Aberdeen Plant Materials Center

2004 Annual Technical Report

United States
Department of
Agriculture

**Natural Resources
Conservation Service**

Aberdeen, Idaho

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Contents

INTRODUCTION

The Plant Materials Center at Aberdeen is part of a national plant materials program operated by the United States Department of Agriculture, Natural Resources Conservation Service. The purpose of the Plant Materials Center is to develop and communicate new technology for the use and management of plants. We also assemble, evaluate and release plant materials for conservation use and develop new techniques for establishment of conservation plants. The Aberdeen Plant Materials Center was established in 1939 and has been the primary breeder and releasing organization for 15 cultivars and a cooperator in the release of 12 additional cultivars. The Aberdeen Plant Materials Center serves portions of Nevada, Utah, California, Oregon and Idaho. This document is a compilation of progress reports for activities by the Aberdeen Plant Materials Center during FY 2004.

The following documents and presentations were developed during FY 2004 and may be obtained by contacting the Aberdeen Plant Materials Center:

DOCUMENTS

Tilley, Derek J. 2004. Aberdeen PMC Works with Region 1 of the Forest Service. Aberdeen PMC, Aberdeen, ID. 3/22/04. 1p.

Tilley, D.J. and L. St. John 2004. USDA Forest Service, Region 1 Native Grass and Forb Initial Evaluation (Preliminary Report). Aberdeen Plant Materials Center, Aberdeen, ID. July 2004. 13p.

Tilley, D.J. 2004. Fact Sheet - Appar Blue Flax. Aberdeen Plant Materials Center, Aberdeen, ID. July 2004. 2p.

Tilley, D.J. 2004. Fact Sheet - Ephraim Crested Wheatgrass. Aberdeen Plant Materials Center, Aberdeen, ID. July 2004. 2p.

Tilley, D.J. 2004. Fact Sheet - Maple Grove Germplasm Lewis Flax. Aberdeen Plant Materials Center, Aberdeen, ID. July 2004. 2p.

Tilley, D.J. 2004. Fact Sheet - Nezpar Indian Ricegrass. Aberdeen Plant Materials Center, Aberdeen, ID. July 2004. 2p.

Tilley, D.J. 2004. Fact Sheet - Paiute Orchardgrass. Aberdeen Plant Materials Center, Aberdeen, ID. July 2004. 2p.

Tilley, D.J. 2004. Fact Sheet - Regar Meadow Brome. Aberdeen Plant Materials Center, Aberdeen, ID. July 2004. 2p.

Tilley, D. J., Ogle, D.G., St.John, L, Duckwitz, W.,Holzworth, L., Majerus, M., and D. Tober 2004. Creeping Foxtail Plant Guide. Aberdeen Plant Materials Center, Aberdeen, ID. April 27, 2004. 6p.

Tilley, D. 2004. Fact Sheet- Anatone Bluebunch Wheatgrass. Aberdeen Plant Materials Center, Aberdeen, ID. July 2004. 2p.

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St. John, L., Ogle, D.G., Holzworth, L.K., Stannard, M., Cornwell, J. 2004. Technical Note No. 19. Calibrating a Seed Drill for Conservation Plantings. Boise, ID, Boise, ID. June 24, 2004. 15p.

St. John, L., Ogle, D.G. 2004. Great Basin Native Plant Selection and Increase Project FY 2003 Annual Report. Aberdeen Plant Materials Center, Aberdeen, ID. February 3, 2004. 2p.

St. John, L., Hoag, J.C., Ogle, D.G. 2004. 2003 Annual Technical Report, Aberdeen Plant Materials Center. Aberdeen, ID, Aberdeen, ID. January 12, 2004. 264p.

St. John, L., D. Ogle 2004. Fact Sheet - Magnar Basin Wildrye. Aberdeen Plant Materials Center, Aberdeen, ID. February 9, 2004. 2p.

St. John, L., Hoag, J.C., Ogle, D.G. 2004. 2004 Progress Report of Activities - Aberdeen Plant Materials Center. Aberdeen Plant Materials Center, Aberdeen, ID. March 16, 2004. 4p.

St. John, L. 2003. 2003 Progress Report - 1998 Hybrid Poplar Initial Evaluation Planting. Aberdeen Plant Materials Center, Aberdeen, ID. October 1, 2003. 2p.

St. John, L. 2004. 2004 Progress Report - 1998 Hybrid Poplar Initial Evaluation Planting. Aberdeen Plant Materials Center, Aberdeen, ID. September 27, 2004. 2p.

St. John, L. 2003. Grass for Gas?. Aberdeen Plant Materials Center, Aberdeen, ID. November 7, 2003. 1p.

St. John, L, Ogle, D.G. 2004. The Best Yielding Forages for Irrigated Conditions. Aberdeen Plant Materials Center, Aberdeen, ID. April 29, 2004. 1p.

Monsen, S., Kitchen, S, and many others 2004. Notice to Release Anatone Germplasm Bluebunch Wheatgrass (Selected Class Natural Population). Forest Service, Rocky Mountain Research Station, BLM Boise, ID, Utah Division of Wildlife Resources, Utah State, NRCS, University of ID, Aberdeen, ID. March 5, 2004. 45p.

McCoy, Pat 2004. Seeding Study Looks at Wetland Plants. Capital Press, Idaho's Agricultural Weekly, Boise, ID. Vol 77, No. 14 April 2, 2004. 2p.

Kitchen, S., St. John,L. and many others 2004. Notice of Release Maple Grove Germplasm Lewis Flax Selected Class Natural Population. Forest Service Rocky Mountain Research Station, NRCS, Utah Division of Wildlife, Utah State, University of Idaho, Aberdeen, ID. July 22, 2004. 22p.

Hoag, J.C. 2004. Harvesting, Propagating, and Planting Wetland Plants. Aberdeen PMC and Boise State Office, Boise, ID. TN Plant Materials No. 13. 11p.

Hoag, J.C. 2004. Willow Clump Plantings. NRCS, Boise, ID and Aberdeen PMC, Boise, ID. December, 2004. 7p.

Hoag, J. Chris 2004. Successful Streambank Soil Bioengineering for Riparian Rehabilitation. American Society

of Agricultural Engineers - Self-Sustaining Solutions for Streams Wetlands and Watersheds, St. Paul, MN. Sept. 12-15, 2004. 61p.

Fagan, J., St. John, L., Ogle, D.G. 2004. Small Acreage Owners Can Win the Weed War. Idaho NRCS State Office, Boise, ID, Boise, ID. May 6, 2004. 2p.

Clayton, K. 2004. New Employees Tour Plant Materials Center. Idaho Highlights (newsletter for Idaho NRCS employees and conservation partners), Boise, ID. Summer, 2004. 4p.

Blaker, P. and L. St.John 2003. Foundation Seed Production at Aberdeen Plant Materials Center, 1995-2003. Aberdeen Plant Materials Center, Aberdeen, ID. October 17, 2003. 1p.

Blaker, P and L. St. John 2004. Foundation Seed Production at Aberdeen Plant Materials Center (1996-2004). Aberdeen Plant Materials Center, Aberdeen, ID. September 21, 2004. 1p.

PRESENTATIONS

Date presented: 10/1/2003
Title: Riparian Ecology and Restoration Workshop Field Exercise
Presenter Hoag **Location** Grand Teton National Park, Moose, WY

Date presented: 10/15/2003
Title: Bear River erosion processes and bioengineering treatments that can be used
Presenter Hoag **Location** Montpelier, ID

Date presented: 10/28/2003
Title: Stormwater Constructed Wetland System for the City of Aberdeen, ID
Presenter Hoag **Location** Aberdeen, ID

Date presented: 11/5/2003
Title: Riparian Planting guidelines and species selection for the Portneuf River, Pocatello, ID
Presenter Hoag **Location** Pocatello, ID

Date presented: 11/12/2003
Title: Riparian Ecology and Restoration Workshop Field Exercise
Presenter Hoag, Moody, Yard **Location** Springerville, AZ

Date presented: 11/12/2003
Title: Riparian Ecology and Restoration Workshop
Presenter Hoag and Moody **Location** Springerville, AZ

Date presented: 11/14/2003
Title: Fundamentals of Seed Production
Presenter St. John, Cornforth **Location** Aberdeen Plant Materials Center

Date presented: 12/8/2003
Title: Wetland planting and weed control using water
Presenter Hoag **Location** Aberdeen PMC

Date presented: 1/29/2004
Title: PMC Activities update to Utah Plant Materials Committee
Presenter St. John **Location** Salt Lake City, Utah

Date presented: 1/29/2004
Title: Couer d' Alene Idaho Riparian Ecology and Restoration Workshop
Presenter Hoag and Fripp **Location** Couer d' Alene, ID

Date presented: 2/4/2004
Title: Successful Bioengineering in semi-arid climates
Presenter Hoag **Location** Stevenson, WA

Date presented: 2/5/2004
Title: Plant Material Considerations for the Intermountain West
Presenter St. John **Location** Nampa, ID

Date presented: 2/11/2004
Title: Red River Riparian Project design parameters for projects on area rivers
Presenter Hoag and Fripp **Location** Aberdeen, ID

Date presented: 2/23/2004
Title: Plant Materials National Program Exhibit
Presenter St. John, Ogle, Stannard, **Location** SRM meeting Salt Lake City, Utah

Date presented: 2/23/2004
Title: New Native Plant Releases from the Aberdeen Plant Materials Center
Presenter L. St. John **Location** St. Louis, MO

Date presented: 3/4/2004
Title: PMC Activities update to Idaho Plant Materials Committee
Presenter St. John **Location** Boise, ID

Date presented: 3/10/2004
Title: Great Basin Native Plant Selection and Seed Increase - 2003 project report
Presenter St. John **Location** Salt Lake City, UT

Date presented: 3/17/2003
Title: Windbreak Planning and Installation
Presenter St. John **Location** Rigby, ID

Date presented: 3/19/2004
Title: Overview of Plant Materials Program and Activities at the Aberdeen Plant Materials
Presenter St. John and Tilley **Location** Aberdeen Plant Materials Center

Date presented: 3/24/2004
Title: PMC Tour for National Park Service and Idaho Department of Transportation
Presenter St. John and Tilley **Location** Aberdeen, ID

Date presented: 3/31/2004
Title: Soil erosion and plant materials to help solve resource problems
Presenter St. John **Location** High school, Aberdeen, Idaho

