs should be transplanted at 30 to 45 cm (12 to 18 in) spacing. This allows plants to fill in interspaces within one growing season. Soils should be kept saturated with no more than 8 cm (3 in) of standing water at any time during the first growing season. Fluctuating water levels during the establishment year will facilitate spreading. Seed can be collected by hand stripping or clipping with hand shears. Standing water should fluctuate throughout the growing season and should be kept less than 1 meter deep. If deeper water is desired the depth can be increased slowly over the season. Water levels can be managed to control terrestrial weeds and to facilitate spreading of creeping spikerush.

Seed Maintenance: Generation 0 (G0) seed is maintained at Aberdeen PMC. Later generation seed (ie G1) is not produced, maintained or available through the USDA-NRCS Plant Materials Center. To make collections of these creeping spikerush releases, contact the appropriate managing agency for the original collection site.

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November 2006

Plants for Solving Resource Problems

'DELAR' SMALL BURNET

Species: ***Sanguisorba minor***

Common Name: **Small Burnet**

Plant Symbol: **SAMI3**
Accession Number: **PI-464584**

Source: The origin of Delar is unknown. Apparently the parent material was traced back to a seed purchase from a private seed company in Paducah, Kentucky.

Native Site Information: This species is native to Eurasia and has been widely cultivated in Europe as a salad herb.

Method of Selection: Delar was first selected as having potential for use in the Intermountain Region by the USDA, Aberdeen Plant Materials Center. It was compared to four other outstanding accessions in trials near Parma, Aberdeen and Tetonia Idaho, under dryland and irrigated conditions. Delar had the highest forage and seed production at all of the test locations and was the most attractive and cold tolerant of the accessions evaluated.

Description: Small burnet is an introduced, hardy, herbaceous, relatively long-lived, evergreen, non-leguminous, perennial forb. It typically grows from a branched caudex (thick base of stems) with a prominent taproot and is sometimes-weakly rhizomatous.

Small burnet plants have alternate pinnately compound leaves with mostly

Robert Mollenbrock, USDA, NRCS, Weed Science Institute

'Delar' Small Burnet

9 to 17 coarsely serrate leaflets. Leaves are oval to oblong, reaching 4 inches long. 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 stamens which are filiform. 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.

Use: Small burnet is noted for having 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. It is used in seed mixes for erosion control and beautification. The leaves can be added to salads, ice drinks, vinegar, butter, and cream cheese to add a fresh, cucumber-like flavor.

Insect and Disease Problems: No detrimental disease symptoms or insect problems have been observed in plantings of Delar.

Environmental Considerations: Since Delar is an introduced plant from Europe, it is not an appropriate component in native plant restoration. 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 has been a site specific report of it having invasive weedy characteristics in Wyoming.

Area of Adaptation: Delar can be planted and will establish in areas with 12 inches or more annual precipitation, but generally does not persist in areas with less than 14 inches annual precipitation. It has excellent cold and drought tolerance. It is considered fire resistant due to leaves and stems staying green with relatively high moisture content during the fire season.

Soil Adaptation: Delar 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.

Planting and Harvesting: 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. 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.

Seed is generally harvested in mid to late August by direct combining. Seed shatter is not a serious problem with this species. 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 precipitation.

Seed Maintenance: Breeder and Foundation seed is maintained at:

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

Foundation seed is available through the University of Idaho Foundation Seed Program and Utah Crop Improvement Association and Soil Conservation Districts in Idaho, Utah and Nevada. Certification of seed shall be limited to Registered and Certified seed.

November 2006

USDA NRCS

Plants for Solving Resource Problems

'EPHRAIM' CRESTED WHEATGRASS

Species: ***Agropyron cristatum***
Common Name: Crested Wheatgrass
Plant Symbol: AGCR
Accession Number: PI-109012

Source: 'Ephraim' crested wheatgrass was introduced from Ankara, Turkey. Detailed collection site information is not available.

Native Site Information: Crested wheatgrass is native to Eurasia. It was first introduced into the U.S. from Siberia in 1898 and is now widely used in dryland pasture and rangeland seedings throughout the western United States.

Method of Selection: Ephraim was originally tested in Utah at Majors Flat in 1946. Later plantings were evaluated at the John K. Olsen farm and the Gilbert Jorgensen farm near Ephraim, Utah. A selection was made from the Jorgensen planting and all subsequent plantings came from this selection. Evaluation plantings were conducted in northern Arizona, Utah, Idaho and Montana. Cooperators in the release include the USDA Forest Service Intermountain Forest and Range Experiment Station, Utah Division of Wildlife Resources and the USDA Natural Resources Conservation Service.

Description: Although crested wheatgrass is typically a bunchgrass, Ephraim is a weakly rhizomatous grass under conditions exceeding 14 inches mean annual precipitation.

Culms are approximately 12 to 15 inches tall. Leaf blades are flat or loosely rolled and ¼ inch wide. The inflorescence is a spike approximately ¾ inches wide at the base with numerous tightly packed ascending florets spreading at wide angles to the rachis.

**'Ephraim'
Crested Wheatgrass**

Use: The rhizomatous nature of Ephraim makes it a good candidate for stabilization of disturbed sites and erosion control. Under irrigated conditions Ephraim will develop rhizomes during the establishment year. Under dryland conditions rhizome production is site dependent. In piñon-juniper and sagebrush-grass sites exceeding 14 inches of mean annual rainfall short rhizomes commonly develop by the third growing season.

Ephraim has established in rainfall areas as low as 8 inches annual precipitation, but provides the best stands with good forage production in areas with more than 10 inches of annual precipitation. Forage production is comparable to 'Fairway' crested wheatgrass. In arid sites, Ephraim is not as productive as standard crested wheatgrass, but it is adapted to a broader range of conditions than standard crested wheatgrass.

Insect and Disease Problems: When in pure stands, Ephraim is susceptible to the black grass bug, *Labops hesperius*.

Environmental Considerations: Since Ephraim is an introduced plant from Europe, it is not an appropriate component in native plant community restoration. This release is from a species that was introduced to the United States in the late 1800's. Ephraim represents an incremental improvement in performance within a well documented species. Ephraim spreads very little via natural seed distribution. It is not considered a weedy or invasive species but can spread into adjoining vegetative communities under ideal environmental conditions. There are no known negative impacts on wild or domestic animals.

Area of Adaptation: Ephraim is well adapted to the sagebrush-grass, piñon-juniper and mountain brush communities of the Intermountain West. It performs best with 10 to 14 inches annual precipitation. Crested wheatgrass is generally not recommended above 7000 feet elevation, however Ephraim and other Fairway type crested wheatgrasses can be used up to 9000 feet elevation.

Soil Adaptation: Ephraim is adapted to a wide range of soils including disturbed sites and mine spoils. However, it is not well adapted to silty sites with a low moisture intake or to extremely stony sites. It has a moderate tolerance to saline and sodic conditions.

Planting and Harvesting: Ephraim should be seeded with a drill to a depth of ¼ to ½ inch into a firm, weed-free seedbed. The full seeding rate is 5 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 Ephraim should be seeded in 36 inch rows at a rate of 1.6 pounds PLS per acre to allow mechanical weed control and to maintain rows. Harvesting seed is best accomplished by swathing, followed by combining of the windrows. Seed is generally harvested in early August. Seed yields range from 200 pounds per acre (dryland) to 650 pounds per acre (irrigated).

Seed Maintenance: Breeder and Foundation seed is maintained at:

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P.O. Box 296
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Phone: (208) 397-4133

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

November 2006

Plants for Solving Resource Problems

'GOLDAR' BLUEBUNCH WHEATGRASS

Species: ***Pseudoroegneria spicata***
Common Name: **Bluebunch Wheatgrass**
Plant Symbol: **PSSPS**
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 are strongly divergent at maturity. Abundant leaves and culms average 24 to 39 inches tall. Spikes are generally loose and open with spikelets about the same length as the rachis internodes at maturity. Plants are diploid, 2N = 14.

'Goldar'
Bluebunch Wheatgrass

Use: Goldar bluebunch wheatgrass can be used 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 also 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 University of Idaho Foundation Seed Program and Utah Crop Improvement Association 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).

November 2006

Plants for Solving Resource Problems

Hardstem Bulrush

Species: Schoenoplectus acutus

Common Name: Hardstem Bulrush

Plant Symbol: **SCACA**
Accession Numbers: **Camas Selection (9057643), Hagerman Selection (9057597), Ogden Bay Selection (9067393) and Stillwater Selection (9057634)**

Source: The Aberdeen PMC has released four performance tested ecotypes of hardstem bulrush from the PMC service area. The Camas Selection was collected from the Camas National Wildlife Refuge near Hamer, Idaho. It was selected for use in Land Resource Region (LRR) B East. The Hagerman Selection was selected for use in LRR B West. It was collected from the Hagerman Wildlife Management Area near Hagerman, Idaho. The Ogden Bay Selection comes from Ogden Bay Wildlife Management Area, west of Ogden, Utah and was selected for use in LRR D South. The Stillwater Selection was selected for use in LRR D North. The collection site was the Stillwater National Wildlife Refuge near Fallon, Nevada.

Method of Selection: Twenty six hardstem bulrush collections from the Aberdeen PMC Service Area were evaluated from 1991 to 1995. All collections were evaluated for survival, vigor, overall growth and spread, potential seed production, and above ground biomass production. The PMC released one selection from each LRR in the PMC service area. The released selections are the accessions with the best overall rating against others from within its respective LRR.

Hardstem bulrush

Description: Hardstem bulrush is a perennial, strongly rhizomatous, obligate wetland plant that is found at low to mid elevations (below 7500 feet) in marshes and along shorelines. Stems are upright, gray to green, round, 1-2 cm (1/2-1 inch) thick and 1-3 m (3-9 feet) tall. Leaves are few and short, found at the base, commonly with a well developed sheath. Flowers are a terminal spike made up of up to 50 or more spikelets which may be on a short pedicel or sessile. The spike is exceeded by a 3-10 cm lateral bract. Seeds are dark brown, lenticular achenes, up to 2.5 mm long.

Hardstem bulrush is found widespread throughout North America, but is most common in the West.

Use: Hardstem bulrush is suitable for erosion control, constructed wetland system applications, wildlife food and cover, wetland restoration and creation and improvement of plant diversity in wetland and riparian communities. Plants spread rapidly by rhizomes and will develop a thick root mass that is resistant to compaction, wave action and erosion. The rhizomes also form a matrix for many beneficial bacteria making this plant an excellent choice for wastewater management applications.

Insect and Disease Problems: There are no known problems with insects or diseases. Aphids will feed on the stems, but little or no damage has been noted, and the vigor of the plants has not been affected.

Environmental Considerations: These selected class releases are from a species native to the Intermountain West and have no known negative impacts on wild or domestic animals.

Area of Adaptation: Hardstem bulrush is generally found in areas of standing water ranging from 10 cm (5 inches) to more than 2.5 m (8 feet) deep. It will not tolerate long periods of deep water. It will grow and spread on soils that range from peat to alkaline silts and coarse substrates.

Soil Adaptation: Plants grow in saturated, fine to coarse textured soils in neutral to alkaline or saline conditions (pH 7 to 8 and EC <14).

Planting and Harvesting: Plantings are recommended using greenhouse grown materials. Germination rates can be enhanced by stratifying seed in a mixture of water and sphagnum moss at 2ºC (35º F) for 30 to 45 days. Seed requires light, moisture and heat for germination. For greenhouse propagation, place seed on soil surface and press in lightly to assure good soil contact. Do not cover seed. Soil should be kept moist, and the greenhouse should be kept hot, 32 to 38ºC (90 to 100º F). Germination should begin within one to two weeks. Maintain soil moisture until transplanting. Plugs should be transplanted at 30 to 45 cm (12 to 18 in) spacing. This allows plants to fill in interspaces within one growing season. Fluctuating water levels during the establishment year will facilitate spreading. Standing water should fluctuate throughout the growing season to control terrestrial weeds but should be kept less than 1 meter (3 feet) deep. If deeper water is desired the depth can be increased slowly over the season. Seed can be collected by hand stripping or clipping with hand shears.

Seed Maintenance: Generation 0 (G0) seed is maintained at Aberdeen PMC. Later generation seed (ie G1) is not produced, maintained or available through the USDA-NRCS Plant Materials Center. To make collections of these hardstem bulrush releases, contact the appropriate managing agency at the original collection site.

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

November 2006

Plants for Solving Resource Problems

‘MAGNAR' BASIN WILDRYE

Species: ***Leymus cinereus***

Common Name: **Basin Wildrye**

Plant Symbol: **LECI4**
Accession Number: **PI-469229**

Source: Parent material of Magnar was originally received from the University of Saskatchewan, Saskatoon, Saskatchewan, Canada in 1939. Detailed collection site information is not available.

Native Site Information: Basin wildrye is a perennial cool season bunchgrass native to the western Great Plains and Intermountain regions of the United States and Canada. It can be found at elevations from 2000 to 9000 feet. It grows best in areas with annual precipitation of 8 to above 20 inches.

Method of Selection: Magnar was first selected as having potential use at the Pullman, WA Plant Materials Center and was further evaluated at the Aberdeen Plant Materials Center by selection of vigorous types during several generations. It also was consistently superior to many other accessions in the production of viable seed.

Description: Magnar is a hardy, robust, long-lived native perennial bunch grass. Culms are numerous, erect and stout, ranging from 3 to 8 feet tall depending on the site. Short, thick rhizomes are present in some plants. Blades are generally blue-green in color, firm, flat, cauline, up to 1 inch wide, and up to 30 inches in length. Large, erect seed heads range from 4 to 12 inches in length.

‘Magnar’ Basin Wildrye

Use: Magnar basin wildrye can be used 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; and critical area stabilization.

Insect and Disease Problems: No detrimental disease symptoms or insect problems have been observed in plantings of Magnar. Ergot has been occasionally observed on basin wildrye and it is susceptible to leaf and stem rust in wetter climatic areas.

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

Area of Adaptation: Magnar is adapted to the western Great Plains and Intermountain regions of the United States and Canada at elevations from 2000 to 9000 feet. It grows best in areas with annual precipitation of 8 to above 16 inches.

Soil Adaptation: Magnar has a broad soil texture adaptation. It is not recommended for use on shallow soils or coarse textured, deep sands. It has some tolerance to saline and sodic soil conditions and will withstand a relatively high water table but will not tolerate extended periods of inundation.

Planting and Harvesting: Magnar should be seeded with a drill to a depth of 1/2 to 3/4 inch 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, Magnar 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. Magnar 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 direct combining with the platform set high to get most of the seed and as little vegetative growth as possible. The seed shatters readily, requiring close scrutiny of maturing stands. Seed is generally harvested in late-July to early August. Seed yields range from 150 pounds per acre (dryland) to 350 pounds per acre (irrigated). The tall stubble should be removed as soon as possible following harvest. Stubble should never be burned because the fire is usually too hot and can severely damage the crown of the plant, resulting in reduced seed production and possible loss of the stand.

Seed Maintenance: Breeder and Foundation seed is maintained at:

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

Foundation seed is available through the University of Idaho Foundation Seed Program and Utah Crop Improvement Association 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).

November 2006

Plants for Solving Resource Problems

MAPLE GROVE GERMPLASM LEWIS FLAX

Species: ***Linum lewisii***

Common Name: **Lewis Flax**
Plant Symbol: **LILE3**
Accession Number: 9076423

Source: Maple Grove Germplasm is a selection from a native plant collection made in Millard County, Utah in 1988 by the USDA Forest Service, Rocky Mountain Research Station, Provo, Utah. The collection site is a mountain big sagebrush plant community approximately 1 km northeast of Maple Grove Campground in the Fishlake National Forest at an elevation of about 6,175 ft (1,900 m). Associated plants included Gambel oak, bluebunch wheatgrass, muttongrass, globemallow and mountain buckwheat.

Native Site Information: Maple Grove Selected Class Lewis flax is native to North America. The species occurs naturally from Alaska to Mexico and from California to Quebec. Lewis flax grows in a wide variety of plant communities ranging from salt-desert shrub to sub-alpine meadow.

Method of Selection: Maple Grove was selected to meet the demand for native flax to use in restoration of disturbed sites in the Intermountain West. It was chosen from 19 native collections from six western states. These were tested in field and greenhouse studies from 1989 to 1993. Maple Grove was selected over other accessions based on superior drought tolerance, plant longevity, seedling vigor, seed production and rust resistance.

Maple Grove Germplasm Lewis Flax

Description: Maple Grove Lewis flax is a medium-lived tap rooted perennial forb with few to many stems arising from a woody caudex. Light-blue petaled flowers bloom during the late spring and early summer. Petals are shed within 24 hrs, but new flowers continue to emerge for as long as six weeks.

Use: Maple Grove can be used for biodiversity enhancement in restoration and reclamation plantings, erosion control, habitat improvement and beautification in the Intermountain West. It can also be used in horticultural applications such as road-side improvement and xeriscaping applications.

Insect and Disease Problems: No detrimental disease symptoms or insect problems have been observed in plantings of Maple Grove.

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

Area of Adaptation: Maple Grove is adapted to the Intermountain West in sites receiving 12 to 18 inches annual precipitation.

Soil Adaptation: Maple Grove is best suited to sites with well-drained to moderately well-drained soils.

Planting and Harvesting: Maple Grove should be seeded with a drill to a depth of ¼ to ½ inch on a firm, weed-free seedbed. The full seeding rate is 4 pounds Pure Live Seed (PLS) per acre. Adjust for desired percentage when used as a component of a seed mix. For seed production, plant in 36 inch rows at a rate of 1.8 pounds PLS per acre.

Maple Grove fields must be swathed before harvest. Seed is typically harvested in early-August. Seed yields from Irrigated production average 300-350 pounds per acre.

Seed Maintenance: G3 seed is maintained at:

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

Certified seed is available through the University of Idaho Foundation Seed Program and Utah Crop Improvement Association and Soil Conservation Districts in Idaho, Utah and Nevada. Certification of seed shall be limited to not more than two generations from the G3 seed.

November 2006

Plants for Solving Resource Problems

Nebraska Sedge

Species: ***Carex nebrascensis***

Common Name: **Nebraska sedge**
Plant Symbol: **CANE2**

Accession Numbers: Centennial Selection (9057599), Modoc Selection (9057612), Sterling Selection (9067420) and Ruby Lake Selection (9057639)

Source: The Aberdeen PMC has released four performance tested ecotypes of Nebraska sedge from the PMC service area. Centennial Selection was collected from the Centennial Marsh Wildlife Management Area (WMA) in Camas County, ID. It was selected for use in Land Resource Region (LRR) B West. The Modoc Selection was selected for use in LRR D North. It was collected from the Modoc National Wildlife Refuge (NWR) near Alturas, CA. The Sterling Selection comes from the Sterling WMA, north of Aberdeen, ID and was selected for use in LRR B East. The Ruby Lake Selection was selected for use in LRR D South. The collection site was at the Ruby Lake NWR in Elko County, NV.

Method of Selection: Twenty-one Nebraska sedge collections were evaluated at the Aberdeen Plant Materials Center from 1991 to 1995. All collections were evaluated for survival, vigor, overall growth and spread, potential seed production, above ground biomass production, stability of land ownership, and public accessibility. The PMC released one selection from each LRR in the PMC service area. The released selections are the accessions with the best overall rating against others from within its respective LRR.

Nebraska sedge

Description: Nebraska sedge is a perennial, strongly rhizomatous wetland plant that is found in low valleys to mid-elevations. It will form dense stands, and is often the dominant member of the wetland community. Stems are erect and triangular from 20 to 110 cm (8 to 43 in) tall. Leaves are alternate, up to 12 mm (0.5 in) wide and can be longer or shorter than the stem. Foliage is green or often a glaucus blue. Spikes can be pistillate, staminate or androgynous (staminate flowers above). The fruit is a light brown achene (2 mm long) surrounded by a perigynium. Perigynia are elliptic to ovate, 3 to 4 mm long and yellowish brown to light brown in color.

Use: Nebraska sedge is suitable for erosion control, constructed wetland system applications, wildlife food and cover, wetland restoration and creation and improvement of plant diversity in wetland and riparian communities. Plants produce a dense root system (over 200 cm of roots /cm³ of soil) which makes this an excellent species for soil stabilization and bioengineering applications in wetland sites.

Plants also have approximately half the protein level of alfalfa and are thus a valuable forage species for big game and livestock later in the growing season. Shoots are grazed by muskrat and geese, while seeds are eaten by small mammals and birds.

Insect and Disease Problems: There are no known problems with insects or diseases. Aphids will feed on the stems, but rarely cause significant damage.

Environmental Considerations: These selected class releases are from a species native to the Intermountain West and have no known negative impacts on wild or domestic animals.

Area of Adaptation: Nebraska sedge is a commonly occurring wetland species found from Canada to Mexico and California to Illinois. Stands are found in wet meadows, marshes, streams, ditches, seeps, ponds and lakes throughout the western U.S. Plants can handle standing water for long periods as long as there are periods when the soils dry.

Soil Adaptation: Plants are best adapted to slightly acidic to somewhat alkaline conditions tolerating pH levels from 5.7 to 7.4. They are also tolerant of medium levels of salinity (EC<14).

Planting and Harvesting: Germination can be enhanced by removing the perigynia and by wet pre-chilling the seeds in a mixture of water and sphagnum moss at 2º C (35º F) for 30 days. Seed requires light, moisture, and heat for germination. For greenhouse propagation, place seed on soil surface and press in lightly to assure good soil contact. Do not cover seed. Soil should be kept moist, and the greenhouse should be kept hot, 32 to 38ºC (90 to 100º F). Germination should begin within one week. Maintain soil moisture until transplanting. Plugs should be transplanted at 30 to 45 cm (12 to 18 in) spacing. This allows plants to fill in within one growing season. Soils should be kept saturated with no more than 2.5 to 5 cm (1 to 2 in) of standing water at any time until the plants are well established and over 30 cm tall. Fluctuating water levels during the establishment year will facilitate spreading. Seed can be collected by hand stripping, clipping with hand shears or by using a gas powered seed stripper.

Seed Maintenance: Generation 0 (G0) seed is maintained at Aberdeen PMC. Later generation seed (ie G1) is not produced, maintained or available through the USDA-NRCS Plant Materials Center. To make collections of these Nebraska sedge releases, contact the appropriate managing agency of the original collection site.

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

November 2006

Plants for Solving Resource Problems

'NEZPAR' INDIAN RICEGRASS

Species: *Achnatherum hymenoides*
Common Name: Indian Ricegrass
Plant Symbol: ACHY
Accession Number: PI-469230

Source: 'Nezpar' was first collected in 1935 from a native plant community near Whitebird in north central Idaho. It was tested under the number P-2575. Detailed collection site information is not available.

Native Site Information: Indian ricegrass is a beautiful perennial bunchgrass native to western North America. It can be found from Mexico to southern Canada on sandy desert floors, canyons, plains or southerly exposed dry mountain sites. It is often found growing with shadscale, fourwing saltbush, sagebrush, greasewood, mountain brush and less often at the edges of coniferous forest communities.

Method of Selection: Nezpar was selected from a group of 125 collected accessions at the Pullman, Washington, Plant Materials Center. It was selected for its good vegetative characteristics and low hard seed content. It was included in one of the first trials conducted at the Aberdeen, Idaho, Plant Materials Center in 1939. Nezpar was compared to more than 70 accessions of Indian ricegrass from 10 states and was found to be superior or equal to all with regard to germination and establishment. It was judged to be superior to 'Paloma' and 11 other accessions for stand survival and yield.

Description: Nezpar is a densely tufted perennial bunchgrass. It produces numerous erect culms up to 30 inches tall with the bases of previous years persisting. Blades are narrow and involute (rolled).

'Nezpar' Indian Ricegrass

The inflorescence is a loose, open panicle, each branch being tipped with a spikelet bearing a single plump floret.

Use: Nezpar is a beautiful grass that can be used as a component of a seed mix for rangeland, erosion control (mine spoil and critical area stabilization), forage, cover and xeriscape seedings in areas receiving at least 8 inches mean annual precipitation.

Indian ricegrass cures well, providing nutritious winter feed for wildlife and all classes of livestock. Plants do best when grazed in fall and winter. Stands deteriorate under spring grazing. The plump seeds are very high in energy and provide excellent food for birds and rodents.

Insect and Disease Problems: No detrimental disease symptoms or insect problems have been observed in plantings of Nezpar.

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

Area of Adaptation: Nezpar will establish and persist as a stand when properly planted and managed. It is best adapted to coarse soils in regions that receive 8 to 14 inches annual precipitation. At higher elevations (6,000 ft and above) where average annual temperature is 40° F or less, plantings should be restricted to south and west facing slopes or other “hot” locations.

Soil Adaptation: Nezpar does best on loamy sands, sandy loams, fine sandy loams and gravelly well drained soils. It does not persist well on fine textured or poorly drained soils.

Planting and Harvesting: Nezpar should be dormant seeded in the fall (late October–December) with a drill on a firm, weed-free seedbed at a depth of ½ to 1 inch on medium-textured soils and ¾ to 3 inches on coarse textured soils. Seeding depth and time of planting (late fall) aid in stratification of the seed. In less arid situations, shallower planting depths may be preferable depending on soil and age of seed. (Older seed does not have as much dormancy or the same capacity as younger seed to emerge from deep planting depths).

The full seeding rate is 6 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, Nezpar should be seeded in 36 inch rows at 3.5 pounds PLS per acre to allow mechanical weed control and to maintain rows. Allow at least two years for stand establishment.

Nezpar seed must be swathed, followed by combining of the cured windrows. The seedheads readily shatter and require close scrutiny of maturing stands. Seed is typically harvested in late July and yields range from 100 pounds per acre (dryland) to 200 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 University of Idaho Foundation Seed Program, Utah Crop Improvement Association 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).

November 2006

Plants for Solving Resource Problems

NORTHERN COLD DESERT WINTERFAT
Selected Class Germplasm

Species: ***Krascheninnikovia lanata***

Common Name: **Winterfat**
Plant Symbol: **KRLA2**
Accession Number: **9067481**

Source: Northern Cold Desert Selected Class Germplasm winterfat is a composite of five seed collections made from 1974 to 1977 and evaluated at the Aberdeen Plant Materials Center. Source locations are Carbon, Emery, Kane and Washington Counties in Utah and Rio Blanco County, Colorado.