Date presented: 4/3/2004
Title: Riparian restoration on the Blackfoot River
Presenter Hoag **Location** Blackfoot, ID

Date presented: 4/3/2004
Title: Riparian Plants on the Blackfoot River
Presenter Hoag **Location** Blackfoot, ID

Date presented: 4/5/2004
Title: Ephemeral rivers in CA and how to restore function
Presenter Hoag and Fripp **Location** Woodland, CA

Date presented: 4/7/2004
Title: Arroyo de la Laguna assessment and planning
Presenter Hoag and Fripp **Location** Livermore, CA

Date presented: 4/8/2004
Title: Restoration plan development for Arroyo de la Laguna
Presenter Hoag and Fripp **Location** Livermore, CA

Date presented: 4/13/2004
Title: Ball Creek Ranch WRP Planting Guidelines
Presenter Hoag **Location** Bonner's Ferry, ID

Date presented: 4/29/2004
Title: Protecting Our Environment with Plants
Presenter St. John, Tilley **Location** Aberdeen Plant Materials Center

Date presented: 5/4/2004
Title: NEDC wetland restoration and enhancement course, Davis, CA
Presenter Hoag **Location** Davis, CA

Date presented: 5/10/2004
Title: Willow clump identification, collection, transportation, and planting
Presenter Hoag **Location** Driggs, ID

Date presented: 5/11/2004
Title: Willow collection and storing
Presenter Hoag **Location** Driggs, ID

Date presented: 5/13/2004
Title: Restoration of the gibbon river in Yellowstone national park
Presenter Hoag **Location** Yellowstone National Park, Mammoth, WY

Date presented: 5/19/2004
Title: PMC Tour for Aberdeen Elementary School Fifth Grade Class
Presenter St. John, Simonson, Bair **Location** Aberdeen Plant Materials Center

Date presented: 5/25/2004
Title: Aberdeen PMC Activities during 2003 to Tri-State Interagency Plant Materials Meeting
Presenter L. St. John **Location** Boise, ID

Date presented: 5/26/2004
Title: IFAFS Cinder Cone Site
Presenter L. St. John **Location** Cinder Cone Site, ID

Date presented: 6/2/2004
Title: PMC Tour for Caribou and Bear Lake Conservation Districts
Presenter St. John, Cornforth, Bair **Location** Aberdeen Plant Materials Center

Date presented: 6/9/2004
Title: Riparian restoration techniques on the Hopi Indian reservation, AZ
Presenter Hoag **Location** Hopi reservation, AZ

Date presented: 6/17/2004
Title: Simple methods for assessing and inventorying riparian areas
Presenter Hoag and Krajewski **Location** Blackfoot River, ID

Date presented: 6/22/2004
Title: Wetland Educator Technical Training
Presenter Hoag **Location** Kaysville, UT

Date presented: 7/13/2004
Title: Plant Materials Field Day for Agency Personnel
Presenter PMC Staff **Location** Aberdeen Plant Materials Center

Date presented: 7/14/2004
Title: Orientation for new employees
Presenter PMC Staff **Location** Aberdeen Plant Materials Center

Date presented: 7/26/2004
Title: Stream Assessment Training
Presenter Hoag and Sampson **Location** McCall, ID

Date presented: 8/2/2004
Title: Oregon Stream Restoration Design Guidelines
Presenter Hoag and Fripp **Location** Portland, OR, LeGrande, OR, and Corvallis,

Date presented: 8/9/2004
Title: Wetland plant ID course
Presenter Hoag, Fink, Hanson, and **Location** Moscow, ID

Date presented: 8/11/2004
Title: Northern Cold Desert Winterfat Seed Production
Presenter St. John, Cornforth **Location** Aberdeen Plant Materials Center

Date presented: 8/30/2004
Title: New York NEDC Wetland Restoration and Enhancement Course
Presenter Hoag **Location** Syracuse, NY

Date presented: 9/15/2004

Title: Aberdeen Plant Materials Center - History, Mission, and Current Activities

Presenter L.St. John **Location** ARS Small Grains and Potato Research

Date presented: 9/29/2004

Title: Third International Conference on Natural Channel Systems - Streambank Bioengineering Workshop, Ottawa, Canada

Presenter Hoag **Location** Ottawa, Canada

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.*

NEW PLANT RELEASES

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE, ROCKY MOUNTAIN RESEARCH STATION
PROVO, UTAH

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT, BOISE, IDAHO

UTAH DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WILDLIFE RESOURCES
EPHRAIM, UTAH

UTAH STATE UNIVERSITY, AGRICULTURAL EXPERIMENT STATION
LOGAN, UTAH

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
BOISE, IDAHO

UNIVERSITY OF IDAHO, AGRICULTURAL EXPERIMENT STATION
MOSCOW, IDAHO

NOTICE TO RELEASE
ANATONE GERMPLASM BLUEBUNCH WHEATGRASS
(SELECTED CLASS NATURAL POPULATION)

The United States Department of Agriculture, Forest Service, Rocky Mountain Research Station; United States Department of the Interior, Bureau of Land Management, Idaho State Office; Utah Department of Natural Resources, Division of Wildlife Resources; Utah State University Agricultural Experiment Station; United States Department of Agriculture, Natural Resources Conservation Service; University of Idaho, Agricultural Experiment Station propose the release of Anatone Germplasm bluebunch wheatgrass (*Psuedoroegneria spicata* [Pursh] A. Löve ssp. *spicata)* for restoration of disturbed sites within the natural range of this species.

Anatone is a natural, non-manipulated bluebunch wheatgrass population accession originating from Asotin County in Southeastern Washington. It is a long-lived perennial bunchgrass better adapted to low elevation, semi-arid sites with long, hot growing seasons than other bluebunch wheatgrass accessions or available releases. Its seedling vigor and establishment also exceed those of other accessions and released cultivars. Anatone's ready germination, rapid development, ability to compete with exotic annuals, and drought tolerance make it an excellent choice for restoration of cheatgrass (*Bromus tectorum* L.) infested landscapes. It can also be used to convert stands of introduced perennial grasses to native plant communities in areas where it once existed. Anatone is

widely adapted throughout the natural range of this species, and can be used to restore extensive disturbances once occupied by shrubs and bunchgrass. Bluebunch wheatgrass is one of the most common native grasses of the Intermountain West. There is a need for a release that can be used in the drier portions of the species range to improve species diversity, resilience, and habitat values.

Scientific Name: *Pseudoroegneria spicata* (Pursh) A. Löve ssp. *spicata*. Synonyms include *Festuca spicata* Pursh, *Agropyron spicatum* (Pursh) Scribner & Smith, *Elymus spicatus* Gould, and *Elytrigia spicata* (Pursh) D. Dewey.

Common Name: Bluebunch wheatgrass, 'Anatone' wheatgrass.

Germplasm Identification: The germplasm will be referred to as 'AnatoneGermplasm' bluebunch wheatgrass to identify and document the original collection site.

Identification Number: Anatone has been identified by the Forest Service as AGSP B53-88.

Origin: Extensive collections of bluebunch wheatgrass were obtained by scientists of the Natural Resources Conservation Service (formerly the Soil Conservation Service) between 1934 and 1938 from the Palouse Prairie, Snake River Canyon, and adjacent areas in Idaho, eastern Oregon, and eastern Washington. Collections from this region performed exceptionally well when planted throughout the Intermountain West. Results of this earlier work prompted further evaluations of materials from the area for big game habitat improvement in central and southern Idaho beginning in 1968. Additional collections from this area were acquired for comparative trials at low elevation, semiarid areas of the Intermountain region as a cooperative study with Idaho BLM and USDA, Forest Service, Rocky Mountain Research Station. Stanley Kitchen collected Anatone bluebunch wheatgrass in 1988 about 4.8 km (3.0 miles) east of Anatone, Asotin County, Washington (N 46^{o} 9.57' W 117^{o} 4.72'). Numerous other collections were made in close proximity from southeastern Washington, northeastern Oregon, and western Idaho area. Subsequent collections have been made from this region since 1988.

The Anatone Germplasm collection site is approximately 0.8 km (0.5 mile) south of Highway 129 near Mill Creek Road at the edge of Mill Creek Canyon. Plants occur on a series of closely related soils. Soils on the flats and ridge tops are identified by USDA-NRCS as the Neconda soil series. The Gwinly-Mallory #36 soil series dominates slopes of 3 to 30%, and the Gwinly-Mallory #37 soil series complex occupies slopes of 30 to 70%. These soils are shallow to moderately deep, well drained, and derived from weathered basalt. Surface layers are typically dark or grayish brown very stony silt loam to cobbly clay loam. Underlying soils vary in depth from 25 to 50 cm (10 to 20 inches), and depth to underlain basalt may vary from 25 to 100 cm (10 to 40 inches). Sub soils are dark grayish brown very cobbly silty clay loam. Rocky and extremely stony loam soils are common. Soils are well drained, but permeability may be slow and available water capacity is low to moderate. Soils are calcareous below a depth of about 85 cm (34

inches). Elevation at the collection site is 975 m (3,200 ft), but the Neconda soil type ranges from 975 to 1097 m (3,200 to 3,600 ft).

Other species associated with bluebunch wheatgrass at the Anatone collection site include Idaho fescue (*Festuca idahoensis* Elmer), Sandberg bluegrass (*Poa secunda* J. Presl), arrowleaf balsamroot, (*Balsamorhiza sagittata* [Pursh] Nutt.), mountain big sagebrush (*Artemisia tridentata Nutt. ssp. vaseyana* [Rydb.] Beetle), stiff sagebrush (*Artemisia rigida [Nutt.] Gray)*, current (*Ribies spp*), serviceberry (*Amelanchier alnifolia* Nutt.), and Wyeth eriogonum (*Eriogonum umbellatum* Torr.).

Average annual precipitation at the collection site during the period 1951 through 1978 was 508 mm (20 inches), but in 2 of every 10 years, total annual precipitation may be as low as 440 mm or as high as 600 mm (17.5 to 23.87 inches). Precipitation is well distributed throughout the year with nearly all months receiving more than 25 mm (1.0 inch) moisture. November through January monthly precipitation averages more than 50 mm (2 inches) while February through June average slightly less. Average daily maximum temperature for the entire year is 13 ^{o}C. Maximum daily temperatures may equal or exceed 27 ^{o}C for nearly 7 months (April through October). Average daily minimal temperatures remain high throughout the year with averages minimal monthly temperatures below freezing only in December and January. The frost-free period ranges from 110 to 135 days. Based on these conditions, the region would be classified as having a long growing season with high temperatures, particularly during the summer months (NOAA 1997, USDA-NRCS, Lewiston, ID, data on file).

The collection site is classified as Major Land Resource Area B9, Palouse and Nez Perce Prairie, by the USDA-NRCS (Anonymous 1981), Intermountain Semi desert Province 342 by Bailey (1995), and EPA Level III Ecoregion 10, Columbia Plateau (U.S. Environmental Protection Agency 2000).

Description: Anatone Germplasm bluebunch wheatgrass is similar in general appearance to 'Goldar' bluebunch wheatgrass, 'Whitmar' beardless wheatgrass (*Pseudoroegneria spicata* [Pursh] A. Löve ssp. *inermis* [Scribner & J.G. Smith] A. Löve), and 'Secar' Snake River wheatgrass (*Elymus wawawaiensis* J. Carlson and Barkworth). The selection is a densely tufted perennial bunchgrass with abundant, long, narrow, light green leaves that are 45 to 50 cm (18 to 20 inches) long. Plants occur as distinct large bunches with numerous leaves creating a characteristic tufted growth habitat. Anatone is a diploid (2n=14) and cross-pollinating. Leaves are mostly basal, erect to lax. Some upper cauline leaves are flat, but mostly involute throughout their length and less than 2mm wide. Blades and sheaths are glabrous. Stems are also numerous, erect, and usually less than 1 m tall (40 inches) with very fine, narrow, lax heads. Spikes are slender, mostly 10 to 15 cm long (4 to 6 inches); spikelets are distinct but not as long as the internodes. Seeds are about 10 mm long, rarely longer than 13 mm. Glumes are short, 5 to 10 mm long, unequal in length, with slightly blunt ends narrowing to a short tip. About 70 percent of the lemmas produce a short, divergent awn that is 8 to 9 mm long.

'Whitmar', 'Goldar' and 'Secar' were all collected from southeastern Washington. Whitmar beardless bluegrass, collected from a prairie-grassland receiving 500 mm of annual precipitation, is an awnless form. It was developed by selection from a spaced planting after the ecotype had been tested in outplanting nurseries (Anonymous 1964; Hein 1958; Kelley, C. [n.d.b]). The original collection site of Whitmar is near Colton, Whitman County, Washington, and the cultivar exhibits similar adaptive traits to arid sites (Anonymous 1947; Mann 1954; Wolf and Morrison 1957) as Anatone. Goldar bluebunch wheatgrass, a cultivar with divergent awns that are 1 to 2 cm long, originated from an open park within a ponderosa pine (*Pinus ponderosa* Douglas ex P. & C. Lawson) woodland (Gibbs and Young 1989). It was collected at a higher elevation and moister climate than Anatone. P-7 is a genetically diverse, multiple-origin polycross of 25 bluebunch wheatgrass collections. Twenty-four of these are diploid while one is tetraploid. Most P-7 plants are without awns (Jones et al. 2002; Larson et al. 2000). Secar, once considered a bluebunch wheatgrass, but later recognized as a new allotetraploid species, Snake River wheatgrass, is awned (Carlson and Barkworth 1997; Jones et al. 1991; Kelley [n.d.b]; Morrison 1981). It is distinguished from bluebunch wheatgrass by its more compact spikelets, shorter internodes, lanceolate glumes, and smaller seeds.

Method of Selection: Anatone Germplasm bluebunch wheatgrass was selected from a series of comparative field trials involving approximately 80 collections from eight Western states: Washington, Oregon, Idaho, Nevada, Utah, Wyoming, Colorado, and Montana. Field plantings of 53 collections, including Goldar and Secar Snake River wheatgrass were established at the Orchard Research Site near Boise, Idaho, and at Nephi, Utah, in the spring of 1989 and 1990 (Monsen et al. 1999). Plantings were evaluated to compare and evaluate establishment, growth habit, growth rate, seasonal growth, vigor, plant stature, seed production, and survival. Seeds of 47 natural populations were examined to determine optimum germination at near freezing temperatures (Kitchen and Monsen 1994, 1999). In addition, greenhouse trials were conducted to develop an index of seedling vigor based on germination and emergence in relation to planting depth. Seed production and seed quality studies were conducted at the Spanish Fork Station, Brigham Young University Field Center in conjunction with wildland and nursery collections from the Orchard and Nephi sites. The USDA-ARS Forage and Range Research Laboratory in Logan, Utah conducted direct seedlings at Blue Creek and Green Canyon, Utah involving 48 perennial grass accessions including Goldar, Secar, P-7, and Anatone. Scientists from the USDA, ARS Forage and Range Research Laboratory, Logan, Utah also conducted DRN tests of a wide array of collections throughout the West, including Anatone and many other sources furnished by the USDA, Forest Service, Shrub Laboratory. Seed production fields varying in size from 0.4 to 40 ha have been established in Utah (1997, 1998, and 1999); Colorado (1998); Washington (1999), and Idaho (2002).

Environmental Considerations and Evaluation: This release is a native species that is widely distributed throughout the western United States. The collection site is in close proximity to the collection locations of Goldar bluebunch wheatgrass and Whitmar beardless wheatgrass and the closely related Secar Snake River wheatgrass. Study sites

have been established and maintained under similar ecological conditions in which bluebunch wheatgrass naturally exists. No attempt has been made to segregate or eliminate genetic characteristics inherent to this ecotype. No definitive attributes have been reported that would suggest this selection would interfere with or prevent natural recovery of associated plants existing in native plant communities. Seed production fields established under cultivation have not demonstrated cultural problems. This species is not regarded as having any adverse negative characteristics that would preclude its use (see attached Environmental Evaluation of Plant Materials Releases). It is an important species that is widely used to restore disturbed areas and re-establish native plant communities.

Anticipated Use: Anatone Germplasm bluebunch wheatgrass can be used to restore extensive areas once dominated by big sagebrush/bluebunch wheatgrass communities and foothill regions dominated by bunchgrass communities in western North America. It is particularly useful for seeding semiarid regions supporting only remnant populations of this species. Anatone is better able to establish on dry sites than other bluebunch wheatgrass cultivars, and it competes relatively well with exotic annuals. It can be used in conjunction with other native plants to re-establish native communities in areas presently occupied by exotic annuals or sites where stands of introduced perennial grasses have been established if the site is properly prepared. It is an important species for re-establishing native communities to regain species diversity, increase seasonal forage quality, improve wildlife habitat, and reduce the incidence of extensive and destructive wildfires. It is also a key species in the successional recovery of important shrub and woodland communities.

Area of Adaptation: Anatone Germplasm bluebunch wheatgrass is widely adapted to the Palouse Prairie, Snake River drainage, southern Idaho, northern Nevada, northern Utah and other areas where the species naturally exists. It is recommended for areas receiving at least 250 to 300mm (10 to 12 inches) of annual precipitation, and it is particularly well adapted to sites with long growing seasons. Whitmar and Secar are recommended for areas receiving similar amounts of annual precipitation, although Secar can be used on sites receiving as little as 200 mm (8 inches) (Ogle and others 2003). Anatone does well on sites that receive fall rains prompting regrowth. It also establishes well and persists on exposed slopes where growth may begin early in the season and where extremely high daily temperatures may occur during the summer and fall months. Anatone is adapted to light and medium-textured soils that are normally well drained and may dry early in the growing season, but it will grow and remain green well into the summer if soil moisture is available. It is adapted to a broad range of sites occupied by big sagebrush. Anatone can be planted on sites supporting mountain big sagebrush (*Artemisia tridentata* Nutt. ssp. *vaseyana* [Rydb.] Beetle), basin big sagebrush (*A. tridentata* Nutt. ssp. *tridentata)* or Wyoming big sagebrush (*A. tridentata* Nutt. spp. w*yomingensis* Beetle & Young). It is also well adapted to upper bench lands and mountain slopes with antelope bitterbrush (Purshia tridentata [Pursh] DC.), Idaho fescue (*Festuca idahoensis* Elmer), bitter cherry (Prunus emarginata [Dougl.] Walp.). It can also be seeded on shallow and rocky soils supporting stiff sagebrush (*Artemisia rigida* Nutt) It has survived well when seeded on heavy-textured soils previously occupied by

black greasewood (*Sarcobatus vermiculatus* [Hook.] Torr.), but it would not be recommended as a replacement for species in salt desert shrub communities.

Increase and Distribution: The USDA Natural Resources Conservation Service, Plant Materials Center, Aberdeen, Idaho will maintain Generation 1 seed. This seed can be requested from the Utah Crop Improvement Association and the Idaho Foundation Seed Program. Growers may produce G2, G3, and G4 generations of seed.

Prepared by: This Notice for the Release of Anatone Germplasm bluebunch wheatgrass was prepared by Stephen B. Monsen (retired), Stanley G. Kitchen, Kelly Memmott, Botanists, U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Provo, UT, and Nancy Shaw, Botanist, U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Boise, ID; Mike Pellant, Coordinator, Great Basin Restoration Initiative, USDI, Bureau of Land Management; Boise, ID; Stanford Young, Secretary/Manager, Utah Crop Improvement Association, Utah State University, Logan, UT; Dan Ogle, Plant Materials Specialist, USDA Natural Resources Conservation Service, Boise, ID; Loren St. John, Team Leader, USDA Natural Resources Conservation Service, Aberdeen Plant Materials Center, Aberdeen, ID; and as a joint release by these agencies and Utah Department of Natural Resources, Division of Wildlife Resources; University of Idaho, Agricultural Experiment Station; and Utah State University, Agricultural Experiment Station.