Native Site Information: Winterfat is a widely distributed native shrub ranging from Saskatchewan and Manitoba, Canada and northern Washington to western Nebraska, Colorado, and western Texas to southern California. It is found from near sea level to 10,000 feet elevation.

Method of Selection: The five original seed collections were selected from an assembly of 45 collections planted and evaluated at the Plant Materials Center from 1978 to 1986. They were selected for their superior tolerance to cold temperatures. The five original collections were then planted into a seed increase block. The seed harvested from the increase block was bulked and used in off-center testing near Grantsville, Utah, and Boise, Idaho to evaluate it under field conditions.

Description: Northern Cold Desert Selected Class Germplasm winterfat is an erect shrub that can grow to three feet tall under ideal soil and moisture conditions. Leaves are simple, alternate, narrowly linear (1/2 to 2 inches long); flat, with rolled under edges and densely hairy.

Northern Cold Desert Winterfat

Winterfat is monecious with both male and female flowers on the same plant. The seed is a utricle and the seed coat is thin and covered with fine, white, silky hairs 1/8 to 1/4 inch long arranged in dense spreading tufts.

Use: The uses of Northern Cold Desert winterfat are erosion control; rangeland restoration; livestock and big game browse; and wildlife plantings in dry, moderately saline or alkaline areas. It has a deep taproot and an extensive fibrous root system near the soil surface to help stabilize soil. Winterfat is one of the most valuable rangeland browse plants on winter ranges because it maintains high crude protein content (10 percent) during winter.

Insect and Disease Problems: No detrimental disease symptoms or insect problems have been observed in plantings of Northern Cold Desert winterfat.

Environmental Considerations: This selected class alternative release is from a species native to the Intermountain West and has no known negative impacts on wild or domestic animals. Northern Cold Desert winterfat is not considered a weedy or invasive species but could spread to adjoining vegetative communities under ideal environmental conditions.

Potential Area of Adaptation: Northern Cold Desert winterfat is potentially adapted to the northern portion of the Intermountain Western United States where annual precipitation averages 7 to 16 inches. It may be adapted to the northern Great Plains.

Potential Soil Adaptation: Winterfat can tolerate moderate to highly saline and alkaline areas. It is adapted to soil textures ranging from clay loams to gravelly loams, stony loams and rocky outcrops. It does not tolerate flooding or extended wet conditions.

Planting and Harvesting: Seed should be placed on the soil surface and pressed into the soil. Do not bury the seed. The full seeding rate is 0.5 pounds Pure Live Seed (PLS) per acre. When used as a component of a mix, adjust to the percent of mix desired.

Establishing plants in a greenhouse from seed and transplanting to the field will result in the most productive stands for seed production. Plant spacing in the field should be 4 to 6 feet within row and a minimum of 8 feet between rows. The use of weed barrier fabric can improve plant establishment, moisture conservation, weed control and seed production. Seed production fields may also be established by seeding. A minimum of 15 pure live seeds per linear foot of row should be seeded on the soil surface to no deeper than 1/4 inch into a firm, weed-free seedbed. Once plants become established, plants can be thinned to optimize seed production. Full seed production is usually reached by the third or fourth year after establishment. Seed ripens following a hard frost in the fall. Harvesting seed is best accomplished by hand stripping.

Mechanized harvesting techniques have been investigated but are unsatisfactory. Expected seed yields range from 200 to 400 pounds per acre.

Seed Maintenance: G0 and G1 seed is maintained at:

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

G1 seed is available through the University of Idaho Foundation Seed Program, Utah Crop Improvement Association and Soil Conservation Districts in Idaho, Utah and Nevada. Growers may produce one generation each of G2 and G3 seed.

November 2006

Plants for Solving Resource Problems

'PAIUTE' ORCHARDGRASS

Species: ***Dactylis glomerata***
Common Name: **Orchardgrass**
Plant Symbol: **DAGL**
Accession Number: PI-109072

Source: 'Paiute' was introduced into the United States in 1934 from Ankara, Turkey. It was tested by the Natural Resources Conservation Service in Arizona and New Mexico and by the Intermountain Forest and Range Experiment Station, Utah Division of Wildlife Resources and Universities in Arizona, Utah and Idaho. Detailed collection site information is not available.

Native Site Information: Orchardgrass is native to Eurasia and Africa, but is now naturalized in temperate zones throughout the western hemisphere. The species was first introduced into the United States prior to 1760 as a pasture grass.

Method of Selection: Paiute was first tested by the NRCS in Arizona and New Mexico. It was subsequently evaluated by the Forest and Range Experiment Station and wildlife agencies in Utah, Idaho and Montana. Seed was then provided to the University of Arizona for further evaluation. It has been found to establish and persist at high elevations for up to 20 years under arid conditions in Arizona, New Mexico, Utah and Idaho.

Description: Paiute is a low-growing heat resistant strain of orchardgrass. Under arid conditions Paiute is a persistent bunchgrass with numerous basal leaves and leafy culms. Flowering stems grow to approximately 15 to 18 inches tall while leaves are usually less than 12 inches long. Under irrigation Paiute grows in close stands of more robust plants.

'Paiute' Orchardgrass

Use: This cool season, shade tolerant grass is well suited as a forage crop for semiarid pasturelands. It also has good potential for erosion control, fire breaks and critical area treatment. Paiute has been shown to be preferred by livestock, big game and rabbits over crested and intermediate wheatgrass. Additionally, it greens up 7 to 10 days earlier in the spring, remains green longer and has better fall regrowth. It does not; however, outperform crested or intermediate wheatgrass in areas receiving less than 16 inches of annual precipitation.

Insect and Disease Problems: No detrimental disease symptoms or insect problems have been observed in plantings of Paiute.

Environmental Considerations: Since Paiute is an introduced plant from Europe, it is not an appropriate component in native plant community restoration. This release is from a species that was introduced to the United States in the late 1700's. Paiute represents an incremental improvement in performance within a well documented species. Paiute spreads very little via natural seed distribution. It is not considered a weedy or invasive species but can spread into adjoining vegetative communities under ideal environmental conditions. There are no known negative impacts on wild or domestic animals.

Area of Adaptation: Paiute is well adapted to semi-arid conditions of the Intermountain West, especially in situations receiving at least 16 inches annual precipitation or on irrigated lands. It is best suited to the sagebrush-grass and piñon-juniper communities.

Soil Adaptation: Paiute performs best on well-drained basic and acidic soils. It grows well in a range of soil textures and depths varying from clays to gravelly loams. It does not perform well in saline soils or under poorly drained soil conditions with high water tables.

Planting and Harvesting: Paiute should be seeded with a drill to a depth of ¼ to ½ inch in a firm, weed-free seedbed. The full seeding rate is 4 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 Paiute should be seeded in 36 inch rows at a rate of 1.2 pounds PLS per acre to allow mechanical weed control and to maintain rows. Harvesting seed is best accomplished by swathing, followed by combining of the windrows. Seed is generally harvested in early to mid July. Seed yields average 300 pounds per acre (irrigated).

Seed fields respond well to early spring burning to stimulate seed production.

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 University of Idaho Foundation Seed Program and Utah Crop Improvement Association 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).

November 2006

Plants for Solving Resource Problems

‘P-27’ SIBERIAN WHEATGRASS

Species: ***Agropyron fragile***

Common Name: **Siberian Wheatgrass**
Plant Symbol: AGFR
Accession Number: PI-108434

Source: 'P27' was selected by the Aberdeen, ID and Pullman, WA Plant Materials Centers from collections originating from Kazakhstan. The original collection was made in 1934. Detailed collection site information is not available.

Native Site Information: Siberian wheatgrass was introduced from Asia and is naturalized from the Pacific coast to New York and is widely used in dryland pasture and rangeland seedings throughout the western United States.

Method of Selection: P-27 was planted in row nurseries and field evaluations beginning in 1935 and individual clones were selected for drought resistance, good seedling vigor and seed yield. P-27 was released in 1953 by Aberdeen PMC, Pullman PMC and the University of Idaho Agricultural Experiment Station.

Description: Siberian wheatgrass is a long-lived, cool season, drought tolerant, introduced, winter hardy bunch grass with an extensive root system. 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.

‘P-27’
Siberian Wheatgrass

Use: Siberian wheatgrass is commonly seeded in the arid regions of the western United States. Siberian wheatgrass is usually recommended for livestock 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, early summer and also in the fall, if additional growth occurs from late growing season rainfall. Siberian wheatgrass is well adapted for stabilization of disturbed soils. It competes well with aggressive introduced plants such as cheatgrass during the establishment period. 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.

Insect and Disease Problems: When in pure stands, P-27 is susceptible to the black grass bug, *Labops hesperius*.

Environmental Considerations: Since P-27 is an introduced plant from Europe, it is not an appropriate component in native plant community restoration. This release is from a species that was introduced to the United States in the early 1900's. P-27 represents an incremental improvement in performance within a well documented species. P-27 spreads very little via natural seed distribution. It is not considered a weedy or invasive species but can spread into adjoining vegetative communities under ideal environmental conditions. There are no known negative impacts on wild or domestic animals.

Area of 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. 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). It is very tolerant of fire.

Soil Adaptation: Siberian wheatgrass is well adapted to silt loam to light-sandy, droughty soils. It 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 will not tolerate long periods of inundation-standing water, poorly drained soils, or excessive irrigation.

Planting and Harvesting: P-27 should be seeded with a drill to a depth of ¼ to ½ inch into a firm, weed-free seedbed. The full seeding rate is 6 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 P-27 should be seeded in 36 inch rows at a rate of 2.7 pounds PLS per acre to allow mechanical weed control and to maintain rows. Harvesting seed is best accomplished by swathing, followed by combining of the windrows. Seed is generally harvested in late July. Seed yields range from 150 pounds per acre (dryland) to 500 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 University of Idaho Foundation Seed Program and Utah Crop Improvement Association and Soil Conservation Districts in Idaho, Utah and Nevada. Certified seed shall be limited to not more than two generations from Foundation seed (Registered and Certified).

November 2006

Plants for Solving Resource Problems

'REGAR' MEADOW BROME

Species: ***Bromus erectus***

Common Name: **Meadow Brome**
Plant Symbol: **BRER3**
Accession Number: **PI-172390**

Source: The original collection was made in 1949 near Zek, in the Kars Province of Turkey. The USDA Natural Resources Conservation Service Plant Materials Center in Aberdeen, Idaho received seed in 1957. Detailed collection site information is not available.

Native Site Information: Meadow brome is native to Eurasia.

Method of Selection: Fifteen clones were selected from an irrigated test nursery at Aberdeen in 1958. This seed was multiplied for testing as P-14941. Plants were evaluated at Aberdeen and Pullman, Washington during the 1960's. P-14941 was officially released in 1966 as Regar, named for its outstanding regrowth characteristic. Other qualities include drought tolerance, winter hardiness, rapid seed germination and seedling establishment.

Description: Regar is a long-lived perennial bunchgrass that may produce short rhizomes. Plants produce numerous light green basal leaves that are somewhat pubescent. Flowering stalks extend taller than the leaves ending in an open panicle. Plants green up in early spring and remain green until late in the fall when irrigated or when adequate moisture is available.

'Regar'
Meadow Brome

Use: Regar is well adapted for use as a pasture grass. Its long green period provides forage that has shown to be very acceptable to cattle, sheep, horses and wildlife. Unlike smooth brome, Regar has good regrowth characteristics and does not go dormant after harvest or during the high temperatures of summer which makes it a good choice for forage and erosion control plantings. Regar can be grown in pure stands or with a legume component such as alfalfa, sainfoin, trefoil or cicer milkvetch.

Insect and Disease Problems: Regar is susceptible to covered head smut (*Ustillago bullata*). All seed should be treated with a suitable fungicide to kill the spores that adhere to the seed. Seed treatments will only prevent infection from spores on the seed, but will not control infection if the soils are contaminated. Infection and the resulting smut are not detrimental when the grass is seeded for erosion control or for forage as pasture or hay.

Environmental Considerations: Regar spreads very slowly vegetatively and very little via seed dispersal. It is not considered a weedy or invasive species but can spread into adjoining degraded vegetative communities under ideal conditions. There are no known negative impacts on wild or domestic animals.

Area of Adaptation: Regar is well adapted to sites receiving 14 inches or more annual precipitation. It is best suited to locations above 3,000 feet elevation in sagebrush-grass, piñon-juniper, ponderosa pine, aspen and Douglas fir communities. Regar is very winter hardy and does better in areas with spring frost than orchardgrass.

Soil Adaptation: Regar performs well in a broad range of soil conditions. It performs best on moderately deep to deep, fertile, well-drained soils, but also performs fairly well in shallower soils. Preferred soil textures range from coarse gravely to medium textured. Regar grows well in moderately acidic to weakly saline to sodic soil conditions. It does not do well in wet, saline soils or areas with high water tables.

Planting and Harvesting: Plant in a clean, firm, weed-free seed bed. Under dryland conditions, plant in late fall or early spring to avoid failure from drought and heat. Irrigated seedings should be completed in early to mid spring. Seed at a depth of ¼ to ½ inch. For dryland or irrigated seedings use a seeding rate of 10 lb Pure Live Seed (PLS) per acre. For critical area treatment or broadcast, double rate to 20 lb PLS/acre. When used as a component of a seed mix, adjust to the percent of mix desired. Forage plantings respond very well to applications of fertilizer.

For seed production, plant fungicide treated seed in 24 to 36 inch rows at 4.5 to 5 pounds PLS per acre to allow mechanical weed control and to maintain rows. Seed is ready for harvest in mid-July to early August. Windrow in the firm dough stage and then combine in about 7 days (once seed has matured in windrow). Seed yields range from 200 pounds per acre (dryland – 16 inch+ rainfall) to 550 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 University of Idaho Foundation Seed Program and Utah Crop Improvement Association 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).

November 2006

Plants for Solving Resource Problems

RICHFIELD SELECTION FIRECRACKER PENSTEMON

Species: ***Penstemon eatonii***
Common Name: **Firecracker Penstemon**
Plant Symbol: **PEEA**
Accession Number: **9008469**

Source: Seed was collected approximately 14 miles southeast of Richfield, Sevier County, Utah in August, 1974. The collection site is approximately 6,600 feet elevation on an upland gravelly loam in a 12 to 14 inch precipitation zone. Plants growing in association include sagebrush, globe mallow and Indian ricegrass.

Native Site Information: This plant is native to the western United States and is adapted to sagebrush-juniper zones at 3,300 to 8,000 feet elevation in 10 to 16 inch rainfall areas.

Method of Selection: Selected from a collection of 119 penstemon accessions assembled and evaluated at the Aberdeen Plant Materials Center from 1981 to 1985. There were 15 firecracker penstemon accessions in the assembly. The Richfield Selection was selected for its beauty, hardiness, seed production and natural range of adaptability. This accession had the best stand establishment and longest survival, and shows great promise for use throughout its range of adaptation.

Description: *Penstemon eatonii* is an erect, short-lived perennial, cool season forb. It has a fibrous root system and the stems are often decumbent or reclining. The leaves are large and slightly pubescent. The flowers are in racemes on 24 to 36 inch tall upright stems. Firecracker penstemon has bright red tubular flowers, blooming in mid-summer through early fall.

Firecracker Penstemon

Use: The potential uses of the Richfield Selection of Firecracker penstemon are erosion control, diversity and beautification. Its fibrous root system and wide canopy cover make it an excellent plant for soil stabilization. The tall erect flower stems with numerous, large colorful flowers also make it a desirable forb for beautification.

Insect and Disease Problems: Firecracker penstemon is susceptible to soil-borne fusarium and rhizoctonia root rot which can be severe in poorly drained loam and clay textured soils. There are no known insect problems.

Environmental Considerations: This selected release is from a species native to the Intermountain West and has no known negative impacts on wild or domestic animals. Firecracker penstemon is not considered a weedy or invasive species but can spread to adjoining vegetative communities under ideal environmental conditions. It co-exists with other native species and adds biodiversity to those plant communities.

Potential Area of Adaptation: The range of adaptation is the sagebrush, juniper, and ponderosa pine zones at 3,300 to 8,000 feet elevation in 10 to 16 inch rainfall areas. Firecracker penstemon can survive in full sunlight, but may not tolerate hot, dry areas. It can survive cold winter temperatures found in the northern portion of its range if the snow is deep enough to cover the plant. It does not grow well in areas with poor drainage.

Potential Soil Adaptation: Shallow rocky, loams, sandy loams, gravelly loams, well-drained to moderately well-drained soils.

Planting and Harvesting: Firecracker penstemon may be seeded with a drill or broadcast planted in late fall and then covered to a depth of 1/8 to 1/4 inches into a firm seedbed. The full seeding rate is 3 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, Firecracker penstemon should be planted at a rate of 1.3 pounds PLS per acre in 36 inch rows to allow mechanical weed control. The use of weed barrier fabric is an alternative to allow closer spacing and facilitate weed control. Firecracker penstemon should be seeded in late fall or early winter to allow the seed to stratify. Germination can occur over several growing seasons.

Seed is harvested by hand stripping or with a combine. Flowering is indeterminate with mature capsules and flowers present at harvest period. Seed is mature when capsules are dry and seed is hard. Multiple harvest periods by hand may be necessary to maximize seed collection. Some seed will shatter as capsules dry and open. Seed can be separated from the capsule with a hammermill or barley debearder followed by air-screening. Seed should be stored in a cool, dry area to maintain viability.

Seed Maintenance: G0 and G1 seed is maintained at:

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

G1 seed is available through the University of Idaho Foundation Seed Program, Utah Crop Improvement Association and Soil Conservation Districts in Idaho, Utah and Nevada. Growers may produce one generation each of G2 and G3 seed.

November 2006

Plants for Solving Resource Problems

'RUSH' INTERMEDIATE WHEATGRASS

Species: ***Thinopyrum intermedium***

Common Name: **Intermediate Wheatgrass**
Plant Symbol: **THIN6**
Accession Number: **PI-575702**

Source: The USDA Natural Resources Conservation Service, Plant Materials Center at Aberdeen, Idaho received the original seed as PI-281863 from the German Botanical Garden, Berlin, in 1962, under the identification *Agropyron junceum*.

Native Site Information: This species is native to Eurasia and has been cultivated there and in the United States for many years.

Method of Selection: Rush was compared with seven released cultivars of intermediate wheatgrass and other cool season grasses at sites throughout the western United States. It was selected for superior seedling emergence and vigor. Rush has equal to or superior forage production compared to other intermediate wheatgrass releases.

Description: Rush is a cool-season, sod-forming, perennial grass. It is moderately rhizomatous, densely tillering with abundant stems and leaves, 48 to 60 inches tall. Foliage varies from moderately glaucous to green. The variety is stable and exhibits limited variability. There is variation in leaf color from green to moderately glaucous and approximately five percent of the plants exhibit reduced rhizomes.

'Rush' Intermediate Wheatgrass

Use: The potential uses of Rush intermediate wheatgrass are for rangeland and pastureland seeding in 12 to 20 inch precipitation zones for erosion control, forage and cover; mine spoil reclamation as part of a mixture to provide fast, early growth and protection; critical area stabilization where a fast germinating, rhizomatous perennial is needed; filter strips to trap sediment; irrigated pasture to provide feed and cover; competition with aggressive annuals such as cheatgrass and medusahead because of its ability to establish quickly.

Insect and Disease Problems: No highly detrimental disease symptoms or insect problems have been observed in plantings of Rush.

Environmental Considerations: This release is from a species that was introduced to the United States in the early 1900's. Rush represents an incremental improvement in performance within a well documented species. Rush 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 environmental conditions. There are no known negative impacts on wild or domestic animals.

Potential Area of Adaptation: Rush is adapted to the Northwest and Intermountain West regions of the United States where annual precipitation is 12 inches or more. It may be adapted to the mountains of the Southwest, the Western and Northern Great Plains and the Southern Canadian Plains.

Soil Adaptation: Rush is well adapted to moderately deep, loamy soils but also grows on sandy and clayey soils.

Planting and Harvesting: Rush should be seeded with a drill to a depth of 1/4 to 3/4 inches on a firm, weed-free seedbed. The full seeding rate is 10 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, Rush should be seeded in 36 inch rows at a seeding rate of 4.9 pounds PLS per acre to allow mechanical weed control and to maintain rows. Rush may be seeded during the spring, late summer, or fall (dormant).

Harvesting seed is best accomplished by swathing, followed by combining of the cured windrows in mid-to-late August. Seeds will readily shatter when mature and if direct combining is desired, close scrutiny of maturing stands will be required. Seed yields range from 250 pounds per acre (dryland) to 500 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 University of Idaho Foundation Seed Program, Utah Crop Improvement Association and Soil Conservation Districts in Idaho, Utah and Nevada. Certification of seed shall be limited to not more than two generations from Foundation seed. Variety protection has been granted under the Plant Variety Protection Act of 1970. Conditions of this license specify that Rush seed can be marketed only as a class of certified seed.

November 2006

Plants for Solving Resource Problems

SNAKE RIVER PLAINS FOURWING SALTBUSH
Selected Class Germplasm

Species: ***Atriplex canescens***

Common Name: **Fourwing Saltbush**
Plant Symbol: **ATCA2**
Accession Number: **9067480**

Source: Snake River Plains Selected Class Germplasm fourwing saltbush is a composite of four seed collections made on the Snake River Plains in Power, Owyhee and Elmore Counties, Idaho in 1976 and evaluated at the Aberdeen Plant Materials Center.

Native Site Information: Fourwing saltbush is one of the most widely distributed and important native shrubs on rangelands in the western United States. Its natural range extends from below sea level to above 8,000 feet elevation.

Method of Selection: The four original seed collections were selected from an assembly of 83 collections planted and evaluated at the Plant Materials Center from 1977 to 1986. They were selected for their superior tolerance to cold temperatures. The four original collections were then planted into a seed increase block. The seed harvested from the increase block was bulked and used in off-center testing near Grantsville, Utah, Boise, Idaho, Squaw Butte, Oregon and Lind, Washington.

Description: Snake River Plains Selected Class Germplasm fourwing saltbush is an erect shrub that can grow to six feet tall under ideal soil and moisture conditions.

Snake River Plains Fourwing Saltbush

Leaves are simple, alternate, and linear to oblong (1/2 to 2 inches long) and are covered with fine whitish hairs.

Fourwing saltbush is mostly dioecious, with separate male and female plants. Some plants have both male and female flowers. Male flowers are red to yellow and form dense spikes at the ends of branches. Female flowers are nondescript in axillary clusters. The seed is enclosed in a four 'winged' membranous capsule.

Use: The potential uses of Snake River Plains fourwing saltbush are erosion control, rangeland restoration, livestock and big game browse, and wildlife plantings in dry, moderately saline or alkaline areas. Its shape and root system provides excellent erosion control especially in areas where very little other vegetation can survive. Fourwing saltbush can be utilized as browse throughout the year.

Insect and Disease Problems: No detrimental disease symptoms or insect problems have been observed in plantings of Snake River Plains fourwing saltbush.

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

Area of Adaptation: Snake River Plains fourwing saltbush is adapted to the northern portion of the Intermountain West where annual precipitation averages 8 to 14 inches. It may also be adapted to the northern Great Plains.

Soil Adaptation: Fourwing saltbush can tolerate moderately saline and alkaline areas. It is adapted to shallow rocky loams, sandy loams, gravelly loams, and silt loams that are well-drained to moderately well-drained.

Planting and Harvesting: Snake River Plains fourwing saltbush should be seeded with a drill to a depth of ¼ to ½ inch in a firm, weed-free seedbed. The full seeding rate is 1 pound Pure Live Seed (PLS) per acre. When used as a component of a seed mix, adjust to the percent of mix desired.

Establishing plants in a greenhouse from seed or rooted cuttings and transplanting to the field will result in the most productive stands for seed production. Because the species is dioecious, planting one male plant to 5 female plants will maximize potential seed production. Plant spacing in the field should be 6 to 8 feet within row and a minimum of 8 feet between rows. The use of weed barrier fabric can improve plant establishment, moisture conservation, weed control and seed production. Seed production fields may also be established by seeding. A minimum of 15 pure live seeds per linear foot of row should be planted approximately 1/2 to 3/4 inch deep into a firm, weed-free seedbed. Once plants are mature enough to distinguish sex, plants can then be thinned to approximate one male per five female plants. Full seed production is usually reached by the third or fourth year after establishment. Seed ripens, turning a dull yellow, following a hard frost in the fall. Harvesting seed is best accomplished by hand stripping. Mechanized harvesting techniques have been investigated but are unsatisfactory. Expected seed yields may range from 200 to 400 pounds per acre.

Seed Maintenance: G0 and G1 seed is maintained at:

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

G1 seed is available through the University of Idaho Foundation Seed Program, Utah Crop Improvement Association and Soil Conservation Districts in Idaho, Utah and Nevada. Growers may produce one generation each of G2 and G3 seed.

November 2006

Plants for Solving Resource Problems

'SODAR' STREAMBANK WHEATGRASS

Species: ***Elymus lanceolatus* ssp. *lanceolatus***
Common Name: Streambank Wheatgrass
Plant Symbol: ELLAL
Accession Number: PI-421021

Source: Sodar streambank wheatgrass was collected near Canyon City, Grant County, Oregon in a 12 inch annual precipitation zone at approximately 3,000 feet elevation. Specific collection site information is not available.

Native Site Information: Streambank wheatgrass is native to the western United States and is adapted to areas where annual precipitation averages 8 inches or more.

Method of Selection: Sodar was compared with 10 other streambank wheatgrass accessions and was improved by mass selection and elimination of off-types during several generations at the NRCS Aberdeen Plant Materials Center. It was released in 1954 by the Aberdeen, ID and Pullman, WA Plant Materials Centers and the University of Idaho and Washington State University Agricultural Experiment Stations.

Description: Sodar is a long-lived, cool season perennial grass. It is strongly rhizomatous, with moderate sod-producing qualities. The stems are erect, 12 to 18 inches tall (up to 30 inches irrigated). The leaves, stems, and seedheads have no pubescence. Leaves are short and narrow with a pale green to bluish cast.

'Sodar' Streambank Wheatgrass

Anticipated Use: The uses of Sodar streambank wheatgrass are as a component of a seed mix for erosion control and cover seedings in 8 to 16 inch rainfall zones; mine spoil reclamation; critical area stabilization where a sod-forming perennial grass is needed; filter strips to trap sediment; and competition with aggressive annuals such as cheatgrass and medusahead because of its ability to establish a vigorous sod. It is not recommended for or well suited for forage production.