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SIGNATURES FOR RELEASE OF:

ANATONE GERMPLASM BLUEBUNCH WHEATGRASS (SELECTED CLASS NATURAL POPULATION) ***Pseudoroegneria spicata*** **(Pursh) A. Löve ssp.** ***spicata*** **(synonyms include** ***Festuca spicata*** **Pursh,** ***Agropyron spicatum*** **(Pursh) Scribner & J.G. Smith,** ***Elymus spicatus*** **Gould, and** ***Elytrigia spicata*** **(Pursh) D. Dewey**

USDA-FS	**Director, Rocky Mt. Exp. Stn.**	**Date**
USDI-BLM	**Idaho State Director**	**Date**
State of Utah	**Director, DWR**	**Date**
Utah State Univ.	**Director, Utah Ag. Exp. Stn.**	**Date**
Univ. of Idaho	**Director, Idaho Ag. Exp. Stn.**	**Date**
USDA-NRCS	**Idaho State Conservationist**	**Date**
USDA-NRCS	**Director ESD, Washington, DC**	**Date**

Environmental Evaluation of Plant Materials Releases

Name of person scoring:	**Loren St. John Dan Ogle**	**Date of scoring:**	**3/19/03**
Scientific Name:	**Pseudoroegneria spicata spicata**	**Common Name:**	**Bluebunch Wheatgrass**
Release Name:	**Anatone**		

Is the plant native to the US? **Yes**

Is the plant native to the area of intended use? **Yes**

Authority used to determine native status: **NRCS PLANTS Database**

What is the intended area of use for this plant? **Intermountain west**

What is the intended use for this plant? **Erosion control, rangeland restoration**

Areas in which the release is known to be invasive or has a high probability of being invasive: **None**

Summary of Criteria from Section A	**Score**
Part 1. Impact on Habitats, Ecosystems, and Land Use	**3**
Part 2. Ease of Management	**14**
Part 3. Conservation Need and Plant Use	**8**
Part 4. Biological Characteristics	**28**

Final Determination of Release Based on the Environmental Evaluation:

X ☐ **OK to Release**

☐ **OK to Release but qualify use and intended area of use***

☐ **Do Not Release - NPL determines if release is made***

☐ **Do Not Release - document and destroy materials**

I certify that this Environmental Evaluation was conducted with the most accurate and current information possible.

/s/ Loren St. John 3/19/03

Signature of Person Scoring Date

Signature of NPL indicating that it is OK to make the release:

National Program Leader, PM **Date**

Section A. Scoring of Criteria for Impact, Management, Need and Biological Characteristics

Circle the appropriate number for each of the following criteria. Add up the scores for each part and record at the end of each part. Comments which clarify answers or provide supporting information may be included in the right margin of the worksheet or attached on a separate sheet of paper.

Part 1: Impact on Habitats, Ecosystems, and Land Use

This section assesses the ability of the species or release to adversely affect habitats, ecosystems, and agricultural areas.

1) Ability to invade natural systems where the species does not naturally occur

a) Species not known to spread into natural areas on its own 0
b) Establishes only in areas where major disturbance has occurred in the last 20 years (e.g., natural disasters, highway corridors) **3**
c) Often establishes in mid- to late-successional natural areas where minor disturbances occur (e.g., tree falls, streambank erosion), but no major disturbance in last 20-75 years 6
d) Often establishes in intact or otherwise healthy natural areas with no major disturbance for at least 75 years 10

2) Negative impacts on ecosystem processes (e.g., altering fire occurrence, rapid growth may alter hydrology)

a) No perceivable negative impacts **0**
b) Minor negative impacts to ecosystem processes 2
c) Known significant negative impacts to ecosystems processes 6
d) Major, potentially irreversible, alteration or disruption of ecosystem processes 10

3) Impacts on the composition of plant communities where the species does not naturally occur

a) No negative impact; causes no perceivable changes in native populations **0**
b) Noticeable negative influences on community composition 5
c) Causes major negative alterations in community composition 10

4) Allelopathy

a) No known allelopathic effects on other plants **0**
b) Demonstrates allelopathic effects on seed germination of other plants 3
c) Demonstrates allelopathic effects to mature stages of other plants 5

5) Impact on habitat for wildlife or domestic animals (aquatic and terrestrial), including threatened and endangered species (coordinate with USFWS and state Heritage Programs as appropriate)

a) No negative impact on habitat, or this criteria not applicable based on intended use for the plant **0**
b) Minor negative impact on habitat (e.g., decreased palatability; lower wildlife value; decreased value for undesirable animal species) 2
c) Significant negative impact on habitat (e.g., foliage toxic to animals; significantly lower value for wildlife; excludes desirable animal species from an area) 5

6) Impact on other land use

a) No negative impacts on other land uses **0**
b) Minor impacts (plant could invade adjacent areas and decrease its value) 3
c) Significant impacts (plant may alter the system or adjacent lands significantly enough to prevent certain uses) 5

Total Possible Points 45

Total Points for Part 1 3

Part 2. Ease of Management

This part evaluates the degree of management which might be needed to control the species or release if it becomes a problem, or eradicate the species or release if it is no longer desirable.

1) Level of effort required for control

a) Effective control can be achieved with mechanical treatment 0
b) Can be controlled with one chemical treatment **2**
c) One or two chemical or mechanical treatments required or biological control is available or practical 5
d) Repeated chemical or mechanical control measures required 10

2) Effectiveness of community management to potentially control the plant release

a) No management is needed, the plant release is short-lived and will significantly decrease or disappear within 5 years under normal conditions without human intervention 0
b) Routine management of a community or restoration/preservation practices (e.g., prescribed burning, flooding, controlled disturbance, pasture renovation) effectively controls the release **2**
c) Cultural techniques beyond routine management can be used to control the release 4
d) The previous options are not effective for managing or controlling the release 10

3) Side effects of chemical or mechanical control measures

a) Control measures used on release will have little or no effect on other plants — 0
b) Control measures used on release will cause moderate effects on other plants — **3**
c) Control measures used on release will cause major effects on other plants — 5

**If spreads by seed, or both seed and vegetative means, go to #4
**If spreads by vegetative means only, go to #5

4) Seed banks

a) Seeds viable in the soil for 1 year or less — 0
b) Seeds remain viable in the soil for 2-3 years — 1
c) Seeds remain viable in the soil for 4-5 years — **3**
d) Seeds remain viable in the soil for more than 5 years — 5

5) Vegetative regeneration under natural conditions

a) Regeneration from resprouting of cut stumps — **1**
b) Regeneration from pieces of the root left in the soil — 3
c) Regeneration from root or stem parts left in the soil — 5

6) Resprouts after cutting above-ground parts

a) Does not resprout or resprouts but the release is sterile and does not produce seed — 0
b) Resprouts and produces seed in future years — **3**
c) Resprouts and produces seed in same year — 5

Total Possible Points 40
Total Points for Part 2 14

Part 3. Conservation Need and Plant Use

This part evaluates the importance of the species or release to meet a conservation need.

1) Potential Use(s) of the Plant Release

a) Used for low-priority issues or single use — 1
b) Has several uses within conservation — **2**
c) Has many uses within conservation as well as outside of conservation — 4
d) Has high-priority use within conservation — 5

2) Availability of Other Plants to Solve the Same Need

a) Many other plants available — 1
b) Few other plants available — **3**
c) No other plants available — 5

3) Consequences of <u>Not</u> Releasing This Plant

a) No impact to conservation practices	0
b) Minor impact on one or more conservation practice	1
c) Serious impact on one conservation practice	**3**
d) Serious impact on more than one conservation practices	5
Total Possible Points	**15**
Total Points for Part 3	**8**

<u>Part 4. Biological Characteristics</u>

This part evaluates the biological properties which indicate the natural ability of the species or release to propagate and maintain itself under natural conditions. Note: these criteria relate to the species <u>under natural conditions</u>, as opposed to the species under managed conditions used to increase the species, i.e. seed increase programs, or specific propagation methods which do not normally occur in nature.

1) Typical mode of reproduction under natural conditions

a) Plant does not increase by seed or vegetative means (<u>skip to #11</u>)	0
b) Reproduces almost entirely by vegetative means	1
c) Reproduces only by seeds	**3**
d) Reproduces vegetatively and by seed	5

2) Reproduction (by seed or vegetative) in geographic area of intended use

a) Reproduces only outside the geographic area of intended use	1
b) Reproduces within the geographic area of intended use	3
c) Reproduces in all areas of the United States where plant can be grown	**5**

3) Time required to reach reproductive maturity by seed or vegetative methods

a) Requires more than 10 years	1
b) Requires 5-10 years	2
c) Requires 2-5 years	3
d) Requires 1 year	**5**

<u>** If reproduces only by seed, skip to #5</u>

4) Vegetative reproduction (by rhizomes, suckering, or self-layering)

a) Vegetative reproduction rate maintains population (plant spreads but older parts die out)	1
b) Vegetative reproduction rate results in moderate increase in population size (plant spreads <3' per year)	3
c) Vegetative reproduction rate results in rapid increase in population size (plant spreads >3' per year)	5

** If reproduces only vegetatively, skip to #11

5) Ability to complete sexual reproductive cycle in area of intended use

a) Not observed to complete sexual reproductive cycle in the geographic area of intended use, but completes sexual reproduction in distant areas of the United States — 1

b) Not observed to complete sexual reproductive cycle in the geographic area of intended use, but completes sexual reproduction in adjoining geographic areas — 3

c) Observed to complete the sexual reproductive cycle in the geographic area of intended use — **5**

6) Frequency of sexual reproduction for mature plant

a) Almost never reproduces sexually — 0

b) Once every five or more years — 1

c) Every other year — 3

d) One or more times a year — **5**

7) Number of viable seeds per mature plant each reproductive cycle

a) None (does not produce viable seed) — 0

b) Few (1-10) — 1

c) Moderate (11-1,000) — **3**

d) Many-seeded (>1,000) — 5

8) Dispersal ability

a) Limited dispersal (<20') and few plants produced (<100) — **1**

b) Limited dispersal (<20') and many plants produced (>100) — 3

c) Greater dispersal (>20') and few plants produced (<100) — 7

d) Greater dispersal (>20') and many plants produced (>100) — 10

9) Germination requirements

a) Requires open soil and disturbance to germinate — **1**

b) Can germinate in vegetated areas but in a narrow range or in special conditions — 5

c) Can germinate in existing vegetation in a wide range of conditions — 10

10) Hybridization

a) Has not been observed to hybridize outside the species — **0**

b) Hybridizes with other species in the same genera — 3

c) Hybridizes with other genera — 5

11) Competitive ability (of established plants)

a) Poor competitor for limiting factors	**0**
b) Moderately competitive for limiting factors	5
c) Highly competitive for limiting factors	10
Total Possible Points	**70**
Total Points for Part 4	**28**

References

Many of the criteria used in this rating system were adapted from the following sources:

Hiebert, Ron D. and James Stubbendieck. 1993. Handbook for Ranking Exotic Plants for Management and Control. US Department of the Interior, National Park Service, Denver, CO.

Randall, John M., Nancy Benton, Larry E. Morse, and Gwendolyn A. Thornhurst. 1999. Criteria for Ranking Alien Wildland Weeds. The Nature Conservancy, Arlington, VA.

Section B. Scoring and Interpretation

Based on the scores from above, circle the points range you scored to determine the appropriate interpretation. The interpretation will be used to determine the course of action for the release.

Part	Points Scored	Interpretation
Part 1. Impacts on Habitats, Ecosystems, and Land Use	0-15	**Low** chance plant is going to affect the environment
	16-25	**Mod**erate chance plant is going to affect the environment
	26-45	**High** chance plant is going to affect the environment
Part 2. Ease of Management	0-20	**Easy** to control
	21-30	**Mod**erate to control
	31-40	**Diff**icult to control
Part 3. Conservation Need and Plant Use	0-5	**Low** need
	6-9	**Mod**erate need
	10-15	**High** need
Part 4. Biological Characteristics	0-25	**Low** chance plant is going to propagate and increase itself
	26-40	**Mod**erate chance plant is going to propagate and increase itself
	41-70	**High** chance plant is going to propagate and increase itself

Release Documentation

For

Anatone Bluebunch Wheatgrass

Site Adaptability Studies

Seed Collection:

Eighty native seed collections of bluebunch wheatgrass (*Pseudoroegneria spicata* [Pursh] A. Löve ssp. *spicata*) and Snake River wheatgrass (*Elymus wawawaiensis* J. Carlson and Barkworth) were obtained in 1988 and 1989. Bluebunch wheatgrass was acquired in eight western states from principal locations in Idaho, Colorado, Montana, Nevada, Oregon, Utah, Washington, and Wyoming. Snake River wheatgrass was also collected from southeastern Washington and northeastern Oregon. A primary objective was to select and develop plant materials adapted to the more arid areas of the species range, particularly sites in the Lower Snake River Plain and portions of the Great Basin. Plants exhibiting good seedling vigor, adaptability to arid sites, and competitive attributes to compete with annual weeds were also emphasized. Unaltered germ plasm was emphasized to provide material that would be native to specific regions. Previous site adaptability trials in central Idaho beginning in 1979 reveled that material from the Palouse Prairie exhibited these characteristics, and collections were concentrated from this region. 'Goldar' and 'Whitmar' bluebunch wheatgrass are currently the only two released cultivars available, and both originate from this region. Goldar does not have sufficient drought tolerance to persist in the more arid regions where the species naturally occurs. Whitmar is an awnless form selected, in part, for this trait. Limited selection was made to promote this cultivar, yet it exhibits many of the seedling vigor and drought tolerance traits of Anatone. The selection processes used to develop this cultivar may have diminished some adaptive traits.

Field Evaluation Studies

Field plantings were established to evaluate initial establishment, survival over time, annual growth, plant vigor, seed production, and phenological growth responses on arid study sites naturally occupied by this species. Containerized seedlings of 53 of the bluebunch wheatgrass and Snake River wheatgrass collections were planted at the Orchard Research Site, Ada County, Idaho, and at Nephi, Juab County, Utah, in the spring 1989 and 1990. At each field location, plantings were arranged in three blocks with a completely randomized block design. Within blocks, a plot of 24 plants represented each accession. Data were collected during the years of 1989, 1991, 1993, 1994, 1995, and 2001.

<u>Orchard Research Study Site Description</u>

The site is located on the Lower Snake River Plain, about 32 km southeast of Boise, Idaho at an elevation of about 955 m. Mean annual precipitation is 200 to 300 mm and the average frost-free season is 140 to 190 days, Appendix 1. Soils are sandy, mixed, mesic Xeric Torriorthents. Native vegetation at the site was dominated by basin big sagebrush (*Artemisia tridentata* Nutt. ssp. *tridentata*), Wyoming big

sagebrush (*Artemisia tridentata* Nutt. ssp. *wyomingensis* Beetle & Young*)*, Sandberg bluegrass (*Poa sandbergii* J. Presl), Thurber needlegrass (*Achnatherum thurberianum* [Piper] Barkworth), and bluebunch wheatgrass. This area is typical of the drier regions of the Snake River Plain and portions of the Great Basin supporting big sagebrush and native bunch grasses including bluebunch wheatgrass. During the period of field evaluations, the area was subjected to periods of extremely low precipitation.

Description of Nephi/Levan Research Study Site

The Nephi site is 13 km southwest of Nephi, UT, on the Utah State University Agricultural Experiment Station's Nephi farm. Elevation is 1,580 m. The soil is deep with a clay loam texture and located on a 0 to 2 percent slope. Mean annual precipitation is 340 mm with 67 percent occurring from November to May, Appendix 2. Monthly precipitation during the first growing season was slightly below normal, particularly during the months of April, May, and June when transplants were becoming established. Mean annual temperature is 9.7 ^{o}C. This study site initially supported some basin big sagebrush, Wyoming big sagebrush, antelope bitterbrush (*Purshia tridentate [Pursh] DC.*), bluebunch wheatgrass, and western wheatgrass (*Pascopyrum smithii [Rydb.] Love)*. The site has been used for testing dryland grains, oil crops, numerous introduced and native forage grasses, broadleaf herbs, shrubs, and some seasonal livestock grazing trials.

Results -- Plant Establishment and Survival

Orchard Study Site - All five collections of Snake River wheatgrass, 'Secar' (B24); Enterprise, OR (B51); Colton, WA (B66); Wawawai, WA (B79); Penawawa, WA (B82), established and persisted better than most all collections of bluebunch wheatgrass, Table 1. With the exception of the Asotin (B54) collection that is in close proximity to the Anatone (B53) and Colton (B67) collection sites, total survival in 2001 of each Snake River wheatgrass collections exceeded any other collection of bluebunch wheatgrass under study. Total survival is a percentage of plants actually alive at the 2001, and is based on the numbers alive in 1990. Accessions with high initial establishment percentages are more likely to record high total survival rates. Collections of bluebunch wheatgrass from southeastern Washington, northeastern Oregon, and extreme western Idaho established better under arid conditions than collections from any other region. Bluebunch wheatgrass collections with the highest total survival in 2001 consisted of material from Asotin, WA (B54); Dodge, WA (B7); Colton, WA (B67); and Levan, UT (B34). Total survival percentages of these collections were not significantly different from the five collections of Snake River wheatgrass.

Persistence of plants that initially established is an important index of the adaptability of each accession to the individual study site. All five Snake River wheatgrass collections including Secar ranked in the top eight positions for survival in 2001. Collections of bluebunch wheatgrass from Colton, WA (B67); Brownlee Dam. ID (B49); Pataha, WA (B77); Dodge, WA (B76); Roosevelt, WA (B74); Asotin, WA (B54); Grande Ronde, WA (B52); and Anatone, WA (B53) recorded the highest survival percentages in 2001 of all bluebunch wheatgrass accessions under test. Survival percentages were not significantly different among these accessions or among the Snake River wheatgrass accessions. However, percent survival for the Colton accession was 97 percent compared with 79 percent for the Anatone accession.

All southeastern Washington/northeastern Oregon/western Idaho collections of bluebunch wheatgrass are within a radius of about 100 kilometers. Most collections from southwestern Washington are located within 20 to 40 kilometers from the Anatone collection site, and appear as similar genetic material.

Although the origin of Goldar bluebunch wheatgrass is from Asotin County in southeastern Washington, the total or long-term survival of this cultivar (B25) was significantly lower at the Orchard site than other collections assembled from this same region. Total survival of many other accessions of bluebunch wheatgrass from other regions also surpassed that of Goldar (B25). In addition, Goldar plants exhibited poor survival during the period between 1990 and 2001. Of the initial plants that established in 1990, only 32 percent survived for the 11-year period. In comparison, survival percentages of other accessions from southwestern Washington ranged from 97 percent Colton (B67) to 79 percent Anatone (B54).

Establishment and persistence of material collected from local stands in close proximity of the Orchard study site included Birds of Prey (B26) and Crows Nest (B 27). These accessions failed to establish or survive at even moderate percentages. In addition, collections from central Utah, Levan (B34), failed to persist well from the time of initial establishment (1990) to 2001.

Table 1. Percent survival of bluebunch wheatgrass and Snake River wheatgrass accessions planted at the Orchard study site in 1989. Within years accessions followed by different letters differ at <0.05. Survival at the juvenile stage in 1990 and the mature stage in 1995 are based on the plants surviving from the previous stage. Survival in 2001 is based on the number of plants alive in 1990. Overall survival is the percent of plants to survive through the 2001 season. **Bold print designates Snake River wheatgrass accessions.**

Origin	Accession Number Survival	1989 Transplant Survival	1990 Juvenile Survival	1995 Adult Survival	2001 Adult	Total Survival
Enterprise, OR	**B51**	**75 ab**	**85 a**	**95 a**	**93 a**	**79 a**
Penawawa, WA	**B82**	**79 a**	**81 ab**	**95 a**	**84 a**	**71 ab**
Wawawai, WA	**B79**	**63 abcd**	**72 abcd**	**95 a**	**88 a**	**64 abc**
Asotin, WA	B54	71 abc	75 abc	87 a	82 a	60 abcd
Colton, WA	**B66**	**53 abcde**	**56 abcde**	**100 a**	**98 a**	**54 abcde**
Secar	**B24**	**60 abcde**	**65 abcde**	**89 a**	**86 a**	**54 abcde**
Dodge, WA	B76	58 abcde	63 abcde	100 a	83 a	53 abcde
Colton, WA	B67	46 abcde	50 abcde	100 a	97 a	49 abcdef
Lavan, UT	B34	61 abcd	68 abcde	73 a	69 a	47 abcdefg
Roosevelt, WA	B74	47 abcde	54 abcde	94 a	82 a	44 bcdefgh
Grand Gorge, WA	B52	47 abcde	54 abcde	78 a	80 a	43 bcdefghi
Pataha, WA	B77	49 abcde	50 abcde	86 a	86 a	43 bcdefghi
Anatone, WA	B53	44 abcde	46 abcde	86 a	79 a	38 bcdefghij
Baker, OR	B68	44 abcde	56 abcde	78 a	65 a	35 bcdefghij
Connell, WA	B80	38 abcde	46 abcde	55 a	63 a	35 bcdefghij
Snowville, UT	B45	49 abcde	57 abcde	79 a	50 a	33 cdefghij
Lewiston, ID	B55	51 abcde	54 abcde	73 a	62 a	33 cdefghij
Crows Nest, ID	B27	42 abcde	56 abcde	52 a	52 a	32 cdefghij
Colton, WA	B83	46 abcde	47 abcde	63 a	59 a	31 cdefghij
Walla Walla, WA	B75	29 abcde	38 abcde	65 a	74 a	28 cdefghij
Maryhill, WA	B72	38 abcde	44 abcde	58 a	56 a	26 cdefghij
Salmon, ID	B57	40 abcde	46 abcde	55 a	55 a	24 defghij
Livingston, WA	B81	33 abcde	42 abcde	68 a	59 a	23 defghij
Lamoille Cyn, NV	B43	33 abcde	44 abcde	52 a	58 a	22 defghij
Roosevelt, WA	B73	51 abcde	53 abcde	65 a	42 a	21 defghij
Denio, NV	B41	28 abcde	31 bcde	82 a	76 a	21 defghij
Goldar	B25	47abcde	56 abcde	60 a	32 a	21 deghij
Riggins, ID	B64	47 abcde	46 abcde	55 a	39 a	19 efghij
Council, ID	B48	42 abcde	40 abcde	43 a	42 a	18 efghij
Dingle, ID	B61	53 abcde	51 abcde	33 a	22 a	17 efghij
Brownlee Dam, ID	B49	19 cde	19 de	91 a	88 a	17 efghij
Arco, ID	B60	15 de	31 bcde	78 a	45 a	17 efghij
Yakima, WA	B84	21 cde	32 bcde	66 a	38 a	13 fghij
Salt Lake City, UT	B30	46 abcde	46 abcde	27 a	19 a	10 fghij
Wallowa Mtns., OR	B50	29 abcde	38 abcde	48 a	20 a	8 fghij
Pittsburg Landing, ID	B46	17cde	19 de	68 a	68 a	8 fghij
Immigrant Pass, NV	B42	26 abcde	32 bcde	38 a	29 a	8 fghij
Riggings, ID	B65	29 abcde	31 bcde	45 a	39 a	7 ghij
Mona, UT	B33	44 abcde	43 abcde	46 a	18 a	7 ghij
Pittsburg Landing, ID	B47	17 cde	17 e	30 a	34 a	7 ghij
Lindon, UT	B31	22 bde	19 de	74 a	18 a	6 hij