Insect and Disease Problems: No detrimental disease symptoms or insect problems have been observed in plantings of Sodar.

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

Area of Adaptation: Sodar is adapted to the Northwest and Intermountain regions of the United States where annual precipitation averages above 8 inches. Sodar has been successfully established on some sites that receive as little as 6 inches of annual precipitation.

Potential Soil Adaptation: Sodar prefers moderately deep, loamy to silt loam soils, but can grow on sandy and clayey soils.

Planting and Harvesting: Sodar should be seeded with a drill to a depth of 1/4 to 1/2 inch deep on a firm, weed-free seedbed. The full seeding rate is 6 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, Sodar should be seeded in 36 inch rows at 2.9 pounds PLS per acre to allow mechanical weed control and to maintain rows. Sodar may be seeded during the spring, late summer (irrigated), or fall (dormant).

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 mid-July to early August. Seed yields range from 100 pounds per acre (dryland) to 400 pounds per acre (irrigated). Because of its strong rhizomatous nature, seed yields drop dramatically after the second year of harvest. Seed crops are generally only harvested 2 years.

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 University of Idaho Foundation Seed Program, Utah Crop Improvement Association and Soil Conservation Districts in Idaho, Utah and Nevada. Certification of seed shall be limited to not more than two generations from Foundation seed.

December 2006

Plants for Solving Resource Problems

'TEGMAR' DWARF INTERMEDIATE WHEATGRASS

Species: ***Thinopyrum intermedium***

Common Name: **Intermediate Wheatgrass**
Plant Symbol: **THIN6**
Accession Number: **PI-109219**

Source: The USDA Natural Resources Conservation Service, Plant Materials Center at Pullman, Washington received the original seed from the Westover-Enlow expedition in 1934. It was collected near Bolu, Turkey.

Native Site Information: This species is native to Eurasia and has been cultivated there and in the United States for many years.

Method of Selection: Tegmar was selected for dwarf size, vigorous sod forming characteristics, fine stems and narrow leaves at the Pullman, WA PMC. Extensive field testing through field plantings at farms in eastern Idaho and at University of Idaho Agricultural Experiment Stations were conducted. It was released in 1968 by the Aberdeen, ID Plant Materials Center and the University of Idaho Agricultural Experiment Station.

Description: Tegmar is a long-lived, late maturing, cool-season, perennial grass. It forms a dense sod and the numerous leaves are light green to blue green and mostly smooth. Stems are fine, mostly smooth and erect. Tegmar is a dwarf strain of intermediate wheatgrass and is typically about one-half the height of other intermediate wheatgrass varieties.

'Tegmar' Dwarf Intermediate Wheatgrass

Use: Tegmar is best suited for erosion control because of its strong seedling vigor, rapid sodding ability, late maturity, and short, dense growth. Although it produces quality forage, it is less productive than the taller and more robust varieties of intermediate and pubescent wheatgrass. Tegmar is adapted to areas receiving 13 inches or more annual precipitation.

Insect and Disease Problems: No highly detrimental disease symptoms or insect problems have been observed in plantings of Tegmar.

Environmental Considerations: This release is from a species that was introduced to the United States in the early 1900's. Tegmar represents an incremental improvement in performance within a well documented species. Tegmar 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 environmental conditions. There are no known negative impacts on wild or domestic animals.

Area of Adaptation: Tegmar is adapted to the Northwest and Intermountain West regions of the United States where annual precipitation is 13 inches or more. It may be adapted to the mountains of the Southwest, the Western and Northern Great Plains and the Southern Canadian Plains.

Soil Adaptation: Tegmar is well adapted to moderately deep, loamy to silt loam soils but also grows on sandy and clayey soils.

Planting and Harvesting: Tegmar should be seeded with a drill 1/4 to 1/2 inch deep on a firm, weed-free seedbed. The full seeding rate is 10 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, Tegmar should be seeded in 36 inch rows at a seeding rate of 4.9 pounds PLS per acre to allow mechanical weed control and to maintain rows. Tegmar may be seeded during the spring, late summer, or fall (dormant).

Harvesting seed is best accomplished by swathing, followed by combining of the cured windrows in mid-to-late August. Seeds will readily shatter when mature and if direct combining is desired, close scrutiny of maturing stands is required. Seed yields range from 250 pounds per acre (dryland) to 500 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 University of Idaho Foundation Seed Program, Utah Crop Improvement Association and Soil Conservation Districts in Idaho, Utah and Nevada. Certification of seed shall be limited to not more than two generations from Foundation seed.

December 2006

USDA NRCS

Aberdeen PMC Grows Rare Plants for WRP Site

Derek J. Tilley, Aberdeen Plant Materials Center

In 2006 the Aberdeen Plant Materials Center (PMC) accepted a request to propagate 300 plants of Indian Valley sedge (*Carex aboriginum* M.E. Jones) as part of a project to reestablish populations in its native habitat at the "Jewel Wetland" in southwestern Idaho.

This unique species was first collected in the Weiser valley by Marcus E. Jones on July 12, 1899, at Indian Valley, ID and wasn't seen again for 100 years. The species was thought to be extinct, until 1999, when a population was discovered south of Council, in Adams County, ID. As a result, Indian Valley sedge was moved from the Idaho Native Plant Society's Taxa Believed to be Globally Extinct category to the Global Priority 1 category.

This project is being coordinated by the NRCS Payette Field Office on a Wetland Reserve Program (WRP) site in cooperation with land owners Jon and Mary Trail, with support from the Land Trust of the Treasure Valley. The project involves several interested parties, including the U.S.D.A. Forest Service Rocky Mountain Research Station and Idaho Department of Fish and Game. Volunteers from these agencies have assisted in seed collection and will be on hand to transplant greenhouse grown plants at the WRP site.

Seeds are presently undergoing stratification at the PMC and will be planted into blocks of greenhouse root trainers later this winter to be ready for transplanting in April 2007.

Great Basin Native Plant Selection and Increase Activities at the Aberdeen, Idaho Plant Materials Center

Derek J. Tilley, Range Conservationist (Plants)
Loren St. John, Plant Materials Center Team Leader
Dan Ogle, Plant Materials Specialist

The USDA Natural Resources Conservation Service (NRCS), Aberdeen, Idaho Plant Materials Center (PMC), in cooperation with the Great Basin Native Plant Selection and Increase Project, continues to produce early generation Certified seed of four plants native to the Intermountain West. These plants include Maple Grove Selected Class Germplasm Lewis flax (*Linum lewisii*), Anatone Selected Class Germplasm bluebunch wheatgrass (*Pseudoroegneria spicata*), Snake River Plains Selected Class Germplasm fourwing saltbush (*Atriplex canescens*) and Northern Cold Desert Selected Class Germplasm winterfat (*Krascheninnikovia lanata*). Seed of these species produced by the PMC is provided to commercial seed growers for large scale commercial seed increase. In 2004 the PMC planted a demonstration planting at the Orchard site east of Boise, ID. The PMC continues to evaluate and maintain this display nursery. Seed increase plots of sulphurflower buckwheat (*Eriogonum umbellatum*), giant biscuitroot (*Lomatium dissectum*), nineleaf biscuitroot (*L. triternatum*), Gray's biscuitroot (*L. grayi*), hotrock penstemon (*Penstemon deustus*), sharpleaf penstemon (*P. acuminatus*) and sagebrush penstemon (*P. speciosus*) have been planted at the PMC. These seed increase plots are allowing us to determine plant performance and required cultural practices for seed production for these species. Seed from these plots will be used for larger scale seed increase and advanced evaluations. In 2005 the PMC began a project in cooperation with Brigham Young University and the Agricultural Research Service in Burns, OR, for reestablishing native plant diversity in crested wheatgrass stands in the Great Basin. For this project, the PMC prepared seed and rice hull mixtures and drill planted test sites in Utah and Oregon with a Truax Roughrider range drill modified by PMC personnel. These seedings were repeated in the fall of 2006 on additional plots at the same locations.

Keywords: native plant testing, release and certified seed production of native plant species

SYMPOSIUM - INTEGRATING WEED CONTROL AND RESTORATION ON GREAT BASIN RANGELANDS

SPECIES SELECTION, SEED PROCUREMENT AND TRUAX DRILL MODIFICATIONS

USDA-NRCS, ABERDEEN PLANT MATERIALS CENTER
Dan Ogle and Loren St. John

The cooperators of the "Integrating Weed Control and Restoration on Great Basin Rangelands" Project selected the test species for studies based on the most common species found in Wyoming big sagebrush plant communities throughout the Great Basin - Snake River Regions. All seed procurement, mixing and planting of experiments were coordinated by USDA-NRCS, Aberdeen Plant Materials Center (PMC) personnel. Experiment 1 involved replicated plot plantings using the Truax drill in fall of 2003 and 2004 at eight locations in Idaho, Nevada, Oregon and Utah. Experiment 2 involved small replicated hand planted plots at the same locations. Experiment 3 involved seeding mixtures on large 10 acre plots in Nevada in fall 2005. The cooperators of the Project decided to use the Truax Rough Rider Drill to seed Experiments 1 and 3 because the drill was considered the best available technology for rangeland seedings. The drill is a major improvement over older rangeland drills because of better control of seeding depth. The Truax drill was delivered to the PMC in September 2003 and PMC staff completed modifications to the drill prior to seeding. Additional modifications were made in 2004 and 2005 to further improve seed placement. Drill modifications included replacement of seed drop tubes, installation of wind-shields around seed cups, reconstruction of seed boots, toe-in of disk openers to widen slot for seed placement, improved calibration adjustment, press wheel adjustments, and the addition of alternate row broadcast seeders for species requiring surface planting. All modifications and the cooperative efforts of PMC and Truax Company personnel have resulted in significant improvement in performance of the Truax Rough Rider Drill under field operation conditions.

Key Words: Species Selection; Seed Procurement; Truax Rough Rider Drill

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INTRODUCTION

This report summarizes the studies and activities conducted by the NRCS Aberdeen Plant Materials Center during calendar year 2006.

COMPLETED PROJECTS

1. Native Plant Restoration (NPS Craters of the Moon National Monument)

   Seed processing and propagation of 2150 plants from 10 native seed collections. Seed harvested summer, 2004 and 2005. Plant propagation begun late fall 2005. Delivered 230 antelope bitterbrush *Purshia tridentata* and 100 limber pine *Pinus flexilis* September 2006.

ONGOING PROJECTS

1. Department of Defense (U.S. Army)

   Seed production of 3 test species (western wheatgrass, Siberian wheatgrass, and slender wheatgrass) and eventual release. Fields established spring 2005 and first seed harvest summer 2006. 3 year seed increase.

2. Grand Teton National Park
   Seed production of slender wheatgrass, blue wildrye, mountain brome and Sandberg bluegrass for revegetation of disturbed areas following road construction. Fields established spring 2006. 3 year seed increase.

3. Bureau of Reclamation

   Ongoing riparian/wetland work.

4. USDA FS – Ogden

   Ongoing riparian/wetland work.

5. Foundation Seed Production (Utah Crop Improvement Association, Idaho Crop Improvement Association, USDA FS Rocky Mountain Research Station)

   Anatone and Goldar bluebunch wheatgrass, Paiute orchardgrass, Bannock thickspike wheatgrass, Maple Grove Lewis flax, Snake River Plains fourwing saltbush, Northern Cold Desert winterfat, Richfield firecracker penstemon, Clearwater Venus penstemon.

6. Study 01-W08 Seagull Bay Wetland Enhancement (Bureau of Reclamation)

   Planted willows around Seagull Bay wetland to create structure for wildlife and to improve water quality.

7. Study 2000-R18 Medicine Lodge Creek Assessment and Revegetation

   Evaluate stream assessment procedures and develop revegetation plan(s) to restore stream functions.

8. Study 2000-R19 Sheridan Creek Riparian Demonstration Project

   Test bioengineering treatments on an overgrazed stream and restore the natural fish habitat.

9. Study 87-R01 American Falls Reservoir Idaho Shoreline Erosion Control Project (Bureau of Reclamation)

   Develop vegetative techniques to control erosion on shorelines of lakes, reservoirs, and ponds.

10. Study 87-R02 Trout Creek Nevada Riparian Evaluation Site

    Test woody riparian accessions on streams in the arid and semi-arid west. Test planting techniques for woody riparian plants.

11. Study 92-W08 Fairview Wetland Idaho Constructed Wetland System (Idaho State University)

    Determine the effectiveness of various wetland species to remove nutrients from an individual farm's irrigation wastewater. Develop design criteria for sizing system components.

12. Study 96-R13 Trout Creek Nevada Bioengineering Demonstration

    Demonstrate the effectiveness of bioengineering techniques in stabilizing streambanks in low precipitation zones of the arid and semi-arid west. Treatments tested include brush mattress, vertical bundles, fascines, and willow structure to stop headcut.

13. Study 98-01 Hybrid Poplar Initial Evaluation

Identify commercial accessions of hybrid poplar used for fuel and fiber adapted to eastern Idaho and northern Utah.

14. Study 98-R10 Carson River Nevada Riparian and Bioengineering Demonstration

    Demonstrate the effectiveness of bioengineering in conjunction with traditional engineering practices to stabilize streambanks in the arid and semi-arid west.

15. Study 98-W07 Pocatello, ID Stormwater Constructed Wetland System (City of Pocatello)

    Create Constructed Wetland System to treat stormwater from the SE side of Pocatello, ID. This wetland is an attempt to help the city meet the EPA phase II requirements.

16. Study ABPMC-S-0203-RA Mutton bluegrass (9067402) initial seed increase and evaluation

    Seed increase G1 and evaluation.

17. Study ABPMC-T-0315-RI Upper Carson River Bioengineering Demo

    Develop bioengineering treatments to stabilize severely eroding streams in low precipitation areas.

18. Study IDPMC-T-0403-RI Willow cutting soaking trials

    Evaluate efficacy of pre-soaking hardwood cuttings to aid in establishment.

19. Study IDPMC-T-0406-WE Wetland species direct seeding evaluation (National Park Service)

    Evaluate techniques to establish wetland plants through direct seeding.

20. Study IDPMC-T-0505-RA Orchard display and adaptation evaluation (USDA FS Rocky Mountain Research Station)

    Establish and evaluate native and introduced grasses, forbs and shrubs.

21. Study IDPMC-T-0506-RA Great Basin forb propagation and initial evaluation (USDA FS Rocky Mountain Research Station)

    Greenhouse propagation and evaluation of 7 native forb accessions for transfer to RMRS.

22. StudyIDPMC-T-0507-RI Willow Pre-soak field trial

    Compare effectiveness of willow pre-soaking treatments under field conditions. Planted 350 hardwood cuttings of 3 woody riparian species on degraded creek bank at Arbon

Valley, ID.

23. IDMPC-T-0605-RA Anatone bluebunch wheatgrass Growth Curves

    Develop growth curves for inclusion in ecological site descriptions.

24. IDPMC-P-0407-RA USDA FS R1 Bluebunch wheatgrass IEP (USDA FS Region 1)

    Evaluate collections of R1 PSSPS for possible selected class release.

25. IDPMC-P-0408-RA USFSR1 Sandberg bluegrass IEP (USDA FS Region 1)

    Evaluate collections of R1 POSE for possible selected class release.

26. IDPMC-P-0409-RA USFSR1 Blue wildrye IEP (USDA FS Region 1)

    Evaluate R1 collections of ELGL for possible selected class release.

27. IDPMC-P-0410-RA USFSR1 Idaho fescue IEP (USDA FS Region 1)

    Evaluate R1 collections of FEID for possible selected class release.

28. IDPMC-P-0411-RA USFSR1 Tufted hairgrass IEP (USDA FS Region 1)

    Evaluate R1 collections of DECA for possible selected class release.

29. IDPMC-P-0412-RA USFSR1 Western Yarrow IEP (USDA FS Region 1)

    Evaluate R1 collections of ACMI for possible selected class release.

30. IDPMC-P-0504-RA Basin Wildrye advanced evaluation

    Evaluate Magnar, Washoe Germplasm and Trailhead against promising accession from Nevada.

31. IDPMC-P-0508-RA Caribou-Targhee NF Slender wheatgrass IEP (USDA FS Caribou-Targhee and Bridger-Teton National Forests)

    Evaluate CT and BT collections of ELTR7 for possible selected class release.

32. IDPMC-P-0509-RA Caribou-Targhee NF Mountain Brome IEP (USDA FS Caribou-Targhee and Bridger-Teton National Forests)

    Evaluate CT and BT collections of BRMA4 for possible selected class release.

33. IDPMC-P-0602-RA Muttongrass (*Poa fendleriana*) AEP

    Compare 9076402 to accessions from other researchers for potential release.

34. <u>IDPMC-P-0615-RA Coffee Point- Basin Wildrye Off-Center Evaluation Nov. 2006</u>

Evaluate released and test material in field conditions at Coffee Point Test Site.

35. <u>IDPMC-P-0616-RA Coffee Point-Sandberg bluegrass Off-Center Evaluation</u>

Evaluate accessions of Sandberg bluegrass under field conditions.

36. <u>IDPMC-P-0617-RA Coffee Point-Bluebunch Wheatgrass Off-Center Evaluation</u>

Evaluate accessions of PSSPS under field conditions.

37. <u>IDPMC-P-0618-RA Coffee Point-Snake River Wheatgrass Off-Center Evaluation</u>

Evaluate SRWG under field conditions.

38. <u>IDPMC-P-0619-RA Coffee Point- Thickspike wheatgrass Off-Center Evaluation</u>

Evaluate releases of ELLAL under field conditions.

39. <u>IDPMC-P-0620-RA Coffee Point- Western Wheatgrass Off-Center Evaluation</u>

Evaluate western wheatgrass under field conditions.

40. <u>IDPMC-P-0621-RA Coffee Point- Slender Wheatgrass Off-Center Evaluation</u>

Evaluate ELTR materials under field conditions.

41. <u>IDPMC-P-0622-RA Coffee Point- Bottlebrush Squirreltail Off-Center Evaluation</u>

Evaluation of bottlebrush accessions under field conditions.

42. <u>IDPMC-P-0623-RA Coffee Point- Shrub Off-Center Evaluation</u>

Evaluation of native shrubs under field conditions.

43. <u>IDPMC-P-0624-RA Coffee Point- Forb Off-Center Evaluation</u>

Observe native forb releases under field conditions.

44. <u>IDPMC-P-0625-RA Coffee Point- Introduced Grass Off-Center Evaluation</u>

Evaluate introduced grass accessions under Idaho field conditions.

45. <u>IDPMC-T-0505-RA Orchard display and adaptation evaluation</u>

Display nursery of native and introduced grasses, forbs and shrubs. Evaluate establishment and performance.

46. IDPMC-T-0601-RA Forb Herbicide tolerance trial (UI Extension)

    In cooperation with U of I to evaluate potential herbicides for weed control in forb seed production.

47. IDPMC-T-0603-Ri Effects of pre-soaking dormant hardwood cuttings of coyote Willow

    Evaluate length of time and water temperatures to increase survivability.

48. IDPMC-T-0604-RA Great Basin Forb Initial Increase and Evaluation

    Develop propagation techniques and evaluate plant growth and seed production characteristics in increase blocks.

49. IDPMC-T-0604-WE Options and cost breakdown for direct seeding wetlands with Baltic rush

    Develop alternatives and costs for direct seeding Baltic Rush.

50. IDPMC-T-0606-RA *Eriogonum* stratification requirements

    Investigate optimum stratification durations for 2 Eriogonum species, *E. umbellatum* and *E. heracleoides*.

51. IDPMC-T-0607-RI Salato Creek Soil Bioengineering Demonstration Site

    Demonstration of soil bioengineering treatments in low precipitation areas of the SW. Soil Bioengineering treatments were combined with harder structures to show how they can fit together and function together.

52. IDPMC-T-0608-RI Restoration techniques for the Hopi Indian Reservation

    Development of riparian planting techniques for the arid SW on the Hopi Reservation. These techniques utilize native culturally significant riparian woody species to restore the riparian areas on the reservation.

53. IDPMC-T-0609-RI Lemhi River Soil Bioengineering Demonstration near Salmon, ID

    Stream bank Soil bioengineering demonstration on the Lemhi River near Salmon, ID. This project evaluates different soil bioengineering treatments that can work at high elevations and in high pH water.

54. IDPMC-T-0610-RI Moose WY streambank soil bioengineering demonstration project

    Demonstration of Stream bank Soil Bioengineering treatments on the Snake River. This project will demonstrate the use of bioengineering treatments in a large river with high velocities and high ice loads.

55. IDPMC-T-0612-WE Stratification requirements for Indian Valley Sedge (*Carex aboriginum*)

56. IDPMC-T-0613-CP Evaluation of Hairy Vetch populations for winter hardiness

    Determine if any of 5 hairy vetch accessions are winter tolerant in ID.

57. IDPMC-T-0614-RA Propagation protocol for containerized *Eriogonum umbellatum* and *E. heracleoides*

    Create greenhouse propagation protocols for ERUM and ERHE2. Study examines stratification requirements, planting depths and irrigation schedules.

PROPOSED OR PLANNED STUDIES

1. Development of ecoregion specific vegetative riparian restoration guidelines following removal of Tamarisk (salt cedar), Russian olive and other invasive species

2. Skull Valley Inter Center Strain Trial

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Reintroducing Native Plants to the American West
Derek J. Tilley, Range Conservationist, Aberdeen Plant Materials Center

The Aberdeen PMC is working together with other team members of the Great Basin Restoration Initiative (USDI-BLM) and the Great Basin Native Plant Selection and Increase Project (USDA-FS) to develop techniques to increase native plant diversity in crested wheatgrass monocultures. Since the early 1930s crested wheatgrass has been used in range seedings in the Intermountain West as a means to stabilize soils and sites after fires, improve forage production and compete against weeds such as cheatgrass. This introduced perennial bunchgrass has many outstanding characteristics that make it a valuable tool for recapturing and revegetating low precipitation areas in the arid to semi-arid west. However; the historical use of this species was to plant monoculture plantings instead of seed mixtures. This has led to the creation of millions of acres of crested wheatgrass monocultures covering broad expanses of western rangelands. In recent years land management agencies and private land owners have begun to realize the importance of diverse plant communities for the health and stability of ecosystem functions. The Aberdeen PMC is helping others look at ways to reduce crested wheatgrass dominance and to increase native plant diversity in these sites.

Rangeland specialists from Brigham Young University (Provo, UT) have developed a series of steps in what they call “assisted succession.” This is a means by which one can make a transition from annual weed monocultures to a healthy native plant community. First, they recommend capturing the site using crested wheatgrass and allowing the annual weed seed bank to be depleted. This may take several years to gain sufficient weed control. Second, reduce crested wheatgrass by mechanical and/or chemical means. Finally, reseed the site with a native seed mixture and then manage the site for a diverse long-term native plant community.

The current study investigates the most effective means of controlling crested wheatgrass in two long-established crested wheatgrass plantings; one at Skull Valley in north western Utah and one near Burns in south eastern Oregon. Investigators are looking at treatments for reducing crested wheatgrass involving chemical and/or mechanical control. Following the control treatments the sites were seeded with a “state-of-the-art” Truax Roughrider Range Drill that allows simultaneous drill and broadcast seeding in alternate rows over rough terrain. The seeded species included bluebunch wheatgrass, Indian ricegrass, Wyoming big sagebrush, fourwing saltbush and others. The treated plots will be monitored for the return of crested wheatgrass and annual weeds as well as establishment of the seeded native plant species.

The Aberdeen PMC staff has assisted with this project in several ways. The PMC provided input on species selection for the seed mixtures and prepared the mixes by adding rice hulls for improved seed delivery through the drill and broadcaster. The PMC also worked closely with the drill manufacturer to make several modifications to the Truax Roughrider Range Drill. The PMC crew replaced accordion style tubes with smooth tubes to prevent seed bridging; they added a generator and vacuum to clean out the seed box between plots; and new seed drop boots were designed that improved seed drop and seed placement into the furrows. The PMC also provided technical expertise in designing the seeding portions of the study and completed the plantings at both sites in the fall of 2005 and fall of 2006.

For more information regarding this study or other activities at the PMC, contact PMC Team Leader, Loren St. John at 208-397-4133.

The Truax Roughrider Range drill (above) being used to seed test plots in Utah. Addition of broadcast seeders (inset) allows planting shallow-seeded species in alternating rows with deep-seeded species in a single operation.

Wider disc opening in the soil for seed to drop into and press wheel adjustment to better cover seeds with soil behind disk openers.

Reintroducing Native Plants to the American West
Derek J. Tilley, Range Conservationist, Aberdeen Plant Materials Center

The Aberdeen Plant Materials Center (PMC) is working together with other government agencies to increase native plant diversity in crested wheatgrass monocultures. Since the early 1930s crested wheatgrass has been used in range seedings in the Intermountain West as a means to stabilize soils and sites after fires, improve forage production and compete against weeds such as cheatgrass. Crested wheatgrass, originally from Asia, has many outstanding characteristics that make it a valuable tool for revegetating low precipitation areas in the arid to semi-arid west. However, this species has historically been planted as a single species instead of as part of a seed mixture. This practice has led to the creation of millions of acres of crested wheatgrass monocultures covering broad expanses of western rangelands. In recent years land managers have begun to realize the importance of diverse plant communities for the health and stability of the ecosystem. The Aberdeen PMC is looking at ways to reduce crested wheatgrass dominance and to increase native plant diversity in these sites.

Rangeland specialists from Brigham Young University (Provo, UT) have developed a series of steps in what they call “assisted succession.” This is a means by which one can make a transition from annual weed monocultures to a healthy native plant community. First, they recommend capturing the site using crested wheatgrass and allowing the annual weed seed bank to be depleted. This may take several years to gain sufficient weed control. Second, reduce crested wheatgrass by mechanical and/or chemical means. Finally, reseed the site with a native seed mixture and then manage the site for a diverse long-term native plant community.

The current study investigates the most effective means of controlling crested wheatgrass with various chemical and/or mechanical treatments. Following the control treatments the test sites were seeded by Aberdeen PMC personnel. The seed mix of native species included bluebunch wheatgrass, Indian ricegrass, Wyoming big sagebrush, fourwing saltbush and others. The treated plots will be monitored for the return of crested wheatgrass and annual weeds as well as establishment of the seeded native plant species.