Table 1 continued

Hyde Park, UT	B32	18 cde	24 cde	18 a	16 a	4 hij
Yuba Dam, UT	B28	29 abcde	32 bcde	39 a	22 a	4 hij
Birds of Prey, ID	B26	13 de	15 e	77 a	43 a	4 hij
Fairfield, ID	B63	24 bcde	22 cde	25 a	11 a	4 hij
Provo, UT	B29	25 bcde	15 e	64 a	27 a	4 hij
Grandview Cyn., ID	B58	22 bcde	25 cde	53 a	27 a	4 hij
Yuba Dam, UT	B62	38 abcde	39 abcde	44 a	16 a	4 hij
Pequop Summit, NV	B44	6 e	14 e	57 a	8 a	3 hij
The Dalles, OR	B71	24 bcde	29 bcde	5 a	5 a	1 hij
Arco, ID	B59	19 cde	21 de	50 a	17 a	1 hij
Paradise Valley, NV	B40	18 cde	18 de	42 a	7 a	1 hij
Frisco, UT	B36	35 abcde	31 bcde	27 a	0	0 j

Nephi Study Site - Bluebunch wheatgrass accessions survived much better at the Nephi study site than any accessions of Snake River wheatgrass, indicating that bluebunch wheatgrass is better adapted to more mesic sites within the range of this species and Snake River wheatgrass is better adapted to more arid conditions. Accessions of bluebunch wheatgrass from Anatone, WA (B53) and Colton, WA (B67) survived and preformed better than any other accession including material from southeastern Washington/northeastern Oregon/western Idaho. Total survival of accessions from Council, ID (B48); Colton, WA (B67); Yuba Dam, UT (B28); Wallowa, OR (B50); and Anatone, WA (B53) exceeded 50 percent. However, plant survival of the Anatone (B53) accession from 1990 to 2001 exceeded the other accessions. Total survival of plants from the Council, ID (B48) accession exceeded any other accession under study, but significant loss of plants occurred from 1990 to 2001 indicating persistence of this accession is only fair or poor.

Selections of bluebunch wheatgrass from Utah populations near the Nephi planting site were much better adapted to this location than accessions from most other regions. Accessions from Yuba Dam, UT (B28), Levan, UT (B34), and Provo, UT (B29) had high total survival and persisted well during the study period. However, survival of accessions from the Anatone region equaled or excelled the Utah and all other accessions.

Goldar (B25) bluebunch wheatgrass preformed much better at this site as it receives higher amounts of precipitation than the Orchard study site. However, total survival and survival from 1990 to 2001 of Goldar (B25) was both lower than Anatone (B53) and three Utah accessions. Based on plantings at the Idaho and Utah study sites, the Anatone, WA and Colton, WA accessions demonstrated better adaptability to a wider range of sites than accessions from other regional locations.

Table 2. Survival percentages of bluebunch wheatgrass and Snake River wheatgrass Accessions planted at the Nephi study site in 1989. Within years accessions followed by different letters differ at <0.05. Survival at the juvenile stage in 1990 and the adult stage in 1995 is based on the plants surviving from the previous stage. Survival in 2001 is based on the number of plants alive in 1990. Overall or total survival is the percent of plants to survive through the 2001 season. **Bold print designates Snake River wheatgrass accessions.**

Accession Number	Origin	1989 Transplant Survival	1990 Juvenile Survival	1995 Adult Survival	2001 Adult Survival	Total Survival
B48	Council, ID	63 abcdef	40 abcdefg	74 a	54 ab	60 a
B83	Colton, WA	65 abcde	63 abc	98 a	88 ab	56 ab
B28	Yuba Dam, UT	92 a	71 ab	90 a	72 ab	53 abc
B50	Wallowa Mtns. OR	75 abc	61 abcd	94 a	78 ab	50 abc
B53	Anatone, WA	54 abcdefg	54 abcdesg	95 a	96 ab	50 abc
B29	Provo, UT	63 abcdef	51 abcdef	91 a	89 ab	47 abc
B34	Levan, UT	65 abcde	61 abcd	100 a	77 ab	46 abc
B25	Goldar	51 abcdefg	51 abcdef	88 a	84 ab	43 abc
B70	Prouder Park, CO	89 ab	86 a	90 a	50 ab	43 abc
B52	Grande Ronde, WA	57 abcdefg	56 abcde	85 a	78 ab	43 abc
B61	Dingle, ID	68 abcdef	53 abcdef	97 a	76 ab	42 abc
B43	Lamoille Cyn. NV	56 abcdefg	46 abcdefg	94 a	91 ab	40 abc
B67	Colton, WA	72 abc	57 abcde	93 a	73 ab	40 abc
B68	Baker, OR	61 abcdef	57 abcde	90 a	72 ab	40 abc
B32	Hyde Park, UT	51 abcdefg	43 abcdefg	95 a	93 ab	40 abc
B80	Connell, WA	71 abc	42 abcdefg	100 a	100 a	40 abc
B32	Conners Pass, NV	78 abc	64 abc	96 a	65 ab	39 abc
B31	Lindon, UT	61 abcdef	42 abcdefg	100 a	92 ad	39 abc
B60	Evanston, WY	72 abc	71 ab	96 a	56 ab	39 abc
B70	**Wawawai, WA**	**68 abcd**	**47 abcdefg**	**72 a**	**77 ab**	**38 abc**
B69	Meeker, CO	54 abcdgeg	47 abcdefg	94 a	74 a	36 abc
B66	**Colton, WA**	**74 abc**	**47 abcdefg**	**82 a**	**76 ab**	**36 abc**
B55	Lewiston, ID	71 abc	47 abcdefg	82 a	65 ab	35 abc
B54	Asotin, WA	50 abcdefg	54 abcdef	92 a	65 ab	38 abc
B47	Pittsburg Landing, ID	38 abcdefg	35 abcdefg	94 a	93 ab	32 abc
B75	Walla Walla, WA	50 abcdefg	43 abcdefg	88 a	72 ab	31 abc
B27	Crows Nest, ID	67 abcde	51 abcdef	85 a	54 ab	29 abc
B56	Lolo, MT	40 abcdefg	40 bcdefg	97 a	57 ab	29 abc
B49	Brownlee Dam, ID	43 abcdefg	35 bcdefg	83 a	80 ab	28 abc
B46	Pittsburg landing, ID	57 abcdefg	36 bcdefg	83 a	75 ab	26 abc
B24	**Secar**	**46 abcdefg**	**38 bcdefg**	**84 a**	**68 ab**	**25 abc**
B65	Riggins, ID	56 abcdefg	44 abcdefg	86 a	75 ab	24 abc
B64	Riggins, ID	51 abcdefg	29 bcdefg	86 a	74 ab	22 abc
B62	Yuba Dam, UT	47 abcdefg	43 abcdefg	92 a	49 ab	21 abc
B30	Salt Lake City, UT	50 abcdefg	35 bcdefg	100 a	50 ab	19 abc
B33	Mona, UT	40 abcdefg	22 cdefg	95 a	54 ab	17 abc
B45	Snowville, UT	50 abcdefg	31 bcdefg	85 a	49 ab	15 abc
B82	**Penawawa Cyn., WA**	**64 abcdef**	**28 bcdefg**	**67 a**	**60 ab**	**15 abc**
B74	Roosevelt, WA	44 abcdefg	18 cdefg	63 a	61 ab	15 abc
B59	Arco, ID	53 abcdefg	32 bcdefg	67 a	48 ab	15 abc

Table 2, continued

B41	Denio, NV	25 cdefg	14 cdefg	100 a	100 a	14 abc
B37	Grt Basin Natl. Park, NV	57 abcdefg	42 abcdefg	75 a	29 b	14 abc
B71	The Dalles, OR	47 abcdefg	31 bcdefg	88 a	55 ab	13 abc
B51	**Enterprise, OR**	**32 cdefg**	**22 cdefg**	**92 a**	**50 ab**	**11 abc**
B42	Immigrant Pass, NV	13 fg	11 defg	100 a	92 ab	10 abc
B76	Dodge, WA	42 abcdefg	25 bcdefg	73 a	36 a	8 abc
B72	Maryhill, WA	47 abcdefg	29 bcdefg	65 a	26 b	8 abc
B26	Birds of Prey, ID	46 abcdefg	19 cdefg	60 a	49 b	7 abc
B58	Grandview, ID	25 cdefg	26 bcdefg	67 a	30 b	7 abc
B36	Frisco, UT	74 abc	64 abc	63 a	8 b	6 bc
B63	Fairfield, ID	42 abcdefg	11 defg	71 a	44 b	6 bc
B57	Salmon, ID	6 g	6 efg	77 a	75 ab	4 bc
B44	Pequop Summit, WA	15 efg	13 defg	72 a	33 b	3 bc
B40	Paradise Valley, NV	18 defg	10 defg	57 a	22 b	3 bc
B77	Pataha, WA	29 cdefg	6 fg	25 a	33 b	1 bc
B84	Yakima, WA	6 g	3g	100 a	33 b	1 bc
B73	Roosevelt, WA	43 abcdefg	10 defg	57 a	6 b	1 bc
B35	Minersville, UT	54 abcdefg	17 cdefg	100 a	0	0

Plant vigor and annual growth were recorded between 1989 and 1995 and data was used to determine the health of each accession. Plant vigor, annual height, and crown measurements were summarized each year to create index values representing overall health and growth indices. Plant heights and crowns were given approximately equal value by adding the centimeters representing each together. This number was multiplied by plant vigor to provide an index of the general health of each accession. Index values were compared by year using analysis of variance. The index values for the Orchard and Nephi sites were not significantly different, thus data from both sites was combined to compare the overall differences among accessions, Table 3.

Plants from southeastern Washington/northeastern Oregon/western Idaho are larger and reach maturity faster than accessions from other regions. They also grow rather quickly in the early spring months. These growth attributes are similarly expressed in both bluebunch wheatgrass and Snake River wheatgrass collections obtained from this central region. The growth index of mature plants of Snake River wheatgrass from Enterprise, OR (B51) recorded in 1995 exceeded all other accessions in general health and plant vigor. Of all accessions under study, three of the top nine accessions were Snake River wheatgrass species. Although the index values of bluebunch wheatgrass from Grande Rhonde, WA (B52); Colton, WA (67); Anatone, WA (B54); Baker, OR (B68); Brownlee Dam, ID (B49); and Lewiston, ID (B67) are lower than the Enterprise accession, ratings are not significantly different among the entire group. The index ratings are significantly better than Secar Snake River wheatgrass, which, in turn, is significantly better than Goldar bluebunch wheatgrass.

The growth index can be used to evaluate the vigor and rate of maturation of individual accessions. Index values recorded in 1991, 1993, and 1994 indicate the vigor of young developing plants and are indicative of plant vigor and establishment capabilities, Table 3. The index values of Goldar and three accessions of Snake River wheatgrass including Secar exceed values of other accessions in 1991. By 1993, the index vales of nearly all accessions from the Washington/Oregon/Idaho region are similar and exceed values of all other accessions. As plants attain mature stature, the index values for Goldar, Secar, and a few other accessions from the same region diminish significantly. In contrast, accessions from Anatone, Colton and a few additional accessions from the same closely related location recorded high values as young and mature plants.

Table 3. Growth Index values for 25 collections of Snake River wheatgrass and bluebunch wheatgrass grown at Orchard Research Site, Ada Co., Idaho and Nephi, Juab Co., Utah. The index was derived for each accession by summing the mean height and crown dimensions (cm) and multiplying the result by a subjective vigor rating of 1-5 with 5 indicating greatest vigor. Within years, means followed by different letters differ significantly ($p<0.05$) (Monsen et al. 1999). **Bold print distinguishes Snake River wheatgrass accessions.**

	Year				
Accession	1989	1991	1993	1994	1995
Enterprise, OR	**76 b c**	**147 b c d e f g**	**510 a b c d**	**458 a b c**	**719 a**
Grande Ronde, WA	61 c d	133 c d e f g h I	528 a b c d	521 a	612 a b
Colton, WA	50 d e	151 b c d e f g	558 a b c	466 a b c	611 a b
Anatone, WA	35 e f g	163 b c d e	520 a b c d	459 a b c	610 a b
Baker, OR	82 b	155 b c d e f g	539 a b c d	532 a	601 a b
Brownlee Dam, ID	44 d e f	162 b c d e f	591 a	484 a b	600 a b
Wawawai, WA	**101 a**	**210 a**	**579 a b**	**507 a**	**586 a b**
Lewiston, ID	80 b	161 b c d e f	524 a b c d	434 a b c	586 a b
Penawawa Canyon, WA	**83 b**	**189 a b**	**486 a b c d e**	**454 a b c**	**581 a b**
Secar	**49 d e f**	**173 a b c d**	**474 a b c d e**	**423 a b c d**	**567 b c**
Colton, WA	**75 b c**	**137 c d e f g h**	**485 a b c d e**	**454 a b c**	**531 b c d**
Wallowa Mtns, OR	57 c d e	125 b c d e f g h i	427 b c d e	415 a b c d e	494 b c d
Dayton, WA	51 d e	112 e f g h i j	411 c d e f	373 b c d e	485 b c d e
Lamoille Canyon, NV	44 d e f	91 h i j	430 b c d e	348 c d e f	469 b c d e
Pittsburg Landing, ID	43 d e f	107 g h i j	507 a b c d	359 c d e f	443 c d e f
Dingle, ID	45 d e f	130 c d e f g h i	435 a b c d e	423 a b c d	441 c d e f
Goldar	26 f g	179 a b c	500 a b c d e	440 a b c	438 c d e f
Riggins, ID	61 c d	124 d e f g h i	349 e f g h	364 c d e f	399 f g
Levan, UT	46 d e f	110 f g h i j	414 c d e f	323 d e f	395 f g
Evanston, WY	42 d e f	106 g h i j	381 d e f g	314 e f	352 f g
Crows Nest, ID	46 d e f	87 h i j	281 f g h	217 g h	329 f g
Arco, ID	43 d e f	92 h i j	412 c d e f	275 f g	312 f g
Salmon, ID	42 d e f	115 e f g h i	257 g h	271 f g	302 f g
Snowville, UT	42 d e f	84 i j	281 f g h	305 f g	272 g
Birds of Prey, ID	20 g	63 j	226 h	175 h	261 g

Leaf and culm heights of all bluebunch wheatgrass and Snake River wheatgrass are similar within and among species and accessions, Table 4. The greatest differences were recorded in crown diameter. Based on crown diameter, plants from the Grande Rhonde (B52) and Anatone (B53) accessions are the largest specimens of all accessions under study. Anatone bluebunch wheatgrass plants are slightly larger than those of Goldar particularly when grown under arid conditions. Under favorable moisture conditions, Anatone plants are usually similar in leaf and stem heights as Secar, but have much larger crowns. Crown diameters of plants from Anatone also exceed those from Asotin (B54), Colton (B67), Roosevelt (73), and Connell (B80).

Seasonal periods of growth generally reflect the inherent adaptability of different populations to climatic conditions from the site of origin. Most accessions of bluebunch wheatgrass and Snake River wheatgrass begin growth early in the season and attain near maximum size within a few weeks, Table 5. Plants from the Anatone site follow this growth pattern, but continue to grow and retain some green leaves late into the summer months until soil moisture is exhausted. In comparison, plant collections from very arid regions typically senesce and become dormant in late spring or early summer as daily temperatures increase. Plants from the Anatone site also resume growth in the fall if moisture becomes available, and plants can remain green and active into the early winter months. The seasonal growth pattern of Anatone is extremely important in providing competition to the establishment and persistent of annual weeds, particularly fall germinating winter annuals such as cheatgrass. Early spring and late fall growth of Anatone furnishes competition to germinated seedlings in both the spring and fall months. In addition, plants that retain some green leaves into the summer months reduce the period when wildfires are likely to occur.

Table 4. Leaf and stem heights, crown size, and number of culms per plant of different bluebunch wheatgrass and Snake River wheatgrass accessions growing at the Nephi, UT study site, 2001. **Bold print distinguishes Snake River wheatgrass accessions.**

Accession Number	Origin	Leaf Height (cm)	Stem Height (cm)	Crown Diameter (cm)	Number Culms
B24	**'Secar'**	**46**	**81**	**79**	**74**
B25	'Goldar'	41	66	93	94
B27	Crows Nest, ID	40	71	48	27
B28	Yuba Dam, UT	41	68	67	37
B29	Provo, UT	44	76	80	43
B33	Mona, UT	43	71	88	72
B34	Levan, UT	39	78	72	63
B43	Lamoille Cyn., NV	45	76	82	96
B44	Pequop Summit, NV	45	71	58	52
B48	Council, ID	41	65	76	36
B50	Wallowa Mtns, OR	41	70	72	57
B51	**Enterprise, WA**	**46**	**88**	**77**	**108**
B52	Grande Rhonde, WA	50	76	100	84
B53	Anatone, WA	46	74	98	98
B54	Asotin, WA	45	72	82	42
B55	Lewiston, ID	52	80	91	75
B56	Lolo, MT	44	71	72	62
B60	Evanston, WY	45	68	62	66
B62	Yuba dam, UT	41	72	65	63
B66	**Colton, WA**	**44**	**81**	**69**	**50**
B67	Colton, WA	42	71	68	43
B69	Meeker, CO	44	74	92	74
B74	Roosevelt, WA	45	82	68	49
B76	Dodge, WA	44	71	88	52
B79	**Wawawai, WA**	**56**	**86**	**96**	**136**
B80	Connell, WA	45	70	84	75
B82	**Penawawa Cyn.,WA**	**49**	**86**	**84**	**80**

Table 5. Weekly growth rates of different accessions of bluebunch wheatgrass and Snake River wheatgrass, Orchard, ID study site, March 5 to March 26, 1997. **Bold print distinguishes Snake River wheatgrass accessions**.