For more information regarding this study or other activities at the PMC, contact PMC Team Leader, Loren St. John at 208-397-4133.

Submitted to the Aberdeen Times for publication February 21, 2007.

Aberdeen PMC crew seeding test plots in Utah fall 2005.

Reporter: **Aaron Kunz**

Native Plant Center In Aberdeen

March 26, 2007 08:46 PM

Among miles of potato fields is a United States Department of Agriculture testing facility. At those facilities, Department of Agriculture employees are growing the next generations of grasses and flowers.

Loren St. John, USDA: "Our mission is to test and select plants that can be used for conservation purposes."

The plants seen here are native to Eastern Idaho. They are being tested in various ground to see if they would be strong enough to grow in the wild.

Loren St. John, USDA: "We need to know how it's going to perform out in the rangeland or whatever type of area that that plant is going to be used in."

After a ten year testing period, if the plant shows it can be self sustaining...

Loren St. John, USDA: "We are responsible for producing stock seed that goes to the commercial seed industry for large scale commercial seed production."

Why native plants? Because it balances the circle of life. For instance, the grouse use wildflowers to attract food.

Loren St. John, USDA: "Produce insects that the grouse chicks can eat and wildflowers draw insects in."

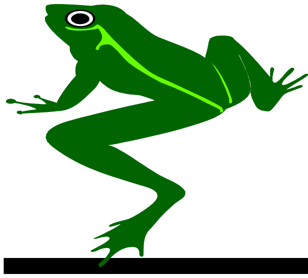
Ultimately the seeds would be used to help mother nature recover from a wildfire or other natural diaster.

Loren St. John, USDA: "And be able to put native species...native plant species back into those sites to help these other animals that need those plants but just aren't there."

Anyone who wants to see what they're growing can come take a look. They are just north of Aberdeen on Highway 39.

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 13 (2007)

Project Contributors
J. Chris Hoag, Wetland Plant Ecologist, Project Leader
Derek Tilley, Range Conservationist, Research Scientist

"Whisky is for drinking, water is for fighting over"- Mark Twain

Introduction

This newsletter is part of the Aberdeen Plant Materials Center's continuing effort to provide technical information to the public on wetland and riparian plants, plant establishment, and their management. This newsletter is the twelfth issue since 1991 when the Interagency Riparian/Wetland Plant Development Project was established.

Riparian Ecology and Restoration Workshops

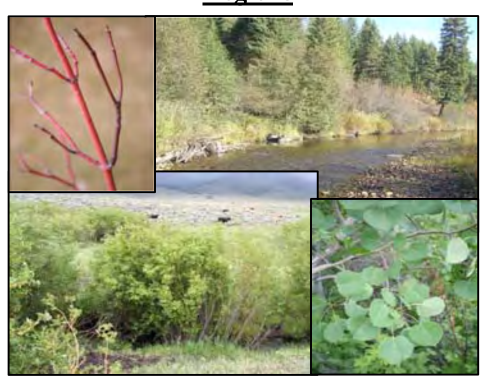
Class installing a brush mattress on Nov. 8, 2007 at Adobe Ranch near Bishop, CA

As part of the Project's technology transfer efforts, a three-day Streambank Soil Bioengineering Technical Training Session was developed. The first day of the course is devoted to the classroom where basic riparian dynamics, riparian zone vegetation, plant acquisition, and bioengineering techniques are discussed. The second day of the course is half in the classroom discussing local topics and half in the field where participants classify a riparian site and develop a restoration plan based on resources and problems at the site. On the third day, the participants install a series of bioengineering structures along an eroding section of a stream.

Each year workshops are conducted in different parts of the western United States. If you are interested in attending this course, contact Pat Blaker at Aberdeen PMC for the next scheduled workshop. If you are interested in having a workshop in your area and you have about 30 people that would attend the training, contact Chris Hoag and we will try to schedule a course in your area.

Riparian/Wetland Project Newest Publications

Field Guide for the Identification and Use of Common Riparian Woody Plants of the Intermountain West and Pacific Northwest Regions



Chris Hoag, Wetland Plant Ecologist
Derek Tilley, Range Conservationist
Dale Darris, Conservation Agronomist
Kathy Pendergrass, Plant Materials Specialist

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

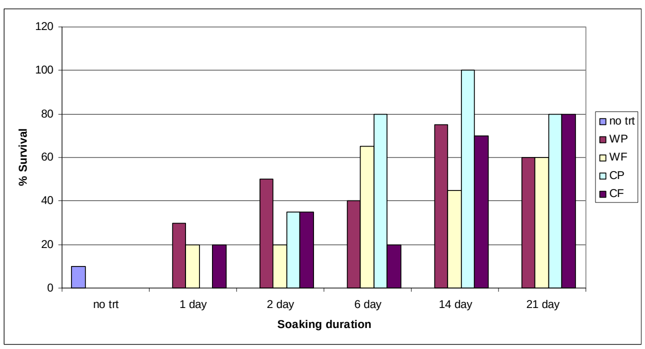
The Aberdeen PMC Riparian/Wetland Project's newest publication in cooperation with the Corvallis

PMC is: ***Field Guide for the Identification and Use of Common Riparian Woody Plants of the Intermountain West and Pacific Northwest Regions***.

The focus of this Field Guide is to provide information on the identification and collection of native plant materials found in riparian areas in the Intermountain West and Pacific Northwestern regions. The Guide is written for practitioners of riparian restoration and streambank soil bioengineering. Species descriptions provide information on the use of native woody plant materials to reduce streambank erosion, collection of propagation material, and typical identification characteristics used to identify the species in the summer and in the winter when there are no leaves or fruits. Full color pictures of the full plant, leaves, bark, twigs, fruit and other identifying characteristics are included for each species. A map of the United States with the states where the plant is found is also included.

This publication will be available on CD or it can be downloaded from the Aberdeen PMC Riparian/ Wetland Project website. Printed hard copies will not be available. If you would like a digital copy, please download it from: http://plant-materials.nrcs.usda.gov/idpmc/riparian.html

Willow soaking trial



Survival of dormant hardwood cuttings of Peachleaf willows following different presoaking treatments. WP=warm partially submerged, WF=warm fully submerged, CP=cold partial, CF=cold full.

This year the PMC investigated the benefits of pre-soaking dormant cuttings of Peachleaf willow (*Salix amygdaloides*) in a controlled study at the PMC. Dormant hardwood cutting survival of Peachleaf willow increased in greenhouse trials following pre-planting soaking treatments. 100% survival was achieved from soaking cuttings partially submerged in cold water for 14 days. Other soaking treatments resulted in varying levels of success, but nearly all treatments had increased survival rates when compared to the non-soaked control. Cuttings survival also improved with increasing diameter of cuttings regardless of pre-soaking treatments.

Direct seeding of wetland plant species

The PMC has been investigating possibilities for direct seeding of wetland species for several years. We've investigated every crazy idea that we, or anyone else could think of from broadcasting with imprinters, to hydroseed mulches to pelletized seed. Several techniques have shown promise in greenhouse and small scale trials. In the 2004 issue of *View from a Wetland*, we highlighted Submerseed™, a seeding method involving binding seeds to small pebbles using clay and polymers. Submerseed is an effective way of delivering seed into shallow standing water where the use of heavy equipment would be impossible. Hydroseeding also had good establishment results in our tests, especially when applied with Fertil Fibers™ Nutrimulch. Fertil Fibers is designed to stimulate soil microbial action and provide a slow-release fertilizer. In our tests, plots seeded with Fertil Fibers and a tackifier had excellent establishment and plants appeared to be larger and have more vigor.

Baltic rush in 2006 establishment trial seeded with 500 PLS/ft². The flat in the top right corner was planted with Fertil Fibers Nutrimulch.

Brush spurs and brush revetments encourage silt deposition

One reason that we install brush spurs and brush revetments is to slow the water velocity near the bank, which allows silt deposition. Once this deposition occurs, it is important to take advantage of this new planting medium. In a project at Grand Teton National Park, brush spurs were installed between rock barbs and brush revetments were installed on the bank between the other treatments. After a summer of average stream flow, we found more than one foot of sediment deposited around the revetment trees along the bank. At this point, there are basically two options. One is the do nothing and through the summer some of that sediment will be washed away. The second option is to plant wetland plants in the deposited sediment. These plants will spread via rhizomes through the sediment and increase the roughness along the bank in conjunction with the riparian woody species that were planted in the original design.

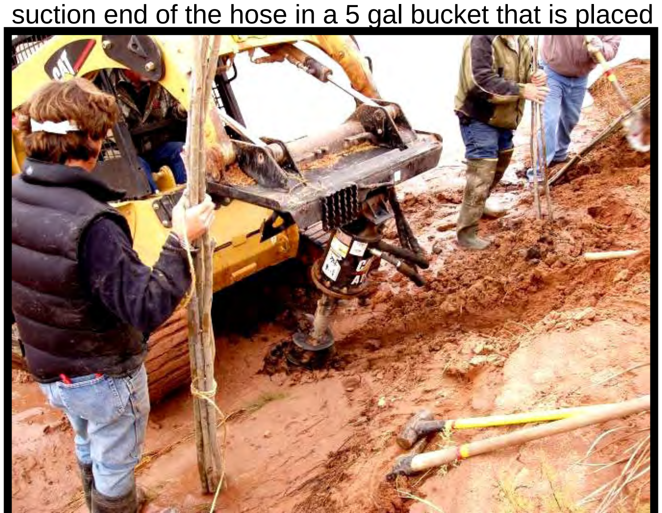
Willows sprouting around brush revetment on the Snake River at GTNP

Sedge plugs planted in accumulated sediment around the base of a brush spur on the Snake River at GTNP

Often a 2 phase planting plan where the second phase is to plant into the accumulated sediment is a great way to quickly improve the plant community along the toe of the bank.

Protecting the waterjet pump

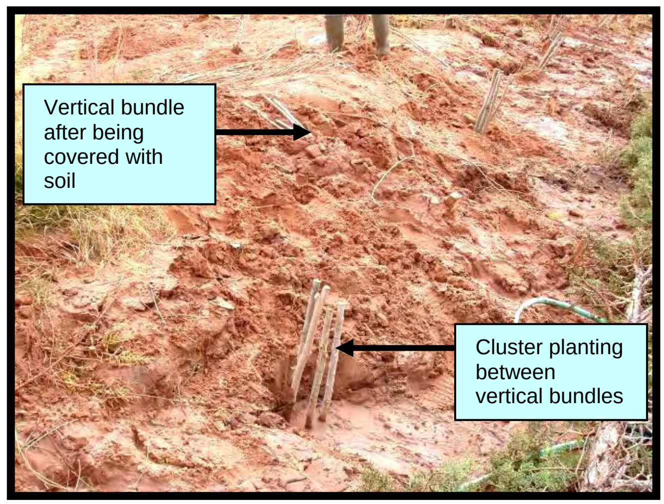
Often when placing the waterjet suction hose end in the water, the bed has a lot of fine sediments that the foot valve sits in. This fine sediment is sucked through the pump. Over time this sediment can cause wear on the impeller blades. A simple solution is to place the suction end of the hose in a 5 gal bucket that is placed



on the bed. This way when the pump is turned on, it will not pick up the sediment off the bed. Point the bucket upstream and the flow into the bucket should match the suction rate.

Another way to plant vertical bundles

At a recent workshop in Utah, Tom Moody (NCD, Engineer, Flagstaff, AZ) came up with another way to plant vertical bundles. We had access to a small trackster with a 6 in auger. Tom had the operator place the auger almost parallel to the bank and auger down at an angle. The vertical bundle was then placed in the hole and laid up in bank in the normal trench. This way the base of the bundle can be placed much deeper than normal which ensures it is in the lowest water table even when the stream water level drops.



Additional Information

All publications are now available on the Internet in Adobe Acrobat format. Download each paper below by going to http://www.Plant-Materials.nrcs.usda.gov/idpmc/riparian.html.
Idaho PM Tech. Notes can also be downloaded from: http://www.id.nrcs.usda.gov/programs/plant.html.
If you do not have access to the Internet or would like to receive a hard copy of a publication, contact us.

Bioengineering Information

1) *The Practical Streambank Bioengineering Guide*
2) *Streambank Soil Bioengineering Field Guide for Low Precipitation Areas*

Individual Wetland Plant Fact Sheets – Description, ecology, collection, propagation, management, and uses of 6 different wetland species.

Riparian/Wetland Project Information Series
(Publications in red are new)

- **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.
- **No. 18** - Streambank Soil Bioengineering Considerations for Semi-Arid Climates.
- **No. 19** - Simple Identification Key to Common Willows, Cottonwoods, Alder, Birch, and Dogwood of the Intermountain West.
- **No. 21** - Wetland Plants: Their Function, Adaptation and Relationship to Water Levels.
- **No. 22** - How to Manipulate Water in a New, Restored, or Enhanced Wetland to Encourage Wetland Plant Establishment

Idaho NRCS PM Technical Notes

- **No. 4** - Reading Seed Packaging Labels and Calculating Seed Mixtures.
- **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. 13 -** Harvesting, Propagating and Planting Wetland Plants.
- **No. 21** - Planting Willow and Cottonwood Poles under Rock Riprap.
- **No. 23** - How to Plant Willows and Cottonwoods for Riparian Rehabilitation (Revision).
- **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.
- **No. 39 -** Waterjet Stinger: A tool to plant dormant unrooted cuttings of willows, cottonwoods, dogwoods, and other species.
- **No. 40** - Biology, history and suppression of Reed canarygrass (Phalaris arundinacea L.).
- **No. 42** – Willow Clump Plantings.
- **No. 43** - Tree Planting, Care and Management

For a copy, write or call:

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Interagency Riparian/Wetland Project
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derek.tilley@id.usda.gov

TECHNICAL NOTE

USDA-Natural Resources Conservation Service
Boise, Idaho

TN PLANT MATERIALS NO. 21 **January 2007**

Planting Willow and Cottonwood Poles under Rock Riprap

J. Chris Hoag, Wetland Plant Ecologist, Interagency Riparian/Wetland Plant Development Project, USDA - Natural Resources Conservation Service, Plant Materials Center, Aberdeen, ID; **Robert W. Sampson,** State Conservation Engineer, USDA Natural Resources Conservation Service, Boise, ID.

Introduction

Rock riprap is an engineering treatment that has been used extensively for streambank protection and stabilization. Blanket riprap is a hard structure that stabilizes the streambank in place. Riprap does not allow the stream to meander and has a low aesthetic value. Riprap alone provides little in the way of water quality benefits. Rock provides some fish habitat, but compared to natural vegetation, it is a poor substitute. Rock alone provides little to no wildlife habitat. However, under severe and emergency conditions, engineering techniques such as riprap are appropriate treatment measures.

Streambank soil bioengineering is defined as the use of live and dead plant materials in combination with natural and synthetic support materials for slope stabilization, erosion reduction, and vegetative establishment (Allen and Leech, 1997). Simply put, streambank soil bioengineering is using vegetation to increase the strength and structure of the soils through extensive root systems and aboveground biomass. Vegetation is flexible and if correctly installed can withstand high stream velocities. Plants are part of the natural streambank and buffer zone along a stream. Vegetation can offer a diverse plant community that provides wildlife habitat that is aesthetically pleasing.

Adding woody vegetation to an engineering structure increases the structure's strength, durability, and reliability (Schiechtl, 1997). Roots add tensile strength, binding together masses of stone and soil. Stems and branches create hydraulic roughness that dissipates wave and stream flow energy, and shields the soil and rock from erosive forces. Growing vegetation sprouts to fill in any open, eroding areas. As a supplement to structural efforts, live woody cuttings have the advantage of extending roots and sprouts that protect and bind masses of soil. Plant canopies create a microclimate for colonization by other species of plants which provides valuable habitat for wildlife. Vegetation overhanging the stream provides shade and hiding cover for fish as well as an energy input to the stream in the form of leaf fall.

A combination of rock riprap and vegetation can improve the overall performance of the rock and also provide needed streambank roughness in the form of stiff to flexible vegetative stem and leaf growth. Vegetation also improves fish and wildlife habitat, water quality, and aesthetics with a diverse community of woody plant materials. Woody vegetation often grows through the stone layer of riprap, adding strength, durability, and reliability. Vegetation also helps prevent movement of filter stone by binding stone and soil layers together.

Vertical willow bundles under rock riprap

Bundles of willows or cottonwoods can be placed vertically under rock riprap during initial construction. This method requires stems that are long enough to reach from the low water elevation to above the top of the planned rock. A Willow bundle is placed on the slope after shaping, but before the rock is placed. The bottom of the willow bundle needs to be put in the toe

Figures 2 and 3: Vertical bundles are placed on 6 feet centers with the tops 1 foot above the top of the bank and the bottoms touching the bottom of the keyway trench. Four months after planting, the vertical willow bundles have grown approximately 6 feet.

trench (a trench dug into the streambed to ‘key’ the rock into the bed of the stream) before the rock is placed in the trench. If possible, shallow depressions should be scraped out of the shaped bank for the bundles to fit in before they are covered by the rock riprap. Putting several inches of soil in an irregular pattern on top of the stems before placing the rock helps protect the cutting, but is not absolutely necessary if there is good soil-to-stem contact with the bank. Too much soil on top of the bundles would be detrimental to vigorous sprouting.

Installation Procedure for Vertical Bundles Under Rock

1) The bottom of the bundles ***must*** be 1 foot below the low water table elevation. If a toe trench is used for the rock riprap, then the bundles that are laid vertically up the bank need to have their butt ends in the trench ***before*** the rock is placed in the trench.
2) The top 1 foot of the bundle needs to stick above the rock riprap. They cannot be covered with rock or they will not grow.
3) The bundles should be prepared and on site before the construction starts. An ideal time to prepare and deliver bundles is when the rock moving equipment is being mobilized. Because willow placement must be timed carefully with rock placement, a preconstruction meeting with the machine operators will probably be useful.
4) Bundle diameters should be 3 to 6 inches. Bundles should be loosely tied with twine (that they will eventually degrade) every 2 to 3 feet. A bundle will have 3 to 8 stems per bundle. Individual cuttings should be larger than ¾ inch diameter at the butt end.
5) This method will also work if the design calls for blanket rock that is lower than the top of the bank (often called toe rock, half rock, etc…). The stems should stick out of the top of the rock at least 1 foot and should extend above anticipated high water level.
6) Vertical bundles should be placed on 6 foot spacing.

Figures 4 and 5: An example of a successful shoreline stabilization project on Henry's Lake and Targhee Creek where vertical bundles were placed under rock riprap. In four years, the willows had grown in solid above the rock providing excellent stabilization, better aesthetics, and better wildlife habitat. (Project by Bob Lehman and Ken Beckmann)

The 45 degree bundle method

This method is used when the banks are too high for the willows to reach the top of the riprap and/or the local willow sources are too short. The bundle is installed at a 45° angle to the bank so the top of the bundle hangs out over the water. First, the toe trench is dug and the bank sloped. Then rock is placed in the trench and rock riprap is laid up the bank to the elevation of the low water table. At this point, the bundles are installed as follows:

Installation procedure for the 45 degree bundle method

1) The backhoe bucket would be placed right above the laid rock, pointed down toward the base of the pre-sloped bank at a 45° angle.
2) The operator would push the bucket down on that 45° angle until he reached the same level as the streambed or the bottom of the key trench depending upon characteristics of the stream.
3) The operator would then stop pushing down and he would lift the bucket up high enough to create a small opening between the bucket and the soil underneath it. This opening would be only wide enough so the willow bundle could be the shoved to the bottom of the hole.
4) The willow bundle is then shoved into the hole ensuring the butt end is at the bottom of the hole and the bundle is laying on the rock riprap.
5) The backhoe operator then pulls the bucket out of the hole dropping the dirt onto the bundle.
6) The operator then continues laying the rock up the bank until the design elevation is reached.

Figures 6 and 7: Excavator bucket is pushed into the streambank above the rock riprap in the keyway trench. Operator lifts the soil up (without pulling the bucket out) to create a small hole underneath. Another person shoves the willow bundle into the hole and the operator pulls the bucket straight out and the soil drops on to the bundle.

The result of this method is to have the bundles sticking out over the water to provide shade, water quality benefits, and fish and wildlife habitat. The vertical bundle method puts the sprouting at the top of the bank and it will be several years before the willows are long enough to provide the same benefits.

The most important considerations for using this method are:

A) The butt ends need to be below the lowest water table elevation.
B) The bundles need to be installed at a 45° angle down, not horizontally. The most common mistake with this method is the operator will put the bucket into the slope almost horizontally, which is the more common movement of the bucket. This does not allow the bottom of the cuttings to be below the lowest water elevation.
C) The height above the streambed that the bundle is placed should be above "normal" flows, but not necessarily flood levels. Bundles placed with part of the length against "dry" soil (above the normal waterline), achieve better rooting.
D) Use only those willow species that have flexible stems so ice and debris will not hang up on the bundle when they mature.
E) The bundle should stick out of the rock no more that 1 foot. This will prevent debris and ice from catching on the bundles and causing scouring problems. Significantly less than 1 foot will create problems with the tops being covered and shaded causing a higher mortality.

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TECHNICAL NOTE

USDA-Natural Resources Conservation Service
Boise, Idaho

TN PLANT MATERIALS NO. 23 **JANUARY 2007**
REVISION

HOW TO PLANT WILLOWS AND COTTONWOODS FOR RIPARIAN RESTORATION

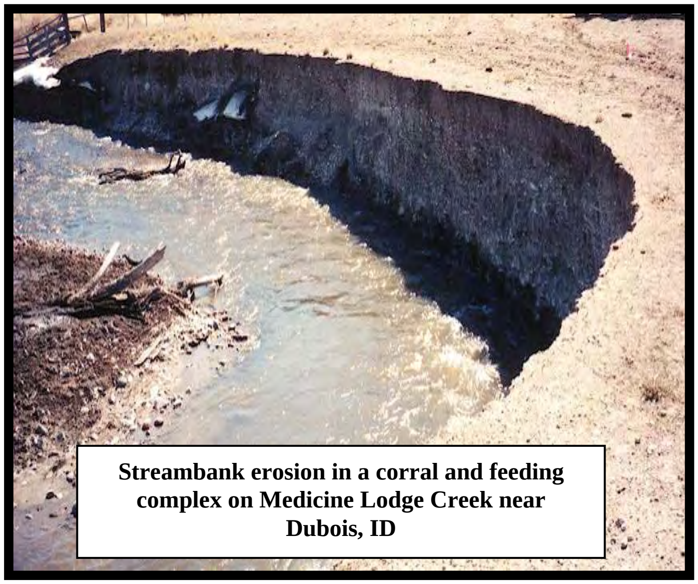
J. Chris Hoag, Wetland Plant Ecologist
USDA-NRCS Plant Materials Center, Aberdeen, Idaho

HOW TO PLANT WILLOWS AND COTTONWOODS FOR RIPARIAN RESTORATION

J. Chris Hoag, Wetland Plant Ecologist,
USDA-NRCS Plant Materials Center, Aberdeen, Idaho

Introduction

Many riparian areas in the West need rehabilitation. Natural climatic events and abuses in the past have caused the destruction of vegetation and accelerated streambank and stream bottom erosion (Kauffman and Krueger 1984; Skovlin 1984; Platts 1981; Thomas and others 1979). Emphasis on water quality, aesthetics, wildlife, and fisheries has prompted interest in methods for revegetating eroding stream channels (Carlson 1992; Carlson et al. 1991).



Streambank erosion in a corral and feeding complex on Medicine Lodge Creek near Dubois, ID

There is increased interest in rehabilitating riparian zones with willows and cottonwoods. The Interagency Riparian/Wetland Plant Development Project, USDA Natural Resources Conservation Service (NRCS), Plant Materials Center (PMC), Aberdeen, Idaho and others are researching harvesting, storage, planting techniques and cultural practices for successful establishment of willows, cottonwoods and other riparian woody vegetation to better meet the needs of riparian rehabilitation.

Guiding Principles of Stable Stream Channels

Riparian vegetation is a critical part of any stream system. Riparian plants provide a huge web of roots that hold the soil together. They also provide significant roughness from their above ground biomass. Determining where to plant them is often one of the hardest decisions to make. Before starting to restore a stream channel, 3 principles need to be understood (Natural Channel Designs, 2006). They are:

1. **Elevations should rise away from the central channel.**
The central channel flow line must be the lowest point across the riparian area and the channel banks, floodplains, and terraces should slope upward continuously away from the channel. The banks will be most stable if they can be stepped as they rise away from the channel. All flat areas should slope toward the river. If they are level or slope away from the river they will tend to divert overbank flows away from the main channel and could contribute to greater erosion. Banks on the outside of meanders are expected to rise more rapidly than those on the inside, but should still be stepped when possible.

2. **Transitions should be gradual to reduce the potential for erosion.**
In order to minimize the risk of lateral bank erosion, water should flow smoothly through the stream corridor. While meander is a natural part of stream processes, tight turns can create excessive pressure to weak stream banks and increase erosion. Meanders should be gradual and within the dimensions

described in specific recommendations. Floodplains and terraces should not be suddenly narrowed by buildings or other structures. Such constrictions force increases in velocity and water elevations that can increase erosion.

3. **Roughness should increase away from the central channel.**
Roughness is resistance to flow contributed by vegetation, rough surfaces, or structures. Increasing roughness away from the central channel tends to center high flows and slows velocities against the more erosive stream banks and terraces. For example, the central channel should be relatively free of vegetation and other obstructions. The areas immediately adjacent to the channel (floodplains) should support dense thickets of shrubby vegetation (i.e., willows, etc) that bend with the flows (Figure 1). Areas further away from the channel (terraces) support stiffer woody vegetation (cottonwoods, Peachleaf willow, etc) that further slows flows. It should be noted that roughness implies a slowing of the flow not necessarily stopping the flow. Structures that completely stop or redirect flow across the floodplain/terrace should be avoided.

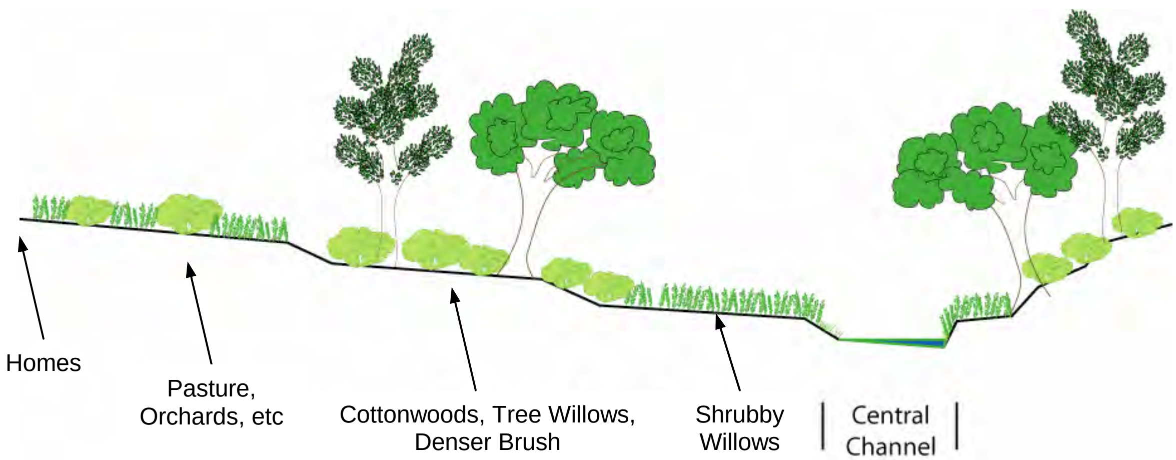


Figure 1: Roughness - Vegetation provides increasing roughness to keep high velocities in central channel (Natural Channel Design, 2006)

This Technical Note addresses principle 3 - the addition of roughness to the channel. It should be noted that planting vegetation in a riparian zone without giving serious consideration to where different species of plants should go can cause more problems than those you are trying to fix. For more information on where to plant riparian vegetation, see *Riparian Planting Zones in the Intermountain West* by Hoag et. al. 2001.

There are a number of steps that should to be completed prior to any planting. They include a site assessment, an inventory of planting site, and a detailed survey and evaluation of the soils, water, and vegetation. Once you have determined the cause of the erosion and where high priority areas are located on the stream, you should develop a planting plan and determine where and how to plant the vegetation that you will use. This Technical note describes how to select, harvest, treat, and plant riparian woody species.

Site Assessment

Before jumping into the water and shoving cuttings in the ground, it is important to understand what is causing the streambank erosion, how extensive it is, and which areas need the most work. A stream assessment should be completed on the stream prior to any restoration or rehabilitation work. The assessment should identify problems on a stream reach basis.   A is defined as a section of stream between two defined points (Fischenich 2000). A number of assessment protocols are available, such as: Stream Visual Assessment Protocol (SVAP), Proper Functioning Condition (PFC), Rapid Stream Assessment, etc. The assessment should identify problems such as, water removal, fish barriers, culverts, etc. that affect fish and hydrology by stream reach. It should also identify eroding areas, the type of erosion, and severity of the erosion. When the assessment is completed, there should be enough information to identify the reaches of the stream that need some kind of treatment, treatment alternatives that could be used, which reaches are the highest priority, other problems that need to be addressed, and an estimate of the potential success of a planting. Based on a good site assessment, you should be able to develop a project rehabilitation schedule or plan including a list of treatment alternatives, a cost estimate for each reach, a cost estimate for the entire project area, and a priority list of which reaches should be treated first.

Site Considerations

Careful planning before planting is necessary to ensure the solution does not create additional problems.

* Management (prescribed grazing system, livestock exclusion, riparian buffers, etc.) must be in-place to maintain or improve riparian vegetation. Without proper management, planting efforts could be destroyed (Crouse and Kindschy 1984; Van Haveren and Jackson 1986).

* If native willows or cottonwoods are not found in the vicinity, planting them may not be a good option.

* Willow and cottonwood plantings apply only to situations where the rehabilitation time frame is long enough to allow the cuttings to become established and stabilize the site. Hard structures (i.e. rock, concrete, etc.) may be more appropriate under emergency situations.

* Unrooted cuttings can be used on sites that range from flat to near vertical slopes. Risks of wash-out and mortality increase as the slopes become steeper.

A reconnaissance upstream and downstream of the site selected for revegetation may save time and effort. If there are willows and cottonwoods on adjacent sites, check the hydrology, soil and site conditions and compare them to conditions at the revegetation site. Plantings will be most successful on sites similar to the stable vegetated areas. Risk of mortality increases as soil, site, and water column parameters depart from those of the vegetated sites.

There are reasons for vegetation not growing on the disturbed site. Some parameters to inventory in addition to management at the revegetation site include: high streamflow velocities, sharp outside curves, vertical to near vertical or undercut banks, hanging streambanks, mixed stratigraphy of cohesive materials over gravel, and evidence of mass soil slumping. When these parameters are present, revegetation can still be considered, but the underlying causes must be addressed. Establishing vegetation is much more difficult under these conditions because the time period required for stabilization increases, the planting schedule must accelerate, and additional soil losses can be expected.

These conditions indicate engineered hard structures or bioengineering techniques not covered in this Technical Note need to be included in the planning considerations.

Some data suggests vegetative protection may be adequate if maximum streamflow velocities do not exceed 8 feet per second. Structural and bioengineering techniques should be considered for velocities greater than 8 feet per second. Woody materials should be considered with velocities less than 8 feet per second. Woody materials in conjunction with herbaceous species should be considered for velocities less than 5 feet per second. Herbaceous materials alone can be used for velocities less than 3 feet per second.

Engineered hard structures or bioengineering techniques may be needed in situations where the toe of the bank is unstable. In these situations, refer to the NRCS Stream Restoration Design Handbook, National Engineering Handbook, Section 654.

Species Selection

During the reconnaissance, identify willow, cottonwood and other riparian species, local soil and site conditions and the moisture regime. If species identification is a problem, at least identify the growth form and conditions where the plant is growing (elevation, soils, zone, etc.). Species and/or growth form identification is important so the correct plant species can be matched to the right planting zone at the revegetation site.

Willow species have several different growth forms. Willows come in all sizes, from small shrubs to large trees. There are three basic types of willows: tree-type, shrub-type, and creeping type. Tree-type species at maturity have a large crown, single or multiple stems, and dense basal area. They are usually taller than 20 ft. Shrub-type willows generally have smaller diameter multiple basal stems and rarely get taller than 15-18 ft. Creeping–type willows sucker profusely and are represented by coyote willow (*Salix exigua*).

Different growth forms of willows along the Snake River near Buhl, ID

Cottonwood species have narrow to wide crowns and some species sucker (generally only about 10% of a stand will sucker) while others have very shallow root systems.

In general, small to medium size shrub-type willows and rhizomatous or creeping-type willows are used for planting within the channel banks. These can be planted as live poles, vertical bundles or as clumps. Tree-type willows and cottonwoods are normally selected for the upper bank and floodplain areas near the transition zone and can be planted as large poles or clumps.

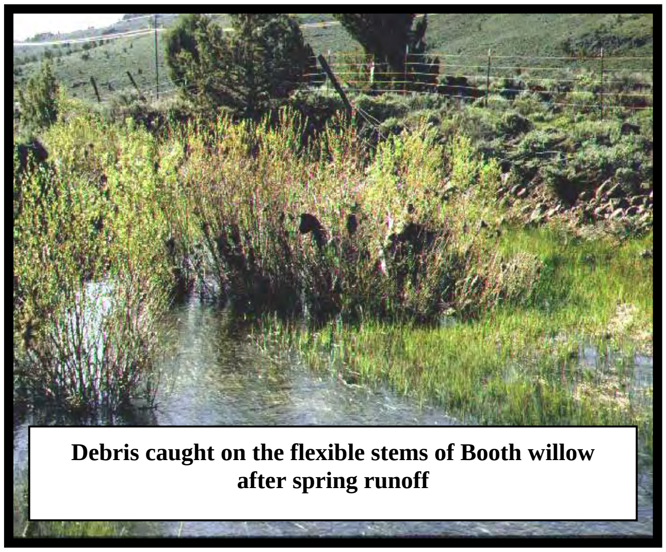
Mature size and growth form will affect species selection. Large species can partially block or deflect stream currents. If the mature basal size of the selected species will block streamflow near the main channel or on adjacent floodplains, another species with more flexible stems should be considered.

There are many species of willows that occur naturally in different habitats. Upland willow species are found in relatively dry areas not necessarily associated with seeps, bogs, or high water. Scouler willow, a common upland species, is rarely found on wet areas, but more commonly on or near moist areas such as springs or intermittent watercourses. Wetland willows are found growing in standing water or saturated conditions and are adapted to long periods of inundation.

If spreading of planted species is considered a problem, selection might include only male clones. Both willows and cottonwoods have male and female plants. Selecting male plants will reduce spreading from seeds.

More shade will be produced with tall and/or wide canopy species. This may be important for water temperatures and fish habitat. Consider the aspect. Concentrate on tree-type species with wide canopies on the south or east side of stream to achieve the most shade over the widest area.

Stem flexibility is important for species at the waterline to mid-bank on streams with high velocities, debris loads, and ice flows (Parsons 1963; Platts and Rinne 1985). Species with deep or rhizomatous root systems might be better suited to streams with severe ice flows (Platts and Rinne 1985).



Debris caught on the flexible stems of Booth willow after spring runoff

Livestock and wildlife can adversely impact the riparian zone. Some plant species such as willow, cottonwood, chokecherry, Skunkbush sumac, golden current, serviceberry, Syringa (mockorange), and silver buffaloberry are fairly palatable. It may be advantageous to plant less palatable species, such as hawthorn, in the bank to overbank zone rather than more palatable species. Other less palatable species include: Woods' rose, Douglas spirea, dogwood, river birch, thinleaf alder, and common snowberry.

Grazing can also reduce regeneration, particularly for those species that reproduce by seed. Species selection of strong suckering or rhizomatous species may be an advantage. Improper grazing management can adversely impact even these species. A grazing management plan is needed whenever riparian areas are grazed, especially after planting. The riparian area should not be grazed for at least 3 years after planting. At the end of 3 years, the area should be assessed for grazing potential and if allowed, be grazed according to a good grazing management plan. Spring grazing is the best because animals have many foraging choices other than the planted woody species. Be careful with fall grazing because woody species are a more desirable foraging choice and there will be no regrowth before the next spring growth period. Overgrazing the woody and herbaceous riparian species will result in less bank and floodplain protection during high runoff events the following spring. The woody riparian species should be used as the key indicator species for when the livestock should be moved out of the riparian zone.

Aesthetics can usually be improved by selecting more than one species to provide differences in size, shape, color, and texture. More than 1 species or clone also increases resistance to pests and diseases, in addition to increasing diversity for wildlife. However, the species planted at the waterline should be a single species so that all the cuttings have similar characteristics for the full length of any one reach so that varying sizes and shapes do not cause the force of water to move behind that planted line.

Most species of willow and cottonwood have good fire tolerance and resprout readily after being burned as long as the fire is not too hot. Many cottonwoods are more susceptible to fire as they mature. Other riparian species such as dogwood and chokecherry also have a high fire tolerance.

A riparian buffer with different species on Bear Creek, IA

There may be times when native species will not meet the landowners' objectives. Introduced species should only be considered in the revegetation plan after careful review of the native sources (more native species are available on the market all the time), landowner objectives, and disease and insect infestations. Refer to the Idaho Tree Planting Handbook, North Dakota Tree Handbook, and Riparian/Wetland Project Information Series No. 19 for plant characteristics.

Species Distribution or Planting Design

A planting design should be developed to show where each species is to be planted on the site. The entire problem section should be planted, not just parts of a reach or curve. This will reduce the chance of water eroding behind the planting.

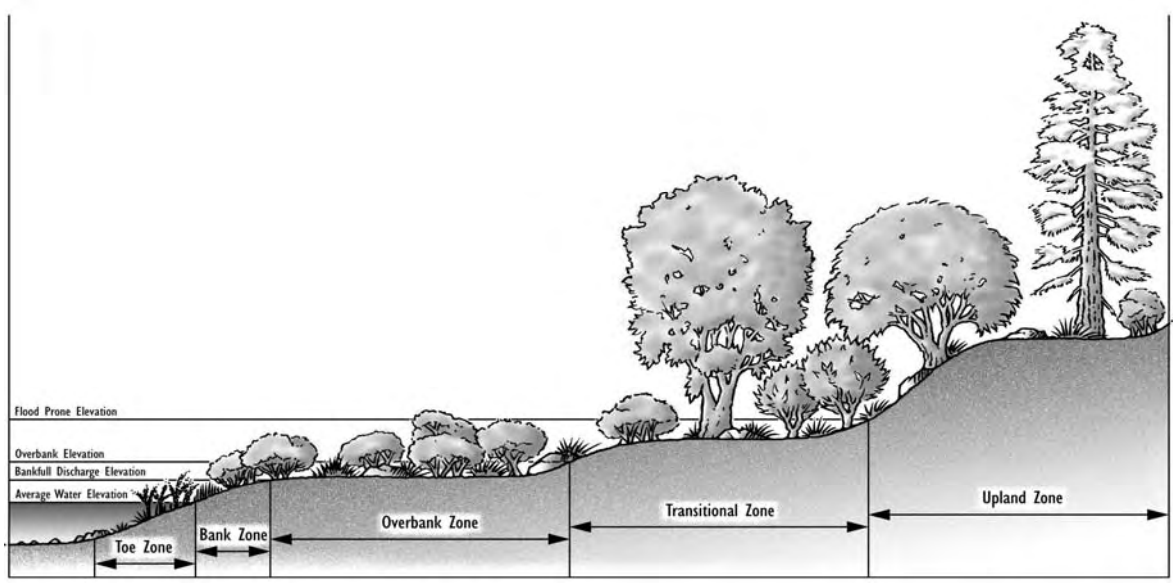


Figure 2: Riparian Planting Zones can be used to determine where riparian species should be planted in relation to the waterline. This is a general depiction of a riparian zone. Not all streams look like this one. In the real world, some of these zones may be absent. (From Hoag 2001, Hoag and Landis 1999)

Each species grows in specific ecological zones along the stream channel and flood plain (Carlson et al. 1992). These ecological zones can be equated to planting zones. Riparian planting zones (Hoag 2001) include the toe zone, bank zone, overbank zone, transitional zone and the upland zone (Figure 2).

Shrubby species are normally planted on outside curves of a stream channel as a continuous barrier. Outside curves incur more erosion from streamflow, but have a shorter inundation period. Plant the entire reach with the same mix of species. Shrubby species with flexible stems are planted on the bank zone and the overbank zone or floodplain for diversity and additional stabilization or as a buffer zone.

Plant tree species up the bank from the shrubby species or on top of the bank. The shrubby species provide protection for the tree species when planted in this manner.

The reconnaissance survey will help identify these relationships. See "Spacing" section to help with planting design and to help determine numbers of plants or cuttings needed.

Type of Planting Stock


Cuttings, whips, plugs, conetainers, bare-root, potted, clumps, balled and burlap, and paper-sleeved planting stock are all viable alternatives (Carlson et al. 1992; Dirr and Heuser 1987; Platts et al. 1987).

Advantages of nursery stock include: good potential root development, good carbohydrate reserves, few pest or disease problems, readily available for many species, and no labor is needed to collect the stock.

Disadvantages of nursery stock include: more expensive than hardwood cuttings collected near the revegetation site, short root systems can wash out easily, short root system may not reach moist soil during the growing season, and roots of local herbaceous vegetation are in the same zone competing for moisture and nutrients.

Stem cuttings

Stem cuttings can be divided into softwood, semi-hardwood (greenwood), and hardwood categories. Hardwood stem cuttings can also be divided into deciduous, narrowleaf evergreen, and broadleaf evergreen (Dirr and Heuser 1987). This Technical Note concentrates on deciduous hardwood cuttings from moderate age stem materials. Deciduous hardwood cuttings of willow and cottonwood species are generally recommended over other types of cuttings because of the high concentration of pre-formed,

dormant root primordia located throughout the length of the stems (Densmore and Zasada 1978; Carlson 1938, 1950; Haissig 1970, 1974).

Pole cuttings (large diameter unrooted stems) of shrub-type willows are recommended for most plantings from water line to mid-bank. Pole cuttings of tree-type willows and cottonwoods are recommended on upper-banks and floodplains where the water table is relatively deep. Pole cuttings provide an effective means to reach saturated soils and establish a high concentration of roots for that portion of the stem within the moist zone.

Pole cuttings have the additional advantage of being relatively inexpensive and easy to harvest and store. They are also easy to plant. High mortality can occasionally occur, but this is somewhat offset by lower cost, ability to rapidly plant large numbers, and ease of replanting the following year.

Generally, whips (less than 3/8 inch diameter) are not recommended because energy reserves in the stem are limited and they are more susceptible to cytospora canker, a fungus that causes twig dieback (Biggs et al. 1983; Briggs 1991).

Container stock

Plugs, conetainers, bare-root, potted, balled and burlap and paper-sleeve planting stock are best when used:

*mid-bank to upper-bank or floodplain where long periods of inundation or water erosion are minimized

*where adequate moisture is available -- i.e. natural precipitation or irrigation is adequate for species selected

*where there is no competing vegetation or a 30" diameter area around plant has the competing vegetation scalped off down to mineral soil at planting time

*where plants have a low risk of physically being pulled or eroded out due to shallow rooted systems during establishment

Source of Cuttings from Commercial Stock

Willows and cottonwoods have been used extensively for riparian rehabilitation because they are easily established from cuttings. Cuttings can sometimes be obtained from commercial nurseries or more commonly from native stands located near rehabilitation sites. When buying cuttings from commercial sources, released varieties of adapted species should always be specified when available.

PMCs conduct extensive research and testing with native willows and cottonwoods collected from service area states having similar climate, soils, and topography. Once a willow or cottonwood meets the testing criteria, it is released to the public. Commercial nurseries and growers then propagate the species on a much larger scale for sale. The released variety name is the key to getting a plant adapted to conditions similar to where it was tested. All named varieties have documentation that describes growth characteristics, performance, and selection criteria. This ensures they are the same stock as originally tested.

Plugs, conetainers, bare-root, potted, and paper-sleeved nursery stock purchased through nurseries should be established from local materials. This could be from a local ecotype or the same watershed, but should not be from more than 200 miles east or west or 100 miles north or south or more than 2000 feet elevation difference from planting site. Ask the nursery where the stock came from.

Source of Cuttings from Native Stands

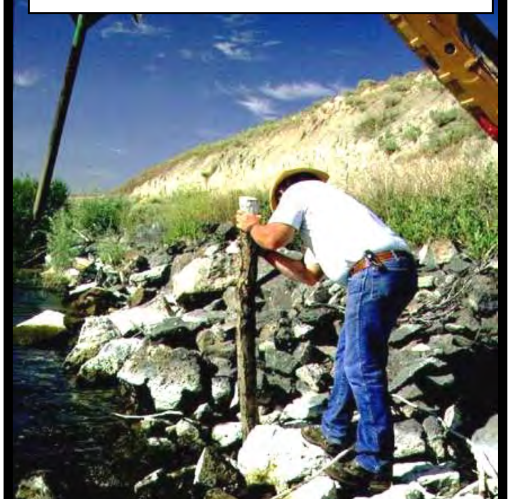
Native willow and cottonwood stands located near the rehabilitation site are the most common source of cuttings. Native stands of willow and cottonwood are adapted to local conditions, but may have or have had insect and disease infestations which can stress the plants in the potential "mother" stand. Low water years and long periods of drought may also stress the plants. This stress means that the stem cuttings may not have peak energy reserves. Low energy reserves translate into lower establishment success.

When planning the number of cuttings to harvest, take these stress indicators into account. Always obtain permission to harvest from the landowner, private or public, before starting to cut.

Timing of Harvest

Establishment success is significantly increased if cuttings are taken from live, dormant willows or cottonwoods either after leaf fall in late fall, winter, or very early spring before the buds start to break. Densmore and Zasada (1978) found that spring collections survived better than fall collections. However, studies in Idaho have found no such differences (Hoag 1991; Hoag et al. 1991; Hoag et al. 1992). See "Storage" section for procedures when harvesting well before the projected planting date.

Placing a large diameter willow pole into a hole created by The Stinger in rock riprap



In some cases, when access to the stream is limited due to regulatory concerns or during fish migration periods (i.e. during salmon migration runs in the spring and the fall), planting may be restricted to non-dormant periods. Rather than do nothing, consider harvesting the cuttings when the plants are in full leaf. When cuttings are harvested during these growth stages, expect the establishment success rate to decrease. Experiments at the Aberdeen Plant Materials Center have shown that when the plants are leafed out and harvested, the establishment success is about 40-50%. If you plan to plant during the active growing season consider planting more cuttings to make up for the lower success rate.

Cutting Diameter

Cuttings should generally be 3/4 inch diameter or larger depending upon the species (Briggs and Munda 1992; Hoag 1991; Hoag et al. 1991; Hoag et al. 1992; Fenchel et al. 1988).

Rhizomatous or spreading willow stems will rarely get much bigger than 3/4 inches in diameter. Tree-type willows can be several inches in diameter. Larger diameter cuttings have more energy and stored reserves than smaller diameter cuttings. Highest survival rates are obtained using cuttings 2 to 3 inches in diameter. Cuttings as large as 8 inches in diameter have been tested with excellent success (Carlson et al. 1991; Hoag et al. 1992). However, the larger the cutting diameter, the longer the cutting should be, and the deeper the hole should be to support it. The deciding factor for selecting the cutting diameter is the planting method you will use (see Planting Methods). Larger diameter and longer cuttings will be needed for more severely eroding sites and where the water table is deeper. When planting into rock riprap cuttings should be at least 3- 5 inches in diameter. Cuttings this size will not bend or break when pushed between the rocks in the riprap.

Cutting Length

Cutting length is largely determined by the depth to the mid-summer water table and erosive force of stream at the planting site (Briggs and Munda 1992; Fenchel et al. 1988; Hoag 1991; Hoag et al. 1991; Hoag et al. 1992). Plantings can occur at the water line, up the bank, and on top of bank in relatively dry soil, as long as cuttings are long enough to reach into the mid-summer water table. Make sure:

* 6-8 inches of cutting are in the mid-summer water table

* 3-4 buds are above the ground

* No less than 1/2 the total length is in the ground

* If long periods of inundation exceeding 30 days are likely, cuttings should be long enough to extend 6-12 inches above the expected high water level

* If weeds are a problem, the cutting should extend above herbaceous growth in summer to receive adequate light and below the weed root mass to minimize competition (Hoag et al. 1991; Platts et al. 1987)

When planting for bank stabilization, the cutting should extend 2-3 feet above ground so as it leafs out, it can provide immediate bank erosion protection. The cutting should be planted as much as 3-5 feet into the ground (sometimes deeper to ensure they are in the mid- summer water table). If they are not planted this deep, moving water can erode around cutting and rip it out of the ground. Tests have shown that even with established root systems as long as 15-28 feet, the erosive power of a stream can rip a short cutting out of the ground (Hoag 1991; Hoag et al. 1991; Hoag et al. 1992).

Boyd Simonson standing next to coyote willow cuttings that were 20 ft long

Harvesting Cuttings

Once cutting size and source locations have been determined, the actual cutting process can begin. Lopping shears, pruning shears, a small wood saw, brush cutters, or a chain saw can be used to harvest cuttings. Size of the cuttings will determine what you use to harvest them.

* Ensure all equipment is sharp and make clean cuts.

* Use live wood at least 2 year old or older. However, very old wood should not be used (Briggs and Munda 1992; Fenchel et al. 1988). Chmelar (1974) indicated that larger and older wood is required to propagate species that are difficult to root. The best wood is 2-7 years old with smooth bark which is not split or deeply furrowed.

* Avoid whips and suckers (current year's growth) because they lack the stored energy reserves necessary to consistently sprout when planted especially in dry conditions.

* No more than 1/3 of any individual plant should be removed. In the case of rhizomatous species, no more than 40-50% of the stand should be removed.

* Select branches which will not impair the source willows health and appearance.

* When harvesting from native stands, ensure the stand will not be denuded or destroyed by your cutting activity.

* Consider removing cuttings from inside the crown area rather than the more visually obvious exterior area. Try to spread your harvesting activity throughout the stand.

* Remove the apical bud plus several inches off of the cutting. The apical bud (bud at the tip of the branch) draws too much energy from stored reserves, reducing the chance of survival. Its removal will reroute energy to the side buds including the root buds. The upper part of the

stem also has the flowering parts (Kay and Chadde 1992). By cutting it off, energy is also redirected to the root and branch primordia in the older parts of stem.

* Trim off all side branches so cutting is a single stem.

* A processing consideration is to cut the top of cutting with a horizontal cut and bottom of cutting with a 45 degree cut. This allows quick recognition of cutting top (see also Sealing Harvested Cuttings).

* Care should be taken to select materials free of splitting, disease, and insect damage.

Painting Harvested Cuttings

One of the most important steps in this process is the identification of the **TOP** of the cutting. If cutting is planted upside down, significant mortality can occur. To identify which end is the top of cutting, look at the leaf scar and emerging buds. Buds emerging from leaf scar always point up. In addition, the stem is usually smaller diameter near top of cutting, but this is not always obvious. The leaf scars are the most reliable key.

When the top of cutting has been identified, it can be painted. Dipping the **TOP** 1-2 inches of cutting into a 50:50 percent mix of light colored latex paint and water, does a number of things. Perhaps the best reason for painting the top of cuttings is it helps inexperienced planting crews plant cuttings properly, with the top up! It also helps locate the cuttings more easily for future planting evaluations. It may also prevent excessive transpiration of water from cutting (the literature is mixed on this point, but Aberdeen Plant Materials Center research shows a higher establishment rate can be expected) This technique is inexpensive, easy, and effective.

Painting the tops of willow cuttings

Storage

The preferred timing for harvesting willow and cottonwood cuttings is when they are dormant. To minimize storage time, harvest cuttings in late winter to early spring and plant immediately when possible. If this is not possible, cuttings can be harvested in late fall or winter and stored in a large cooler at 33-40°F until just before planting. Cuttings can be stored for 3-4 months in a cooler. In Illinois, cuttings are stacked outside and covered with snow until they are planted in the spring (personal communication, D. Roseboom, Illinois State Water Survey, 1993). Whether cuttings are kept in a cooler, root cellar, garage, or shop floor, make sure the storage area is dark, moist, and cool at all times. If cuttings are stored at higher temperatures, a fungicide should be applied to prevent damage caused by pathogens or saprophytes (personal communication, D. Darris, Corvallis PMC, 1993).

Treatment of Cuttings

Testing at Aberdeen PMC using fertilization, treatments with rooting hormone, or treatments with a fungicide have not significantly affected the rooting or establishment of willow and cottonwood cuttings (Hoag 1991; Hoag et al. 1991; Hoag et al. 1992; Fenchel et al. 1988; Ogle 1990). Many willows and cottonwoods are very easy to root without special treatment. These treatments increase cost, labor requirements, and time necessary to plant without significantly increasing survival.

Pre-plant Soaking of Cuttings

Soaking the cuttings prior to planting will increased survival in addition to root and shoot production. Pre-soaking improves stem water content and early root and shoot initiation (Phipps et al 1983; Schaff et al 2002). Phipps et al (1983) indicated that pre-soaking in water is beneficial under hot, dry conditions that induce high moisture stress. The increased water content from pre-soaking allows the cuttings to cope with planting in dry conditions by delaying desiccation and loss of cell turgor (Schaff et al 2002). Pre-soaking that results in early root and shoot formation can also extend the growing period during the establishment year, which is important when establishing plants in colder climates (Phipps et al 1983). Soaking is important because it initiates root growth processes within the inner layer of bark in willows and cottonwoods.

Soaking willow poles in a small pond prior to planting

Prior to planting, all cuttings should be soaked for a minimum of 24 hours (Hoag 1991; Hoag et al. 1991; Hoag et al. 1992). Some research recommends soaking the cuttings for as long as 10-14 days (Briggs and Munda 1992; Fenchel et al. 1988). The main criterion is that cuttings should be removed from water prior to root emergence from the bark. This normally takes 14 days or longer depending upon species (Peterson and Phipps 1976).

The entire cutting should be covered with water. Any part of cutting that is exposed will start sprouting as the soaking date comes closer to bud break. Soaking can be accomplished in a garbage can, irrigation ditch, stream, pond, lake, or other body of water that is deep enough as long as the cuttings are protected from sun and wind exposure during the soaking process. Soaking significantly increases the survival rate of the cuttings (Briggs and Munda 1992; Fenchel et al. 1988; Hoag 1991; Hoag et al. 1991; Hoag et al. 1992; Peterson and Phipps 1976).

Spacing Considerations

Plant cuttings about 1-3 feet apart for creeping-types, 3-8 feet apart for shrub-types and about 8-16 feet apart for tree-types. In areas where you expect erosion, plant creeping-types 1-2 feet apart to ensure better protection of the banks. If the holes are large enough, multiple stems can be planted together. Exact spacing between tree-types further up the bank in the transition zone and creeping or shrub-types in the bank or overbank zone should be based on crown characteristics and height. General ideas on spacing can be found in Idaho Plant Materials Technical Note No. 43: *Tree Planting Care and Management* (Stange et al 2002). However, crowding cuttings a little will not stress them because they will not lack for water when planted into the mid-season water table and more dense plantings will provide better protection to the bank.

When to Plant

Willow and cottonwood cuttings have been successfully planted from early spring to late fall (dormant plantings).

* Preferably, cuttings should be planted in early spring after spring runoff occurs in streams or after high water drops to typical levels on reservoirs, ponds, or lakes.

* Rooted stock should be planted in early spring after frost has left soil. See Idaho Plant Materials Technical Note No. 43 for additional information. Avoid planting cuttings or rooted stock during the heat of summer because of the stress it places on them.

* When planting multiple sites along a stream, sites may need to be planted in different years.

* Consideration should be given to planting outside curves first and allowing time for establishment. Delay planting the inside curve until two or three years later. The inside curve is often not eroding and will begin to heal without planting. In addition, if the inside curve becomes established prior to the outside meander; there is a good chance that the stream current will be pushed into the eroding outside meander. This will increase the stress on the outside meander and make establishing woody riparian species more difficult.

Planting Methods and Planting

Cuttings

Bobcat with auger attachment, Parker, AZ

Backhoes, excavators, tractor-mounted posthole diggers, one- or two-person posthole diggers, soil augers, planting bars, shovels, soil probes, The Stinger, the waterjet stinger, or simply pushing the cutting into moist soil have all been used successfully to plant willow and cottonwood cuttings. When selecting the appropriate planting method, you should keep several things in mind.

* It is essential to have good contact between cutting and soil for roots to sprout. Air pockets around the cutting will kill the roots.

* Additional soil may be needed to ensure good soil to stem contact. Preference should be given to native soil nearby to encourage mycorrhizal formation and/or nodule formation by nitrogen-fixing organisms.

* Mud the cuttings in after they are placed in the hole. Use a bucket and mix soil and water together to get the consistency of cheap syrup. Pour the mix into the hole around the cutting until it reaches the surface. As the water leaches into the surrounding soil, the soil will settle out around the cutting and will ensure good soil to stem contact.

* The planting depth will determine the planting method. Deeper holes will be easier if you use a power auger, The Stinger, the waterjet stinger, or a soil auger.

* Experimentation with planting methods before starting will ensure the right equipment has been selected. This would also be a good time to train the planting crew on use of equipment, safety and planting techniques.

The Stinger planting tree-type willows on the Snake River near American Falls, ID

The Stinger is a 3.5 in diameter bar of cold rolled steel that is attached to a backhoe or excavator in place of the bucket. It is used to retrofit rock riprap with willows and cottonwoods.

For more information, see Idaho Plant Materials Technical Note 6: *The Stinger, a tool to plant unrooted hardwood cuttings of willow and cottonwood species for riparian or shoreline erosion control or rehabilitation* (Hoag and Ogle 1994).

The Waterjet Stinger used for planting willow poles on Fox Creek, Driggs, ID. The pump is riding on a small raft with the suction hose in the water.

The waterjet stinger is a hydrodrill that uses high pressure water to drill a hole in the streambank. This tool is composed of a high pressure water pump with 2 probes that have stainless steel nozzles that increase the water pressure so it comes out the holes in the nozzle at 80 psi. When the nozzle is placed on the streambank, the water liquefies the soil and cuts a hole as it goes down. The soil is in solution with the water. When the hole is deep enough, the probe is removed and an unrooted willow or cottonwood pole is inserted into the hole. As the water and soil solution settles, the water moves into the soil profile and the soil settles out around the cutting eliminating air pockets that might form around the cuttings resulting in excellent stem to soil contact. Complete information on how to build a waterjet stinger and it's use can be found in Idaho Plant

Materials Technical Note 39: *Waterjet Stinger, A tool to plant dormant unrooted cuttings of willows, cottonwoods, dogwoods, and other species* (Hoag et al 2001).

Clump Planting

Clump plantings can be used in areas where heavy runoff occurs or where the water column directly impacts vertical banks. See Idaho Plant Materials Technical Note 42: *Planting Willow Clumps* (Hoag 2003) for more information. These areas are difficult to plant and establish with traditional methods.

* The basic procedure is to locate clumps of willows that are accessible to a backhoe.

* The backhoe digs up a clump of willows, travels back to the planting site, and places the willow clump in a predetermined location by pushing out a hole as it deposits the clump.

* Clumps are then placed close together along the entire problem section of stream to keep water from cutting around the planting. Pulling or pushing soil from the streambank above willow clumps and packing it behind clumps will improve establishment success and assist in bank shaping.

* Sod of rhizomatous grass and grass- like species can be placed behind the willow clumps to speed up recovery time of the mid to upper banks. Some minor bank shaping will improve establishment of the herbaceous material. Grass species can also be seeded by hand.

Willow clump harvest, Fox Creek, Driggs, ID

* Planting should be completed following high water flows in the spring to reduce chance of ripping clumps out before the clumps are well rooted and start to spread.

* Temporary protection, such as steel posts with woven wire, sunlight degradable netting, etc., may be necessary to hold willow clumps in place until they are well established which may take 1-3 years. Usually, this is only necessary in areas were high velocities impact the bank.

Other Planting Stock

See Idaho Plant Materials Technical Note No. 43: *Tree Planting Care and Management* (Stange et al 2002) for information on planting nursery stock.

Permits

The landowner is responsible for all permits prior to any planting. The completed plan should be copied as needed and provided to the landowner for submission to the state Department of Water Resources and/or US Army Corps of Engineers. Each state has specific permitting requirements and the landowner is responsible for locating the appropriate agency. Normally any work done in a stream channel requires notification and approval by these agencies and the issuance of permits before work can begin.

Management and Maintenance

Preserve or initiate management that will keep, maintain, and improve the planting and other riparian vegetation. Proper management is necessary to maintain healthy, competitive plants that function for the intended objectives. This is as important as the planting itself to ensure long- term rehabilitation of the riparian area. Some maintenance will be needed on site for several years after planting. Vegetation should be evaluated and monitored annually. Some replanting will be needed in succeeding years. If you don't replant the first or second year, your continuous barrier could be jeopardized. Once water gets behind the protected line you have planted, it is extremely difficult to repair the damage.

Monitoring the site is necessary so any in-stream dead organic material (i.e. old logs, dead root masses, branches, etc.) can be removed before stream flow is deflected or gravel bars form. It is much easier to prevent this kind of damage than it is to repair it. As the planting ages and plants start to develop their growth form, some may need to be trimmed or cut to stimulate smaller and denser growth. Trimming should be done in the dormant season so willow growth is not slowed during the growing season. During the establishment period, leave standing dead branches in the clump plantings to reduce stream flow velocities, thus protecting the establishing clumps.


Restoration project on Targhee Creek, a tributary of Henry’s Lake near the Montana/Idaho border - project was installed in 1998 and this picture was taken in 2000

If livestock use the area, a prescribed grazing plan should be developed. Little to no grazing should occur during the establishment period. This can take 2-5 years depending on growing conditions. Larger planting stock may be more resistant to grazing pressure, but should be monitored closely to avoid serious damage.

Temporary fencing may be necessary to control livestock and wildlife use of the planting during the establishment period. Permanent fencing is an option to prevent grazing by livestock and/or wildlife. Consideration should be given to the creation of "riparian pastures", i.e. grazing units that include riparian zones and floodplains as a majority of the pasture. These riparian pastures increase management flexibility but often require increased maintenance as a result of heavy grazing pressure from both livestock and wildlife. Water gaps to allow livestock access to the stream when necessary should be planned in transition sections between meanders. Off site water may be a better choice in terms of protecting the riparian buffer, increased calf gains, and better overall herd health. These areas have reduced erosion potential, are generally gravelly, and can be planted to a rhizomatous willow that will resprout easily. Access to water gaps can also be protected with gravel or concrete pads if heavy trampling problems arise.

Finally it is critical to protect streambanks and plantings from continuous use during long winter feeding periods. Feed grounds should be located away from streamside areas. If this is not possible, the area should be fenced and water gaps or off-site water provided so direct access to riparian corridor is controlled and potential pollutants can be filtered prior to overland surface waters enter the stream.

Additional information and more technical papers

Visit http://www.plant-materials.nrcs.usda.gov/idpmc/riparian.html for additional information on a variety of riparian and wetland plants and planting techniques.

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Riparian/Wetland Project Information Series No. 21
May 2007

Wetland Plants: Their Function, Adaptation and Relationship to Water Levels

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Introduction

Wetlands display a wide range of hydrologic conditions, ranging from permanent inundation to merely soil saturation for at least some portion of the growing season. This hydrologic regime produces a reducing environment characterized by the absence of free oxygen within the soil profile. The resulting soils are called “hydric soils”.

Wetland plants (also called hydrophytes) are specifically adapted to reducing conditions in the soil and can; therefore, survive in wetlands. These adaptations can be morphological, reproductive, or physiological and are characteristic of many wetland species. Conversely, species without these special adaptations (i.e., "upland" plants), are intolerant of the absence of oxygen in the soil profile and may not survive under these conditions.

Adaptations to low soil oxygen characterize many wetland species. This is done by a variety of means. Perhaps most prominent is the development of aerenchymous tissue found in many herbaceous wetland species. This tissue is filled with large, connected intercellular spaces allowing free gas flow through the tissues, thus effectively overcoming the reduced environment and allowing rhizomes and roots to be supplied with oxygen. Wetlands and riparian species must also be adapted to the harsh physical conditions presented by the constant movement and fluctuation of water. Some species have evolved with flexible stems and leaves, while others have developed extensive spreading root systems.

Wetland and riparian species are essential to healthy ecosystems, and each species provides specific functions beneficial to the system and to man, and wetland and riparian areas should be designed and managed to incorporate all of these functions. By absorbing the force of strong winds, fluctuating water levels, abating flood peaks, and preventing shoreline erosion, wetlands, and the plants growing in them, protect terrestrial areas from storm and flood damage. The plants in wetlands help to filter chemical and particulate pollutants, and trap sediment in the water column. The trapped sediment gradually develops into mud flats, sand bars, or gradually fill-in creating habitat and food web support for a wide range of organisms. All of these functions add to the stability and health of the wetland and provide useful benefits to the flora and fauna of the wetland and surrounding ecosystems.

Many hydrophytes produce visual clues as to their affinity for wetlands; however, few provide clues to indicate their tolerance to water depths and duration of soil saturation within which they can survive. The US Fish & Wildlife Service has produced a reference on hydrophytes (*National List of Vascular Plant Species that Occur in Wetlands*, http://www.fws.gov/nwi/bha/list88.html) which provides information on a species' frequency of occurrence in wetlands. Caution is raised in using this document since a "frequency of occurrence" is not the same as a "tolerance of depth and duration" of hydrology. The "frequency" information within this document is commonly misconstrued for depth and duration. The primary way of knowing a species' tolerance to wetland condition, including depth & duration, is by knowing the individual tolerances for each species. The remainder of this document contains information on individual species as to the hydrologic conditions where they commonly occur. With this information it will be easier to select species for restoration activities or to identify the hydrologic condition of an area during dryer portions of the year.

This publication is designed to elucidate some of the commonly found wetland and riparian plant types and their relationship to water levels. A typical wetland or riparian zone can be broken into four hydrologic regimes: the area of short-term saturation, the area of long-term saturation, the draw down zone, and the permanently flooded region (figure 1). This figure indicates optimal moisture conditions, although local conditions are the best benchmarks for design. Because of ever-changing water levels these zones are often indistinct and may have broad reaches of transition or overlap. The area of short-term saturation is typically dry but may receive short periods of inundation. Plants in this zone must be both flood tolerant and drought tolerant to survive possible long stretches with or without available water. The long term saturation zone sits above the ordinary high water mark but receives ample water from capillary action through the soil as well as from periodic flooding. This area can, on occasion, be flooded for long periods of time and face high flood water energies, so the plant species found here may have special adaptations such as flexible stems (e.g. coyote willow) or aerenchymous tissues (Nebraska sedge). The draw down zone is the region between the ordinary high and low water marks. Draw down zone water levels are high generally after spring runoff and then drop over the summer as the water soaks into the ground, moves off the site, or is lost to evapotranspiration. This area is frequently flooded or may also be dry for long periods. Plants in this region are suited to withstand sustained periods of inundation, frequently changing water levels and floating debris. The permanently flooded region is, as its name suggests, permanently flooded in the course of an average water year. Plants in this region can be either free floating (duckweed), rooted to the bottom with leaves floating on the surface (lotus) or rooted to the bottom with the vegetation fully submerged in the water column (coontail).

This paper is divided into four sections describing groups of morphologically similar plants that may be encountered within each of the water depth zones. These sections are as follows: 1) emergent plants including dense rhizomatous, shallow water perennials, deep water perennials, bunch-type perennials, broad leafed rhizomatous, emergent woody plants and riparian trees and shrubs; 2) Floating leafed aquatics; 3) submerged aquatics; and 4) free floating aquatics. Again, zones may, and often do, overlap, so species will frequently be found in more than one zone. Also, the plants cited within this paper are examples only. The lists are by no means meant to be exhaustive.

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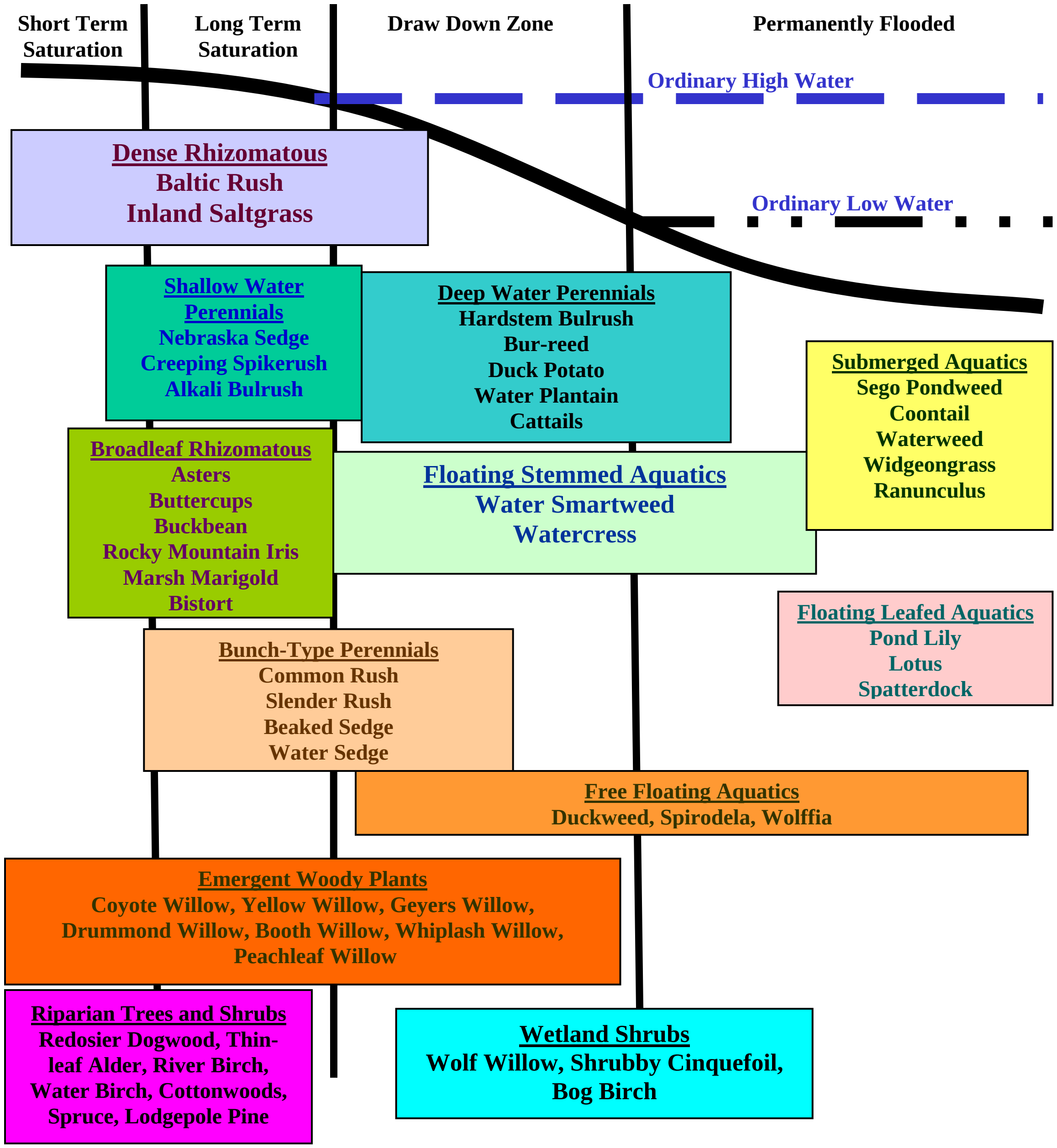


Figure 1: This is a graphic representation of different plant types and their relationship to water depths.

Emergent Plants

1. Dense Rhizomatous

- Found in seasonally saturated areas (prefer soil that is saturated early in the season but later dry out)
- Perennials with heavy, dense rhizomes
- Reproduce by seed and underground rhizome runners
- Spread mainly by rhizomes
- Dense monotypic stands
- Can be quite drought tolerant
- Found at water's edge and even in wet depressions in upland areas
- Examples – Baltic Rush *(Juncus balticus)*, Reed Canarygrass *(Phalaris arundinacea)*, Tufted Hairgrass *(Deschampsia caespitosa)*, Redtop *(Agrostis stolonifera)*, Inland Saltgrass *(Distichlis spicata)*

2. Shallow Water Perennials

- Shoots from rhizomes are produced throughout the growing season and into late fall
- Require annual draw down or maximum water depths of 6 inches during most of the growing season
- In water depths that remain at a one foot or more, they will persist for sometime, but eventually disappear
- Considerable variation in hydrologic regimes tolerated by these species
- Thick root mass that is resistant to compaction, erosion, and herbivory.
- Can survive periods where the water table is more than 1 m below the surface
- In riparian areas found on fringe between upland and wetland in toe zone
- Also found in marshy habitats in standing water
- Examples – Threesquare Bulrush *(Scirpus pungens)*, Creeping Spikerush *(Eleocharis palustris)*, Nebraska Sedge *(Carex nebrascensis*), Alkali Bulrush (Scirpus maritimus)

3. Deep Water Perennials

- Require annual draw down or maximum water depths of 12-18 inches during majority of growing season
- They will persist for sometime in water depths up to 3 feet, but eventually will disappear
- They will grow and spread much faster in fluctuating water depths
- Examples – Hardstem Bulrush *(Schoenoplectus acutus* var. *acutus),* Softstem Bulrush *(Schoenoplectus tabernaemontani),* Cattails *(Typha* sp.*),* Bur-reed *(Sparganium* sp.*),* Duck Potato (*Sagittaria latifolia)* , American Water Plantain (*Alisma subcordatum)*

Hardstem Bulrush

Common Cattail

4. Bunch-Type (Caespitose) Perennials

- Prefer flooding in the early portion of the season. Can grow in shallow standing water, but can withstand long dry periods.
- Plants grow in tight clumps forming characteristic mounds or "hummocks"
- Species found in saturated soils and upper draw down zones
- Intolerant of long term inundation
- Examples – Common Rush *(Juncus effusus),* Western rush (*Juncus occidentalis*), Beaked Sedge *(*Carex *rostrata),* Water Sedge (*Carex aquatilis)*

5. Broad Leafed Rhizomatous

- Prefers seasonally flooded areas that dry out later in the year.
- Tolerant of short lived inundation
- Usually rhizomatous
- Monotypic stands in saturated soils
- Spectacular show of wild flower colors
- Attract pollinators which provide food for fish, birds and other larger animals
- Examples – Asters *(Aster* sp.*)*, Rocky Mountain Iris *(Iris missouriensis)*, *Yellow* Marsh Marigold *(Caltha palustris)*, Meadow Bistort *(Polygonum bistorta)*, Buttercups *(Ranunculus sp.)*

Yellow Marsh Marigold

Meadow Bistort

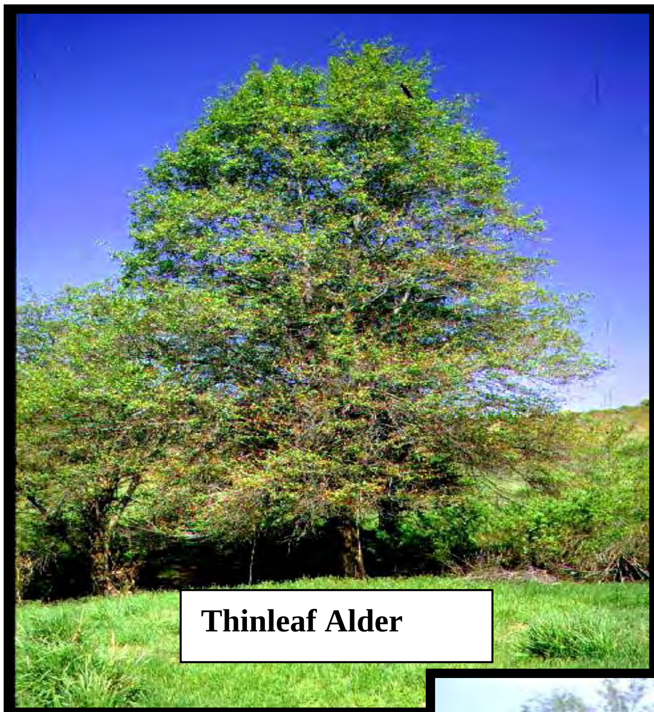
Rocky Mountain Iris

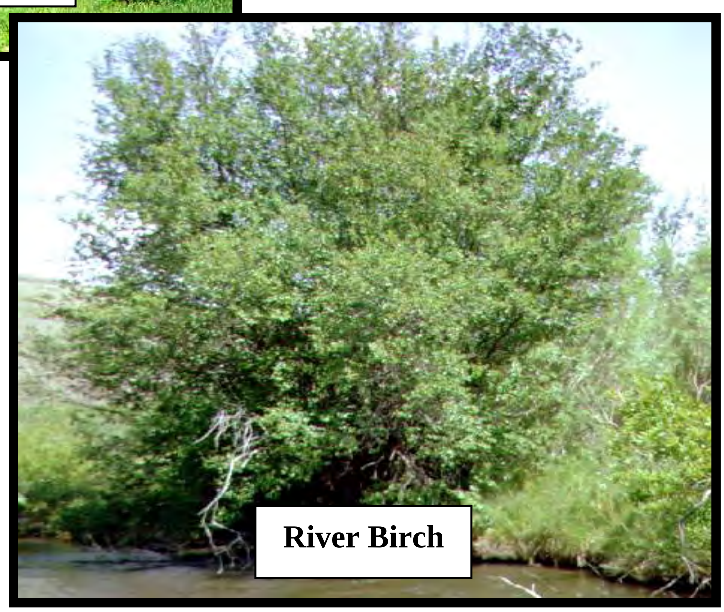
6. *Emergent Woody Plants*

- Tolerant of long to permanent inundation; Some species had withstand deep water for 4-6 months and sprout when their tops are finally exposed
- Produce adventitious roots to aid in obtaining oxygen for the water column
- Generally found in upper portions of the zone
- Useful for stabilizing streambanks due to spreading nature and numerous flexible stems that reduce water flow energies in flood situations
- Examples – Coyote Willow *(Salix exigua)*, Yellow W*illow (Salix lutea)*, Geyers Willow *(Salix geyeriana)*, Drummond Willow *(Salix drummondiana)*, Booth Willow *(Salix boothii)*, Peachleaf Willow *(Salix amygdaloides)*

7. Riparian Trees and Shrubs

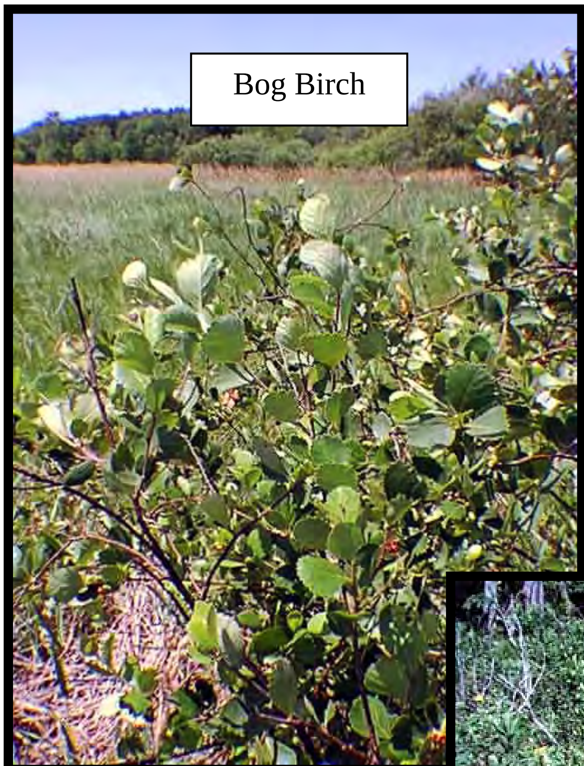
- Tolerant of short term, seasonal inundation and soil saturation
- Do not survive long term inundation or permanent soil saturation
- Have large deep growing root systems
- Provide shade and organic matter to the ecosystem
- Important for a wide variety of wildlife species in terms of habitat nesting, roosting,
- Examples – Redosier Dogwood *(Cornus sericea)*, Thinleaf Alder *(Alnus incana)*, River Birch *(Betula nigra)*, Cottonwoods *(Populus sp.)*, Spruce (*Picea* sp.*)*, Elderberry *(Sambucus* sp.*)*, Chokecherry *(Prunus virginiana)*, Hawthorn *(Crataegus* sp.*)*, Lodgepole Pine *(Pinus contorta)*





8. Wetland Shrubs

- Tolerant of soggy or marshy conditions most of the year
- Can be excessively wet in the winter, spring, and after heavy rain, but often is dry in the summer
- Generally wet, neutral to calcareous soils in the shrubby margins of bogs and wooded swamps
- Problems with over-shading by other woody species as a result of succession
- Forms dense colonies at the margins of fens and neutral bogs
- Examples - Wolf Willow *(Salix wolfii),* Shrubby Cinquefoil *(Dasiphora fruticosa* ssp. *floribunda),* Bog Birch *(Betula pumila)*



Floating Leaves

1. Floating Leafed Aquatics

- Structured to reach higher points and receive more sunlight
- Plants rooted in deeper water and send their leaves to the surface where they float
- Leaves are filled with aerenchyma to allow them to float on the water surface and to carry gasses to the roots below
- All stomata are found in the upper epidermis of the leaves since the lower portion is always submerged
- No photosynthetic structures in the water column
- Leaves tend to be broader without major lobing; remain flat on the surface; maximize surface area and make use of full sunlight
- Chloroplasts found on the top of leaves
- Usually rhizomatous
- Examples – Fragrant Water Lily *(Nymphaea odorata),* American Lotus *(Nelumbo lutea),* Spatterdock *(Nuphar luteum),* Floating Pondweed *(Potamogeton natans)*

American Lotus

<u>Submerged</u>

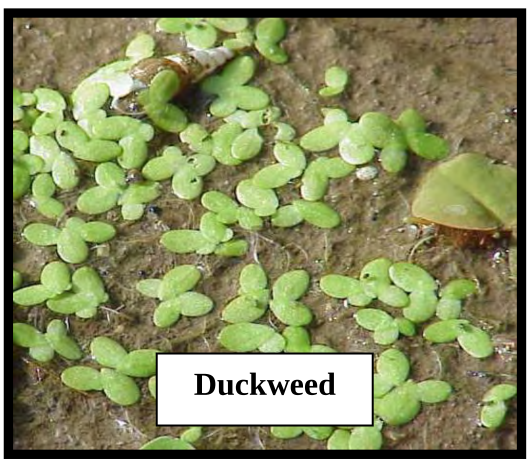
1. ***Submerged Aquatics***

- Typically found in deep water (3 feet plus) that never or rarely draw down
- Submersed leaves receive low levels of sunlight because light energy diminishes rapidly while passing through a water column
- Rooted in the bottom, tops float in the water. Air spaces within the tissues to keep the plant buoyant so that its leaves can reach the top of the pond, maximizing the amount of sunlight received
- Can form dense stands or mats underwater
- Examples – Sago Pondweed (*Stuckenia pectinata)*, Coontail (*Ceratophyllum demersum)*, Waterweed *(Elodea canadensis)*, Widgeon Grass (*Ruppia maritime)*

<u>**Free Floating**</u>

1. *Free Floating Aquatics*

- These plants are very simple, lacking a stem or leaves, but consisting of a small blade-like structure floating on or just under the water surface, with or without simple rootlets
- Reproduction is mostly by budding
- The fruit is a *utricle,* a sac containing air and a seed designed to float
- Hair on its leaves trap air
- The plants can provide nitrate removal (if cropped) and cover for fry
- The plants are used as shelter by pond water species, such as bullfrogs and bluegills
- The duckweeds are important in the process of bioremediation because they grow rapidly, absorbing excess mineral nutrients, particularly nitrogen and phosphates. A cover of duckweed will reduce evaporation of water compared to an open surface
- Roots hang down into the water column and are not connected to the bottom
- All the nutrients come from the water column
- Generally very small in size
- Examples – Common duckweed *(Lemna minor),* Giant Duckweed *(Spirodela polyrrhiza)*



Riparian/Wetland Project Information Series No. 22
June 2007

How to Manipulate Water in a New, Restored, or Enhanced Wetland to Encourage Wetland Plant Establishment

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Factors affecting plant species distribution

Wetlands are dynamic ecosystems which are highly dependent upon disturbance and changing conditions. Hydrology is perhaps the most important factor in determining wetland type and quality, and it is usually the "easiest" to manage or manipulate. Changes in water levels influence species composition, structure, and distribution of plant communities. Wetland vegetation is primarily limited by hydrology. Water limits the diffusion of oxygen to buried seeds and root zones, which restricts germination and growth of most species. Wetland plants differ from terrestrial plants by having vigorous morphological and physiological mechanisms that enable them to tolerate inundation of their roots. Different species tolerate longer inundation than others. Too much water, especially during the growing season, will stress the plants which will limit growth and establishment. Complete inundation of most plant species, even wetland plant species, can be lethal. Therefore, it is very important to be able to ensure that the site will have enough water in the right place at the right time of year to support the plant species targeted for the planting area.

It should be noted that young plants that are just developing from seeds or plant fragments do not have the same flood-tolerance as mature plants of the same species. Young plants are very susceptible to complete inundation, particularly during the growing season. Establishment success of herbaceous emergents, shrubs and trees is often increased if water levels are controlled the first one or two years to allow only short flooding periods and saturated substrates.

The plant species themselves are good indicators of conditions on the site. They can help you determine the frequency and duration of inundation and help you determine soil conditions and potential planting plans by mapping or reading the plant distribution. It is important to note that the different growth forms of the pants indicate conditions over time. As one would assume, tree life spans are longer than herbaceous species. Often conditions under which a tree species was established may have changed over time, where as short-lived species are more likely to reflect recent conditions. If there is a difference between the environmental tolerance ranges between herbaceous species and tree species, this could indicate a change has occurred at the project site.

Water quality is another factor that determines where different wetland plant species will establish. Water quality factors, such as nutrients, pH, alkalinity, turbidity, salinity, and toxins are important to consider when developing your planting plan. Since most wetland plants acquire their nutrients from the soil, water quality is more important when considering floating leafed wetland species which acquire nutrients from the water column itself.

Understanding the soils in a wetland site is crucial to the success of a planting project. Look at whether there is a stable rooting layer to an adequate depth for the target plant species. Soil texture interacts with the hydrology and ground surface slope to determine the drainage capacities of the site. This will affect the period of inundation. The soils also provide the nutrients necessary for growth and maintenance.

The root penetration depth can be used to determine where to plant different plant species. Identify if an impenetrable layer (i.e. clay, calcic, gravel, or rock) is located on the project site. Remember, rooting depths differ by plant species. Generally, most fine roots that absorb nutrients are in the top foot of soil. It the layer is deeper than one ft, rooting depth is not a problem for herbaceous species and shrubs. Trees, however, will require soils that are much deeper for increased stability against wind and currents.

Besides determining what species will grow on a site based on rooting depth, the impenetrable layer will also affect drainage on the site. It can help in some cases because it will maintain the wetland conditions. If, however, the layer can create undesirable standing water conditions, the layer will need to be broken up or the planting moved to a more appropriate location.

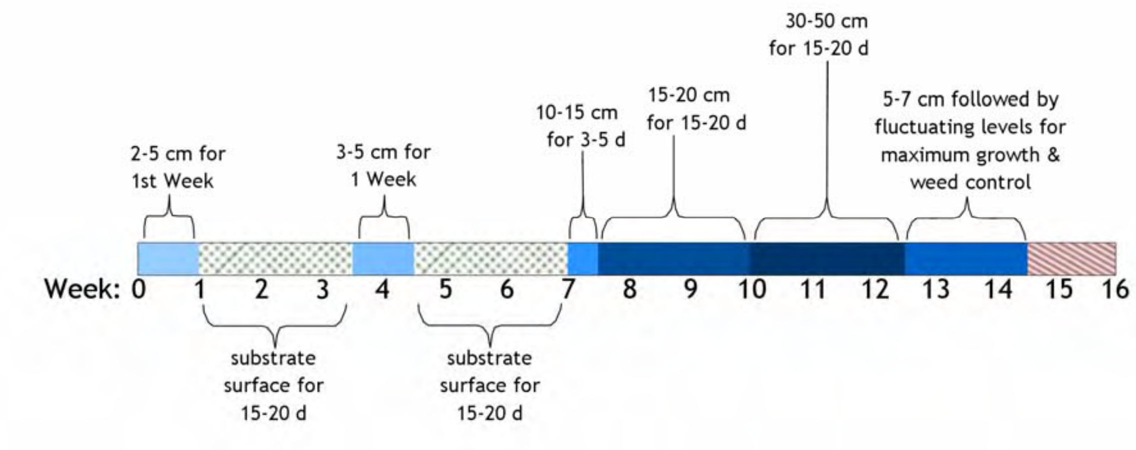
Water management is absolutely critical during plant establishment, and remains crucial throughout the life of the wetland for proper community management. When designing a wetland project, make sure that the design engineers thoroughly understand the importance of water control to the establishment, management, and overall function of the vegetation in the wetland system. If hydrologic control is not built into the system from the start, plant establishment may be severely inhibited, and opportunities for future plant community management will be handicapped. Ideally, you should be able to control the amount of water coming in and going out of the system.

Here is a simple chart to help determine what water depths common wetland plant species need:

Plant Growth Form	**Average Water Depth (in.)**
Submergents (e.g. pondweeds, elodea, milfoil, etc.)	**>36**
Floating Leaved (e.g. lotus, water lily, spatterdock)	**18-120**
Herbaceous emergents (e.g. bulrush, spikerushes, cattails, etc)	**0-36**
Shrubs (e.g. willows, dogwood, buttonbush, etc) Note: water should be around the shrubs no longer than 3-4 months MAX	**0-8**
Trees (e.g. willows, cottonwood, sycamore, etc) Note: water should be around the shrubs no longer than 3-4 months MAX	**0-8**

Water manipulation schedule

After the initial planting of emergent vegetation, be careful not to raise the water level to more than 2- 3 cm (about 1 in.) above the substrate. Too much water during the initial establishment of new plants will result in severe stress to the new plants. Maintain the water at 2- 3 cm for about one week. This will inhibit the germination and growth of any terrestrial species that may be present in the new wetland. The water level can then be lowered to the substrate surface for 15- 20 days. This will expose the mud surface, stimulating any wetland seeds that were brought in with your transplants (if used) or by waterfowl to germinate as well as increase the rate of spread of the transplants. You can then raise the water level to 3- 5 cm (1- 2 in.) for another week. Then lower the water to the substrate surface for another 15- 20 days. After this period, slowly raise the water level to 10- 15 cm (4- 6 in.) for 3- 5 days. Continue to gradually increase the water depth to 15- 20 cm (6- 8 in.). The aerenchymous tissues in the plant shoots supplies the roots with oxygen, so be careful not to raise the water level over the tops of the emergent vegetation. If the plants are not showing stress, continue to carefully raise the water level to 30- 50 cm (12- 20 in.) if possible. The goal here is to inundate the transition zone between wetland and upland as much as possible to control any invading terrestrial species. After about 20 days, lower the water level to about 5- 7 cm (2- 3 in.). For the rest of the growing season, adjust the water level to maximize the desired community type. The key to determining the appropriate water level is to monitor the emergent wetland plant community. Raise the water level if weed problems surface. Lower the water level to encourage emergent wetland plant growth and spread.



Ideally, the water level should be raised to 10- 15 cm (4- 6 in.) or more before the onset of winter. This allows for free water between the ice and the substrate to protect the roots of the plants from freezing. Be extremely careful however, as you don't want to drown the plants. In areas that do not have ice buildup, keep the fluctuating schedule.

In many areas of the Intermountain West, water availability is tied to the irrigation season and therefore not available through the winter months. Many western wetlands are dry for most of the winter, but recover with little damage in the spring. During the second spring, raise the water level again to flood most of the transition zone. Maintain this level until warm weather sets in and new growth has started. Once the wetland vegetation starts to grow, lower the water to the level of the substrate for 5- 10 days followed by 1- 2 cm (1/2 in.) of water for 2- 3 days. Again, lower the water to the surface of the substrate for 5- 10 days or more. This creates a warm moist mud flat situation, which is ideal for the germination and growth of wetland seeds that may be in the wetland. When new plant growth is evident gradually raise the water level to 8- 10 cm (3- 4 in.). Again, for the rest of the growing season, adjust the water level to maximize the desired community type.

Monitor weed incursion and emergent plant stress. Treat the fall and winter water levels the same as the first year. Once the wetland is well established, the water levels can be manipulated to maintain the desired conditions for your system. The key to remember is that wetland plant communities are dynamic and require a fluctuating water level to remain healthy and to function properly.

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TECHNICAL NOTE

USDA-Natural Resources Conservation Service
Boise, Idaho

PLANT MATERIALS TN NO. 5 **JUNE 2007**

RIPARIAN BUFFER DESIGN

AND SPECIES CONSIDERATIONS

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The purpose of this technical note is to provide information on design and implementation of riparian buffers to improve water quality on Winter Feeding Operations (WFO) and Winter Pasture Operations (WPO). This technology is very effective at minimizing water quality impacts and improving and providing wildlife habitat. This technology is not considered “zero discharge” and is therefore not applicable for Animal Feeding Operations (AFO) or Confined Animal Feeding Operations (CAFO).

A riparian buffer is land adjacent to streams, lakes and wetlands that is predominantly perennial vegetation (grasses, grass-like plants, forbs, shrubs and/or trees) and managed to enhance and protect aquatic resources from adverse impacts of agricultural practices.

This practice is partially covered under the following NRCS Standards

- **393 Filter Strip**
- **390 Riparian Herbaceous Cover**
- **391 Riparian Forest Buffer**

Riparian buffers are partially used to assist with the following purposes that will be covered under this technical note and design information:

- Assist with stabilization of eroding streambanks
- Filter sediment and organic material from agricultural runoff
- Filter nutrients, pesticides, other chemicals and animal waste from agricultural runoff
- Provide wildlife habitat and establish wildlife corridors

Other purposes from Standards not discussed in this document include:

- Create shade to maintain or water temperatures to improve habitat for aquatic organisms
- Provide a source of detritus and large woody debris for aquatic and terrestrial organisms
- Produce a timber, fiber, forage, fruit, or other crop consistent with other intended purposes
- Provide protection against scour erosion within the floodplain
- Restore natural riparian plant communities
- Moderate winter temperatures to reduce freezing of aquatic over-wintering habitats
- To increase carbon storage

Stabilize Eroding Streambanks

Buffers can be effective in stabilizing eroding streambanks on small (low order) streams. Vegetation in the buffer will minimize the high velocity and erosive forces of flowing water and wave action. Species with deep fibrous root systems are recommended for this purpose. Vegetation located within 25 ft of the stream channel aid in riparian and streambank stabilization. The effectiveness of a buffer at stabilizing eroding streambanks will begin to diminish with increasing stream order. Buffers will be ineffective at stabilizing eroding streambanks on large unstable streams with high stream velocities and severe bank erosion. Structural measures may be needed on streams with velocities above 8 ft per second (fps) and where severe bank erosion is occurring.

Filter Sediment from Agricultural Runoff

Buffers are very effective at filtering larger sediments and crop residue. Properly designed riparian buffers can filter up to 90% of sediment carried by runoff. Reductions of 40 to 70% in soil sediments reaching surface water are typical. Vegetation and organic litter slow the velocity of runoff to allow sediments and larger particles to settle out of the flow. Some fine sediment will also be removed due to the higher infiltration rate of the undisturbed soil in the buffer, but because fine sediments fall out very slowly in the water column, it is not an efficient method of removal. Roots will stabilize the trapped sediment and hold the new soil in place. Buffers with higher plant diversity including grasses, grass-like plants, forbs and shrubs do a better job of filtering sediments compared to buffers composed of only grasses. Diverse plant community buffer strips also tend to have a longer sediment trapping life span.

Filter Nutrients, Pesticides, and Animal Waste from Agricultural Land Runoff
Buffers are very effective at removing particulate wastes and sediment-attached microbes, nutrients, and pesticides through immobilizing, storing, and transforming chemical inputs from upland runoff. Treatment of nutrients through buffers is achieved by a combination of the following:

- Sediment deposition
- Infiltration
- Dilution by incoming rainfall
- Adsorption / desorption reaction with buffer soil and litter
- Nutrient uptake by vegetation

Studies show that concentrations of pollutants treated with a buffer were reduced by a factor of three or four in most cases (Palone and Todd 1998). Nearly 90% of inorganic phosphorus is carried to streams attached to soil particles or organic matter. Therefore reducing sediment transport will reduce inorganic phosphorus loads. Because the majority of inorganic phosphorus is adsorbed onto finer fractions of soil and it takes long periods of time for fine sediments to drop out of the runoff, inorganic phosphorus is usually reduced by a factor of one and a half to two after treatment by a buffer. A buffer's ability to retain dissolved phosphorus, especially under high loading conditions is limited.

Riparian forests buffers will reduce nitrogen by 40 to 100% and grass buffers will reduce nitrogen by 10- 60% (Schuetz et.al. 1994). If shallow groundwater is present below the buffer, soluble contaminants may be removed before the water enters the water table. Buffers are generally less effective at treating pesticides. However, excellent nitrate removal can be achieved from shallow groundwater when wetland plant roots make contact with it. Studies have shown winter nitrate removal at sites where the vegetation is deciduous forest. Groundwater passing through the buffer may be cleansed of nitrate and acidity due to a combination of denitrification, biostorage and changes in soil composition. Grass and dense vegetation are more effective at trapping particulates from runoff, but woody vegetation is a necessary component for removing soluble nutrients.

Provide Wildlife Habitat and Establish Wildlife Corridors

Buffers placed along small first and second order streams will provide shade and habitat. Leaf foliage shades water and helps maintain or reduce the temperature of the stream. Plant litter and insects supply food for fish, while perennial vegetation supplies diversity of cover and food for wildlife. Larger plant debris and root systems also provide shelter for fish. However, the effectiveness of the buffer to meet these goals minimizes as the surface water increases in size.

Buffer Components

Buffers can be designed as grass filters, forest buffers, or a combination of both based on the treatment desired and the site considerations. A brief discussion on the main components of a buffer and the benefits associated with each component follows.

> **Trees** (Planted Next to the Surface Water)
> Primary purpose is to stabilize streambanks and provide habitat for aquatic organisms as well as terrestrial species. Trees aid in filtering surface runoff and, in some landscapes, can help remove nutrients carried to the groundwater.
>
> **Trees, Grasses, Grass-like plants, Forbs and Shrubs**
> The primary function of the trees, grasses, grass-like plants, forbs and shrubs is to remove, transform, or store nutrients, sediments and other pollutants flowing over the surface and through to the groundwater. Buffers help remove surface borne pollutants. Debris from the trees slows and traps sediments in the runoff, giving the nutrients time to infiltrate into the ground where they may be stored or removed or utilized by vegetation. Studies have found that buffers can remove 50- 80% of the sediment in runoff from upland fields. Microbes in the soil can uptake, store and/or breakdown nutrients. Denitrification can also take place under the proper conditions by microbial populations found in the root zones of many wetland and riparian plants.
>
> **Grass Filter Strips**
> Grass filter strips slow runoff, filter sediment and its associated nutrients and chemicals, allow plant water and nutrient uptake, and encourage water to infiltrate into the ground. Effective sediment trapping requires that runoff entering the buffer be in the form of sheet flow. Several studies show that grass filter strips are highly effective at reducing sediment runoff, with removal rates of 50% or more. Also, the filter strips are highly effective at removing sediment-bound nutrients such as phosphorus, but less effective at removing dissolved nutrients. Periodic maintenance may be required to remove sediment, reestablish vegetation, and remove channels.

Design Considerations

Narrow buffers may be adequate when the stream system is small, the riparian area is in good condition, the resource risk to surface water is low, and/or the desired buffer functions are few. Conversely, wider buffers are necessary when the stream system is larger, the buffer quality is poor, resource risk to surface water is great and multiple buffer functions are desired.

Buffers have the greatest potential to improve water quality when adjacent to low-order streams. However, the importance of the buffer in floodwater detention and storage will increase with stream order.

Soil characteristics are important in determining potential for removal of nitrogen and pollutants carried by sediment such as phosphorus and some pesticides. Primary considerations are soil texture, depth to water table, and organic matter content of soils.

The following table indicates factors that will affect the effectiveness of a buffer strip.

Factors that Enhance Effectiveness	Factors that Reduce Effectiveness
Slopes less than 5 percent	Slopes greater than 5 percent
Contributing flow length < 150 ft	Contributing flow length over 300 ft
Seeps, high water table - subsurface flow	Flow path to deep or regional groundwater
Permeable, but not highly sandy soils	Compacted soils
Level spreaders or flow dispersal	Concentrated flow
Organic matter, humus, or mulch layer	Snowmelt, ice conditions, low organic soil
Entry runoff velocity less than 1.5 fps	Entry runoff velocity more than 5 fps
Routine maintenance	Sediment buildup at entrance
Poorly-drained soils, deep roots	Shallow root system
Forest and dense grass cover (6 in)	Tall bunch grass; Sparse vegetative cover

*Chesapeake Bay Riparian Handbook: A Guide for Establishing and Maintaining Riparian Forest Buffers

Upland conditions will determine sediment loading on the buffer. The following table indicates possible sediment loads based on watershed characteristics.

Relative Loading from Upland Sources According to Upland Conditions

Site Condition	Low Loading	Medium Loading	High Loading
Upland Loading	<1,000 lbs. sediment/acre	1,000 - 10,000 lbs. sediment/acre	>10,000 lbs. sediment/acre
Upland Slope Length	<150 ft	150-300 ft	<300 ft
Upland Slope Percent	1-5 percent	5-15 percent	>15 percent
Upland Soil Credibility	K<0.22	K=0.22-0.36	K<0.36
Upland Cover	Forest or hayfields	Pastures	Cultivated crops
Upland Practice	No-till or no earth disturbance	Till-plant, strip and contour cropping	Conventional plowing, not along contour

*Chesapeake Bay Riparian Handbook: A Guide for Establishing and Maintaining Riparian Forest Buffers

At acceptable loading rates (generally where sediment delivery is less than 5,000 pounds per acre), the outermost area of the buffer should be planted in grasses or mixtures that can be mowed or harvested to allow for periodic removal or smoothing of accumulated sediments. Where loading rates are low enough such that routine sediment removal is not required (generally below 1,000 pounds per acre), herbaceous forbs and shrubs could be included.

A sustainable width is essential for buffers to minimize water quality impacts from adjacent land use. Buffers of less than 50 ft have proven difficult to maintain as effective filters in the field, except on small drainages. Very narrow buffer strips of 15 to 25 ft are generally inadequate for sediment or nutrient reductions, except on small streams. Buffers of less than 35 ft cannot sustain long-term protection of water quality. Cropped or grass vegetated filter strips have also been shown to trap sediment effectively at a width of roughly 25 ft if located on slopes less that 16%. Narrow forest strips may provide soil and bank stability, but may not accumulate organic matter and provide the water storage necessary for nitrogen removal. Larger buffer widths are likely to provide more physical, chemical, and biological protection of surface water.

Slope has the greatest influence over sediment removal and is a factor in the rate and deliver of water flow. It is recommended that a 50 ft buffer width be used on slopes less than 6%. Buffer width is increased by 4 ft for each percent of slope over 6%.

Concentrated Channelized Flow

The efficiency of a buffer at removing sediment is directly correlated to runoff water entering the buffer in sheet flow verses concentrated flow. Channelized flows are likely to form when the slope length is over 250 ft, the upland slope is over 10% and the landform is concave. An engineered biofiltration swale is one tool that can be used to disperse concentration flow. Engineered swales intercept the channelized flows from the upslope areas and direct them parallel to the riparian corridor. They are typically 15 to 25 ft wide and 1 to 2 ft deep, located at the beginning of the buffer. Biofiltration swales have been shown to reduce sediment delivery up to 80%. Biofiltration swales are designed so that the flow depth is very shallow, less than two-thirds the height of the grass (typically 6 in), resulting in a flow velocity of less than 2 ft per second (fps). NRCS TR-55, Urban Hydrology for Small Watersheds, can be used to calculate the runoff for the 2- year 24- hour design flow. The one hundred year flood event should also be determined to ensure that the banks of the swale are not overtopped. Where calculations indicate that peak flow velocities will exceed 2 fps, check dams should be installed. Where peak velocities over 5 fps are projected, check dams should be installed in intervals so that the ponded water extends up to the base of the upstream check dam. The discharge channel through the buffer to the receiving stream should be stabilized with geotextiles or riprap to minimize erosion. A level lip spreader can also be used to redirect runoff into sheet flow. Level lip spreaders can cause sediments to settle immediately upstream and require maintenance to operate effectively.

Operation and Maintenance

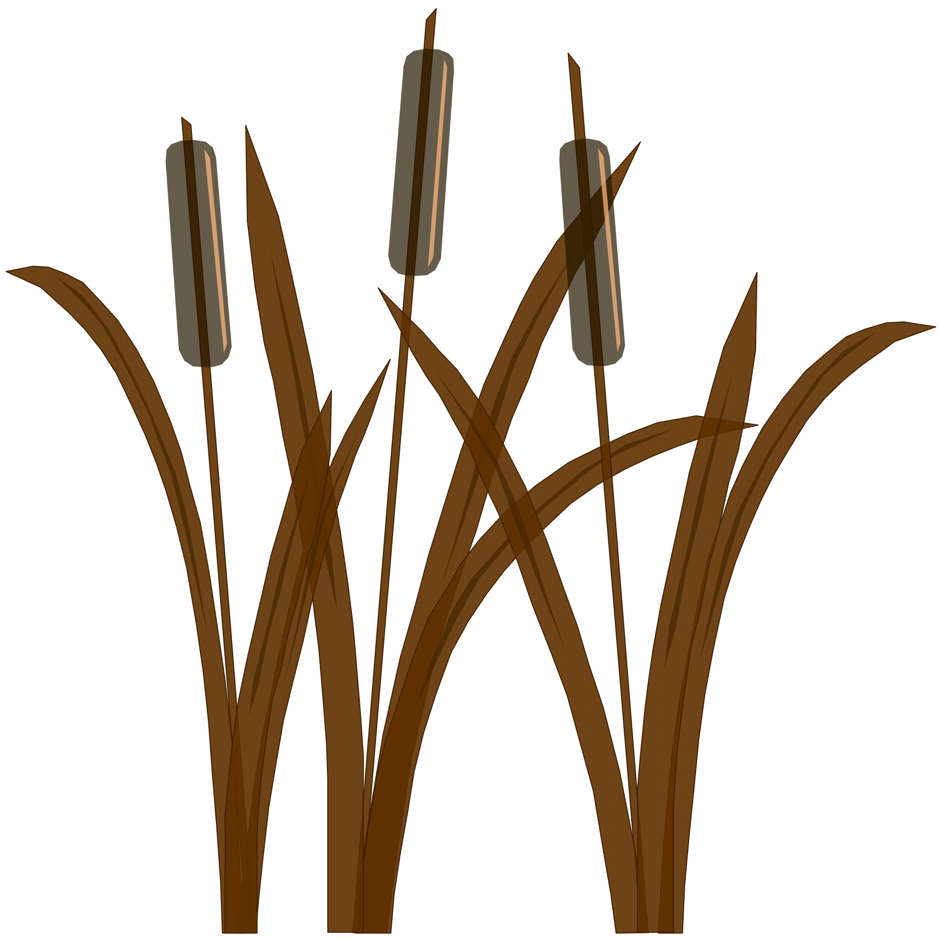
Concentrated channel flow can destroy the continuity of the buffer. Some method to eliminate channelized flow must be provided to ensure sheet flow conditions. Sediment accumulation along the edges of the buffer will have to be removed and areas of concentrated flow will have to be modified. Periodic harvesting of vegetation may be required where nutrient loads are high in order to remove the nutrients it contains, maintain plant growth, and promote nutrient uptake.

Appendix A

Biofiltration Systems

Vegetal Retardance Cover Type

(Vegetation Condition/Height/Slope)



APPENDIX A: Biofiltration Systems - Vegetal Retardance Cover Type (Vegetation Condition/Height/Slope)

Species listed are primarily introduced species noted for good to excellent erosion control traits.

Vegetal Retardance / n[1]		Cover	Average Condition/Height[3]/Slope
A /	0.170[1] .37-.06[2]	Reed Canarygrass[5] Creeping Foxtail	Excellent/20-36"+ /5-10%
B /	0.098[1] .31-.04[2]	Smooth Bromegrass[5] Reed Canarygrass[5] Tall Fescue Grass-Legume-Forb Mixture Timothy[4]/Brome/Orchardgrass[4]/ Tall Fescue/Tall Wheatgrass/ Alfalfa[4]/Forbs	Good / 12-20" /5-10%
C /	0.057[1] .27-.032[2]	Redtop Smooth Bromegrass[5] Intermediate Wheatgrass Pubescent Wheatgrass Western Wheatgrass Grass-Legume-Forb Mixtures Bromegrass, Orchardgrass[4]/ Sod or Bunch Wheatgrasses[4]/ Alfalfa[4]/Forbs	Good / 6-15" / < 5%
D /	0.046[1] .20-.03[2]	Kentucky bluegrass Red Fescue Grass-Legume-Forb Mixture Sheep Fescue[4]/Hard Fescue[4]/ Bromegrass[5]/Sod or Bunch Wheatgrasses[4]/Alfalfa[4]/Forbs	Good / 2-6" / < 5%
E /	0.030[1] .83-.024[2]	Kentucky Bluegrass	Burned / 0-1" / < 5%

1 n values were selected using Velocity & Hydraulic Radius (VR) Product = 2

2 n values vary according to product velocity and hydraulic radius (low velocity and shallow flows result in higher Mannings "n"; high velocity and deep flows result in lower Mannings "n"). Refer to SCS-TP-61 "Handbook of Channel Design for Soil and Water Conservation" for experimental results of Vegetal Retardance/VR/Mannings "n" relationships.

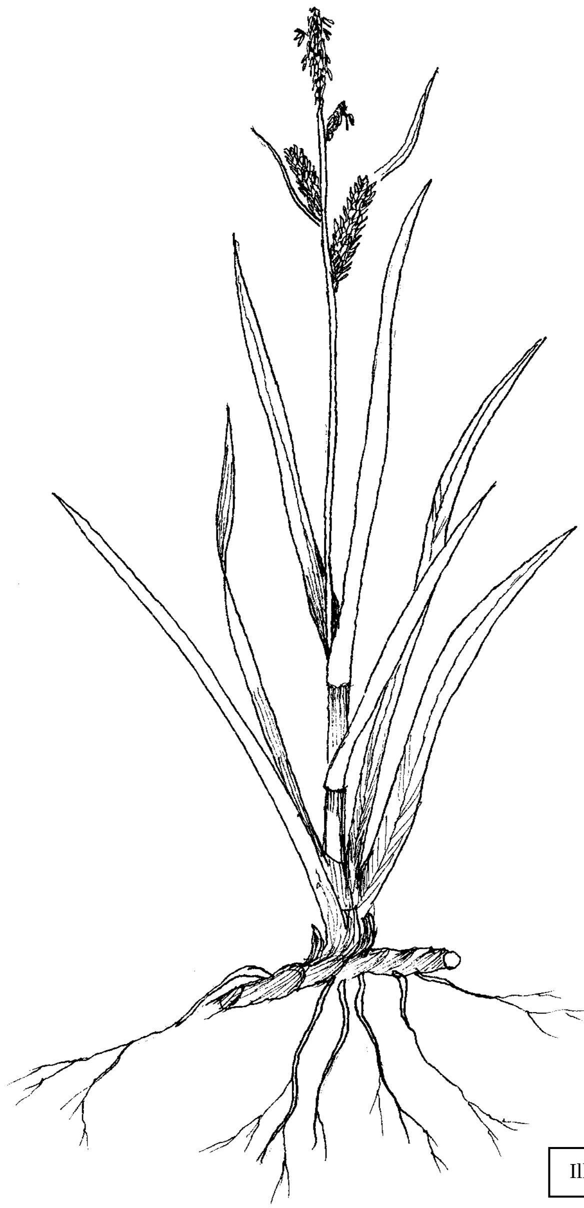
3 During normal critical flow periods, if vegetation has been mowed or flattened due to snow cover, the appropriate vegetal retardance and n value should be used, for example, smooth bromegrass mowed to 4 inch stubble height, use D / 0.046.

4 These are bunchgrasses or bunch type legumes and should be used only in seed mixtures and on slopes less than or equal to 5 percent.

5 Reed canarygrass and smooth bromegrass are commonly found in Northern Idaho, some consider these species to be weedy.

Appendix B

Plant Information Tables



Illustrated by G. Bentrup

HERBACEOUS SPECIES	PLANT ATTRIBUTES					Contour Buffer Strip	Cross Wind Trap Strip	Field Border	Filter Strip	Grass Buffer Strip	Grassed Waterway	Herbaceous Wind Barrier	Riparian Forest Buffer	Riparian Herbaceous Cover	Shallow Water Areas for Wildlife	Streambank/Shoreline Protection	Vegetative Barriers	Winter Grazing and Feed Areas	Wildlife Upland Habitat	342 Seeding Rates PLS LBS/AC ***
GRASSES	GROWTH[1] CHARACTERISTICS	TOLERANCE TO SALINITY[2] PONDING[3]	PRECIPITATION (INCHES)	STEM DIAMETER	CRITICAL AREA SUITABILITY[4]															
Bentgrass, Redtop**	IMBC	L - 1	18+	<1/8”	E						X		X	X	X	X		X		1
Bluegrass, Big	NMBC	L - 4	9-18	1/8 to 1/4”	G			X	X										X	3
Bluegrass, Canada	IMRC	L - 2	18+	1/8-1/4	G	X		X	X	X	X					X				2
Bromegrass, Meadow	IMRC	M - 3	14+	1/8 to 1/4”	G	X		X	X	X	X		X	X				X	X	15
Bromegrass, Smooth*	IMRC	M - 2	14+	1/8 to 1/4”	E	X		X	X	X	X					X	X	X		9
Bromegrass, Mountain**	NMBC	L - 4	16+	1/8 to 1/4”	E								X	X		X			X	15
Fescue, Hard	ISBC	L - 4	14+	<1/8”	G	X		X	X	X	X						X		X	6
Fescue, Red	ISRC	L - 3	18+	<1/8”	G	X		X	X	X	X					X				6
Fescue, Sheep	ISBC	L - 4	10+	<1/8”	G	X		X	X	X	X						X		X	6
Fescue, Tall*	IMBC	H - 2	18+	>1/4”	G	X	X	X	X	X	X	X		X	X	X		X		8
Foxtail, Creeping*	IMRC	M - 1	18+	1/8 to 1/4”	E	X		X	X	X	X		X	X	X	X		X		4
Hairgrass, Tufted	NMBC	L - 2	18+	1/8 to 1/4”	G						X		X	X	X	X				2
Orchardgrass	IMBC	L - 2	18+	>1/4”	G	X		X	X	X	X							X	X	6
Saltgrass, Inland	NMRW	H - 2	15+	1/8 to 1/4”	G			X	X				X	X	X	X	X			4
Timothy	IMBC	L - 2	18+	>1/4”	F	X		X	X	X	X		X	X	X	X		X		4
Wheatgrass, Standard Crested	ISBC	M - 2	9+	<1/8”	G	X		X	X									X	X	8
Wheatgrass, Fairway Crested	ISBC	M - 2	14+	<1/8”	G	X		X	X		X							X	X	8
Wheatgrass, Newhy	IMBC	H - 2	14+	1/8 to 1/4”	F				X		X			X				X		12
Wheatgrass, Intermediate	IMRC	M - 3	12+	>1/4”	G	X	X	X	X	X	X	X					X	X	X	12
Wheatgrass, Pubescent	IMRC	M - 3	12+	>1/4”	G	X	X	X	X	X	X	X					X	X	X	12
Wheatgrass, Siberian	IMBC	M - 3	7+	<1/8”	G	X		X	X		X							X	X	9
Wheatgrass, Slender**	NMBC	H - 3	10+	<1/8”	G				X	X			X	X	X	X			X	9
Wheatgrass, Tall	IMBC	H - 3	12+	>1/4”	G		X	X	X		X	X			X	X	X	X	X	15
Wheatgrass, Streambank & Thickspike	NSRC	M - 3	8+	1/8 to ¼”	F	X		X	X	X	X								X	9
Wheatgrass, Western	NSRC	H - 2	12+	1/8 to 1/4”	E	X		X	X	X	X		X	X	X	X	X	X	X	9
Wildrye, Basin	NTBC	M - 2	10+	>1/4”	F		X	X	X			X	X	X		X		X	X	10
Wildrye, Blue**	NTBC	L - 3	16+	>1/4”	G			X					X	X		X		X	X	7
Wildrye, Mammoth	IMBC	L - 3	7+	>1/4”	F	X	X	X	X	X		X								22
Wildrye, Russian	IMBC	H - 3	8+	>1/4”	G			X	X									X	X	9

1/ N = Native, I = Introduced; Stature T = Tall, M = Mid, S = Short; B = Bunchgrass, R = Rhizomatous; C = Cool season, W = Warm season; 2/ Salinity Tolerance H = High, M = Moderate, L = Low;
3/ 1 = Ponded several weeks, 2 = Ponded only few days on surface, 3 = Water not ponded on surface, 4 = No water table; 4/ E = Excellent, VG = Very Good, G = Good, F = Fair, P = Poor
*These species are prolific spreaders and may cause invasive problems; **Short-Lived - use only for quick establishment - use no more than 15% in mixtures; *** Broadcast rates should be 1.5 times higher. Wildlife – consider species for cover, nesting habitat and/or as a food source.

HERBACEOUS SPECIES	PLANT ATTRIBUTES					Contour Buffer Strip	Cross Wind Trap Strip	Field Border	Filter Strip	Grass Buffer Strip	Grassed Waterway	Herbaceous Wind Barrier	Riparian Forest Buffer	Riparian Herbaceous Cover	Shallow Water Areas for Wildlife	Streambank/Shoreline Protection	Vegetative Barriers	Winter Grazing AFO/CAFO	Wildlife Upland Habitat	342 Seeding Rates PLS LBS/AC ***
	GROWTH [1] CHARACTERISTICS	TOLERANCE TO SALINITY [2] PONDING [3]	PRECIPITATION (INCHES)	STEM DIAMETER	CRITICAL AREA SUITABILITY [4]															
GRAINS, SMALL																				
Barley	IMBC	H - 3	12+	1/8 to 1/4”	F		X		X			X							X	50
Triticale	IMBC	L - 3	9+	1/8 to 1/4”	G		X		X			X							X	60
Sorghum/Sudan grass	ITBC	M - 3	17+	>1/4”	G		X		X			X							X	25
Wheat	IMBC	L - 3	12+	1/8 to 1/4”	F		X		X			X						X	X	60
LEGUMES/FORBS ****																				
Alfalfa, Crown Type	ITBC	L - 3	9+	1/8 to 1/4”	G			X											X	8
Alfalfa, Creeping Root	IMRC	L - 3	9+	>1/4”	G	X		X	X	X	X								X	8
Burnet, Small	IMRC	L - 4	14+	<1/8”	G	X		X	X	X			X	X				X	X	30
Clover, Alsike	ISBC	L - 2	18+	<1/8”	G	X		X	X	X	X		X	X	X	X			X	5
Clover, Ladino & White	ISRC	L - 2	18+	>1/4”	G	X		X	X	X	X		X	X	X	X			X	5
Clover, Strawberry	ISBC	H - 2	13-20	1/8 to 1/4”	G	X		X	X	X	X		X	X	X	X			X	6
Flax, Blue	IMBC	L - 4	10+	1/8 to 1/4”	F			X		X									X	6
Flax, Lewis	NMBC	L - 4	10+	1/8 to 1/4”	F			X		X									X	6
Kochia, Forage	IMBC	M - 4	7+	1/8 to 1/4”	F		X	X										X	X	1
Milkvetch, Cicer	ISRC	M - 3	15+	1/8 to 1/4”	F	X		X	X	X			X	X	X	X		X	X	10
Penstemon, Firecracker	NMBC	L - 4	10+	>1/4”	F			X		X									X	6
Penstemon, Rocky Mountain	NMBC	L - 4	18+	>1/4”	F			X		X									X	6
Penstemon, Venus	NMBC	L - 4	16+	>1/4”	F			X		X									X	3
Sainfoin	IMBC	L - 3	18+	>1/4”	F			X											X	35
Sweetclover, Yellow/White **	IMBC	M - 4	9+	>1/4”	G	X	X			X									X	6
Sunflower, Little	NMBC	H - 4	12+	>1/4”	F		X	X											X	20
Trefoil, Birdsfoot	IMBC	L - 2	18+	>1/4”	G	X		X		X									X	7

1/ N = Native, I = Introduced; Stature T = Tall, M = Mid, S = Short; B = Bunchgrass, R = Rhizomatous; C = Cool season, W = Warm season; 2/ Salinity Tolerance H = High, M = Moderate, L = Low
3/ 1 = Ponded several weeks, 2 = Ponded only few days on surface, 3 = Water not ponded on surface, 4 = No water table; 4/ E = Excellent, VG = Very Good, G = Good, F = Fair, P = Poor
***These species are prolific spreaders and may cause invasive problems; **Short-Lived – use only for quick establishment - use no more than 15% in mixtures; *** Broadcast rates should be 1.5 times higher;**
****** Legumes and forbs should be used in seed mixtures only and should comprise no more than 15 percent of mixture. Wildlife – consider species for cover, nesting habitat and/or as a food source.**

SHRUBS - TREES	PLANT ATTRIBUTES					Root Type	Root From Cuttings	Deposition Tolerance	Flood Tolerance	Salinity Tolerance	Drought Tolerance	Riparian Forest Buffer	Shallow Water Areas for Wildlife	Streambank/Shoreline Protection	Vegetative Barriers	Winter Grazing	Wildlife Upland Habitat	Commercially Available
COMMON NAME	SCIENTIFIC NAME	SIZE - FORM	ELEVATION RANGE	RIPARIAN ZONE	PLANT INDICATOR STATUS													
Alder, Red	Alnus rubra	Sm. Tree	Mid - High	3, 4	FAC	SS	P	M	M	L	L	X		X			X	X
Alder, Sitka	Alnus viridis ssp. sinuata	Sm. Tree	Mid - High	2, 3	FACW	SS	P	M	M	L	L	X		X			X	X
Alder, Thinleaf	Alnus incana spp. tenuifolia	Sm. Tree	Mid – High	2, 3	FACW	SS	P	M	M	L	L	X		X			X	X
Aspen, Quaking	Populus tremuloides	Med. Tree	Mid - High	4	FAC	S	P	L	L	L	M					X	X	X
Birch, Water	Betula occidentalis	Sm. Tree	Mid - High	2, 3	FACW	DS	P	M	M	L	L	X		X			X	X
Boxelder	Acer negundo	Med. Tree	Low – Mid	4	FAC	MS	P	H	H	H	H	X	X	X			X	X
Buffaloberry, Silver	Shepherdia argentea	Lg. Shrub	Low - Mid	3, 4	FACU	R	P	M	M	H	H	X		X	X	X	X	X
Cinquefoil, Shrubby	Dasiphora floribunda	Sm. Shrub	Low – Mid	3, 4	FACW	SS	P	L	H	L	H		X				X	X
Chokecherry	Prunus virginiana	Med. Shrub	Low – Mid	4	FACU	R	G	L	L	L	M			X			X	X
Cottonwood, Black	Populus trichocarpa	Lg. Tree	Low – Mid	4	FACW	SF	VG	H	H	L	M	X		X		X	X	X
Cottonwood, Fremont	Populus fremontii	Lg. Tree	Low – Mid	4	FACW	SF	VG	H	H	L	M	X		X		X	X	X
Cottonwood, Narrowleaf	Populus angustifolia	Lg. Tree	Mid	4	FACW	SF	VG	H	H	L	M	X		X		X	X	X
Current, Golden	Ribes aureum	Med. Shrub	Low – Mid	3, 4	FAC	R	F	L	L	H	H	X		X		X	X	X
Current, Wax	Ribes cereum	Med. Shrub	Mid	3, 4	FACU	R	F	L	L	M	H	X				X	X	X
Dogwood, Redosier	Cornus sericea	Med. Shrub	Mid	2, 3, 4	FACW	S	F	L	H	L	M	X	X	X			X	X
Elderberry, Blue	Sambucus nigra ssp. cerulea	Lg. Shrub	Mid	4	FAC	R	P	M	M	L	M	X					X	X
Elderberry, Red	Sambucus racemosa	Med. Shrub	Mid – High	4	FACU	R	P	M	M	L	M	X					X	X
Hawthorn, Black	Crataegus douglasii	Sm. Tree	Low – Mid	3, 4	FAC – U	DS	P	M	L	L	H	X		X	X	X	X	X
Pine, Lodgepole	Pinus contorta	Conifer	Mid - High	3, 4, 5	FACW - U	S	P	L	H	L	L	X	X				X	X
Rose, Wood's	Rosa woodsii	Sm. Shrub	Low – Mid	2, 3, 4	FACU	R	F	M	M	L	H	X		X	X		X	X
Serviceberry	Amelanchier alnifolia	Lg. Shrub	Low - Mid	4, 5	FACU	R	P	L	L	L	M	X					X	X
Silverberry	Elaeagnus commutata	Sm. Shrub	Low – Mid	3, 4	FAC	R	VG	H	H	M	M	X	X	X		X	X	X
Snowberry, Common	Symphoricarpos albus	Sm. Shrub	Mid – High	3, 4	FACU	S	VG	M	M	L	M	X		X			X	X
Spruce, Engelmann and White	Picea engelmannii and P. glauca	Conifer	Mid - High	3, 4, 5	FACW - U	S	P	L	H	L	L	X	X				X	X
Sumac, Skunkbush	Rhus trilobata	Med. Shrub	Low - mid	4	FACU	R	P	H	M	L	H	X		X		X	X	X
Syringa (mock-orange)	Philadelphus lewisii	Sm. Shrub	Low - Mid	3, 4	FACU - U	FS	P	L	L	L	L	X		X			X	X

ELEVATION RANGE: Low- 2000- 4500 ft, Middle- 4500- 7000 ft, High- 7000- 10000 ft; RIPARIAN ZONE: 1- Toe Zone, 2- Bank Zone, 3- Overbank Zone, 4- Transition Zone, 5- Upland;
PLANT INDICATOR STATUS: OBL- obligate, FACW- facultative wet, FAC- falcultative, FACU- facultative upland, U- upland;
ROOT TYPE: DS- deep spreading, FS- fibrous spreading, MS- moderately spreading, S- shallow, SS- shallow spreading, R- rhizomatous; ROOT FROM CUTTING: F- fair, G- good, VG- very good, P- poor;
TOLERANCES: L- low, M- moderate, H- high; WILDLIFE: consider species for food, cover and/or nesting habitat

WILLOWS	PLANT ATTRIBUTES					Root Type	Root From Cuttings	Deposition Tolerance	Flood Tolerance	Salinity Tolerance	Drought Tolerance	Riparian Forest Buffer	Shallow Water Areas for Wildlife	Streambank/Shoreline Protection	Vegetative Barriers	Winter Grazing	Wildlife Upland Habitat	Commercially Available
COMMON NAME	SCIENTIFIC NAME	SIZE -FORM	ELEVATION RANGE	RIPARIAN ZONE	PLANT INDICATOR STATUS													
Willow, Bebb	Salix bebbiana	Lg. Shrub	Low - Mid	4	FACW	DS	G	H	H	L	L	X	X	X			X	
Willow, Black	Salix nigra	Lg. Tree	Low - Mid	4	FACW	DS	G	M	M	L	L	X		X			X	
Willow, Booth	Salix boothii	Med. Shrub	Mid	2, 3	FACW	DS	F	H	M	L	L	X	X	X			X	
Willow, Coyote	Salix exigua	Med. Shrub	Low - Mid	2, 3, 4	OBL	R	VG	H	H	L	L	X	X	X			X	
Willow, Drummond	Salix drummondiana	Med. Shrub	Mid - High	2, 3	FACW	DS	G	H	H	L	L	X	X	X			X	
Willow, Geyer	Salix geyeriana	Med. Shrub	Mid	2, 3	OBL	DS	G	H	H	L	L	X	X	X			X	
Willow, Golden (White)	Salix alba	Lg. Tree	Low – Mid	4	FACW	DS	VG	H	H	L	M	X		X			X	
Willow, Laurel	Salix pentandra	Lg. Shrub	Low - Mid	4, 5	FAC - U	DS	VG	M	H	L	L	X		X			X	
Willow, Lemmon	Salix lemmonii	Med. Shrub	Mid - High	2, 3	FACW	DS	G	H	M	L	L	X	X	X			X	
Willow, MacKenzie	Salix prolixa	Sm. Tree	Low - Med	2, 3	OBL	DS	G	H	M	L	L	X	X	X			X	
Willow, Pacific	Salix lucida ssp. lasiandra	Sm. Tree	Low - Mid	4	FACW	DS	G	H	M	L	L	X		X			X	
Willow, Peachleaf	Salix amygdaloides	Sm. Tree	Low	4	FACW	DS	VG	H	H	L	L	X		X			X	
Willow, Plainleaf	Salix planifolia	Sm. Shrub	Mid - High	2, 3	OBL	DS	F	H	M	L	L	X	X	X			X	
Willow, Sitka	Salix sitchensis	Sm. Tree	Low - Mid	3	FACW	DS	M	H	M	L	L	X		X			X	
Willow, Scouler	Salix scouleriana	Lg. Shrub	Low - Mid	4, 5	FAC	DS	F	H	M	L	M	X		X			X	
Willow, Yellow	Salix lutea	Med. Shrub	Low	2, 3	FACW - OBL	DS	G	M	M	L	L	X	X	X			X	
Willow, Wolf	Salix wolfii	Sm. Shrub	Mid - High	2, 3	OBL	DS	F	H	H	L	L	X	X	X			X	

ELEVATION RANGE: Low- 2000- 4500 ft, Middle- 4500- 7000 ft, High- 7000- 10000 ft;
RIPARIAN ZONE: 1- Toe Zone, 2- Bank Zone, 3- Over-bank Zone, 4- Transition Zone, 5- Upland;
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TOLERANCES: L- low, M- moderate, H- high;
WILDLIFE: consider species for food, cover and/or nesting habitat

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