Origin	Heights				Crowns			
	3/5	3/12	3/19	3/26	3/5	3/12	3/19	3/26
	(cm)							
B24, Secar	**30**	**38**	**34**	**33**	**49**	**54**	**47**	**53**
B25, Goldar	10	7	20	20	20	17	17	33
B27 Crows Nest	16	16	15	12*	26	28	30	33
B28 Yuba Dam	19	17	*		34	34		
B34 Levan	37	18	17	15	29	21	27	25
B43 Lamoille, NV	22	17	17	15	35	31	33	22
B45 Snowville	10	12	12	18	19	39	24	25
B50 Wallawa	12	15	17	*	25	22	20	
B51 Enterprise	**27**	**26**	**26**	**25**	**43**	**43**	**43**	**43**
B52 Grande Ronde	32	23	24	22	43	50	42	43
B53 Anatone	28	30	25	33	49	43	43	48
B54 Asotin	40	34	34	25	49	52	51	50
B60 Evanston	14	18	13	*	26	27	26	
B66 Colton	**46**	**43**	**45**	**45**	**68**	**62**	**66**	**68**
B67 Colton	52	46	49	43	58	58	58	45
B74 Roosevelt	44	47	52	40	54	61	62	60
B76 Dodge	34	33	33	27	50	53	51	58
B79 Wawawai	**41**	**44**	**43**	**30**	**69**	**67**	**60**	**60**
B82 Penawawa	**37**	**39**	**41**	**30**	**60**	**54**	**57**	**60**
B89 Antelope Island	15	10	17	17*	17	10	20	22
B90 Boise	27	23	17	24	27	26	20	26

* Plant senescence detected

Seed Features, Germination, Seedling Vigor and Establishment Studies

A series of closely related seed germination, planting depth trials, seed weight, and seed production trials were conducted and reported by Kitchen and Monsen (1994). Seeds collected from 47 naturally occurring populations of bluebunch wheatgrass and commercial collections of 'Hycrest' crested wheatgrass and Goldar bluebunch wheatgrass were germinated under laboratory conditions at 15/25 and 2 ^{o}C to determine near-optimum and near- freezing germination rates. Indices of germination rate were calculated using methods modified from Maguire (1962). In addition, greenhouse experiments were conducted to determine germination and emergence success from a planting depth of 0.4 cm. Seed weights for nine selected populations of bluebunch wheatgrass were also collected and weighed from native parental populations, common garden plantings, and field studies sites at Orchard, ID and Nephi, UT from 1988 to 1993.

Greenhouse germination rate indices varied from 25.2 to 51.2 at 15/25 ^{o}C and from 9.6 to 20.5 at 2 ^{o}C, Table 6. Cold-germination rate, seedling emergence success, and mean dry shoot weight of the Anatone accession were superior to all other accessions including Goldar. At 2 ^{o}C the germination rate index of Anatone approached that recorded for Hycrest crested wheatgrass, Table 7. Seeds of Anatone are programmed to germinate in the early spring at cool soil temperatures, which enhances seedling establishment and allows emerging seedlings to compete with early germinating weeds. Difference in germination rate is due to the rapid initiation of the coleoptile. The germination rate index of Anatone is significantly better than accessions from areas throughout the Snake River Plain and Great Basin where competition with annual weeds is a significant problem to artificial restoration and natural recruitment.

Seedling success of Anatone from a deep planting trial was superior to all bluebunch accessions and closely compared with Hycrest crested wheatgass, Tables 6, 7. In addition, the size or dry shoot weights of Anatone seedlings were also greater than any other bluebunch wheatgrass accession tested and compared favorably with Hycrest crested wheatgrass. The ability of this accession to germinate quickly at cold temperatures and emerge from deep planting trials affirms its superiority in seedling establishment and seedling vigor attributes.

Field plantings of a series of native and introduced perennial grass cultivars conducted as part of a Northern Great Plains Regional Grass Trials by scientists from the USDA, ARS Laboratory, gan, Utah included the Anatone accession, (Data on file at USDA, ARS Laboratory, Blair Waldron, Logan, UT). Direct seeding trials were established at Green Canyon, UT and Blue Creek, UT in 2000. Field ratings completed in the seedling year, 2001, recorded stand frequency and stand vigor, Table 9. Stand ratings of Anatone exceeded most accessions of bluebunch wheatgrass including Goldar, and equaled or exceeded the ratings of most other species under evaluation including many cultivars of crested wheatgrass.

Table 6. Mean germination rate, emergence percentage, dry shoot weight (mg), and number of seeds per gram for 47 collections of bluebunch wheatgrass from natural occurring populations and the cultivar, 'Goldar' (Kitchen and Monsen 1994) produced under agricultural conditions.

Geographic region	Germination rate index		Deep planting		
County, state	15/25 °C	1 °C	Emergence	Dry shoot weight	Seeds g-1
			%	mg	
Palouse Prairie					
Anatone	34.8	20.5	66	9.5	228
Asotin, WA	40.3	16.0	65	7.1	259
Garfield, WA (1)	39.1	20.3	25	4.0	276
Garfield, WA (2)	42.3	19.3	50	5.0	298
Whitman, WA	38.5	16.6	53	5.7	255
Nez Perce, ID	40.8	15.0	43	6.8	233
Snake River Canyon Area					
Adams, ID	33.1	-----	48	7.5	216
Idaho, ID (1)	34.5	14.4	39	5.6	260
Idaho, ID (2)	30.2	13.6	53	4.7	274
Idaho, ID (3)	29.7	14.6	41	4.1	243
Washington, ID (1)	33.3	14.3	43	7.2	176
Washington, ID (2)*	30.4	-----	16	2.5	240
Washington, ID (3)	36.3	16.7	53	5.4	197
Baker, OR (1)	33.9	13.3	38	5.6	196
Baker, OR (2)	28.5	11.8	25	2.7	253
Baker, OR (3)	31.7	12.8	58	5.7	176
Baker, OR (4)	27.0	15.3	59	5.7	178
Snake River Plain					
Ada, ID	33.9	14.8	40	4.0	258
Butte, ID	35.5	16.8	19	5.6	309
Clark, ID	29.7	14.6	8	0.6	437
Owyhee, ID	30.4	12.0	8	2.2	374
Malheur, OR	25.2	11.0	20	2.0	264
Western Great Basin					
Elko, NV	27.0	13.1	24	3.4	262
Eureka, NV	29.3	14.3	36	3.7	270
Humboldt, NV (1)	32.7	10.6	22	3.4	323
Humboldt, NV (2)	33.2	17.6	17	2.8	273
Eastern Great Basin					
Bear Lake, ID	32.7	14.2	25	2.7	376
Cache, UT	28.0	12.5	39	3.8	344
Davis, UT (1)	33.4	15.3	14	5.5	301
Davis, UT (2)**	29.3	12.2	-----	-----	285

Juab, UT (1)	29.8	15.0	14	3.5	343
Juab, UT (1)	33.3	13.9	12	3.3	317
Juab, UT (1)	31.5	13.0	5	5.5	403
Salt Lake, UT	28.4	12.0	8	3.3	312
Utah, UT	25.9	12.6	15	3.0	432
Utah, UT (2)	29.5	14.4	12	5.8	262
Salmon River Valley					
Custer, ID	40.1	18.1	28	2.7	352
Lemhi, ID	46.5	17.5	44	7.3	279
Bitterroot River Valley					
Missoula, MT	36.8	12.3	55	4.7	254
Ravalli, MT	37.6	15.3	39	3.6	237
Upper Colorado Plateau					
Garfield, CO	36.0	10.2	23	3.0	360
Moffat, CO	33.5	11.0	58	4.3	356
Rio Blanco, CO	33.0	10.8	34	3.9	356
Uinta, WY	32.9	13.0	6	2.5	378
Colorado Front Range					
Larimer, CO (1)	31.2	10.9	8	1.6	375
Larimer, CO (2)**	26.1	9.6	-----	------	403
Larimer, CO (3)	33.3	14.1	21	2.5	318
Cultivar					
Goldar'	51.2	17.8	47	8.4	201
Overall mean	33.4	14.2	32	4.4	291

*The 1 ^{o}C germination rate test was omitted for these accessions due to lack of seed.

**These accessions were not used in the greenhouse emergence test.

Table 7. Mean germination rate, emergence percentage, dry shoot weight (mg), and number of seeds per gram for select accessions of bluebunch wheatgrass and Hycrest crested wheatgrass (Kitchen and Monsen 1999).

This table summarizes data in Table 6 and compares performance of all bluebunch wheatgrass accessions in Table 6, Goldar, Anatone, and Hycrest crested wheatgrass. The Goldar and Hycrest seed was produced in seed fields, all other accessions were wildland collections.

	Germination Rate Index		Deep Planting		
Accession(s)	15/25 °C	1 °C	Emergence	Dry Shoot Weight	Seeds g^{-1}
			%	mg	
Mean of 48 bluebunch wheatgrass accessions	33.4	14.2	32	4.4	291
Goldar	51.2	17.8	47	8.4	201
Anatone	34.8	20.5	66	9.5	228
Hycrest	47.1	26.8	69	12.2	----

Table 8. Mean number of seeds per gram for nine accessions of bluebunch wheatgrass collected from native parent populations and from common garden and nursery sites at Orchard, Idaho and Nephi and Spanish Fork, Utah from 1988 to 1993. Within accessions means followed by the same letter are not significantly different (p>0.05) (SNK) (Kitchen and Monsen 1999).

	Seed Collection Site and Year[1]				
Accession	**P-88/89**	**P-93**	**0-93**	**N-93**	**S-93**
	----------seeds g^{-1}----------				
Brownlee, ID	175b	173b	170b	175b	136a
Anatone	228c	------	205b	194a	186a
Provo, UT	262b	263b	------	------	217a
Salmon, ID	279c	250b	------	------	186a
Asotin, WA.	------	282b	286b	------	172a
Grand Rhonde, WA	298c	------	210b	164a	------
Levan, UT	316d	254c	233b	196a	196a
Hamilton, CO	356c	256b	------	214a	211a
Meeker, CO	356d	302c	------	236b	218a

[1]P-88/89 or P-93 = Parent site or naturally occurring population collected in 1988/89 or 1993. O-93 = Orchard, ID common garden, 1993 collection. N-93 = Nephi, UT common garden 1994 collection. S-93 = Spanish Fork, UT nursery, 1993 collection.

Table 9. Performance of selected grass accessions at Green Canyon and Blue Creek, UT. Collections were seeded in November 1999 with a cone seeder at a rate of 40 PLS ft^{-2}. Data were collected in 2000 after the first growing season. Stand frequency is based on the grid method described by Vogel and Masters (2001). Dry matter yield (DMY) is expressed in kg ha^{-1}. Stand vigor: Visual rating: 1-9 (9=best). Obs=observations, 14 possible (Data provided by Blair Waldron, USDA-ARS, Logan, UT).

Species	Entry	DMY (kg ha^{-1})	Obs.	Stand freq (%)	Obs.	Stand vigor	Obs.
Bluebunch wheatgrass	ACC_238_2X	1670	6	42	6	6.2	6
Bluebunch wheatgrass	ANATONE	1855	5	54	5	7.2	5
Bluebunch wheatgrass	GOLDAR	2109	6	46	6	7.0	6
Bluebunch wheatgrass	P4_4x	2089	6	46	6	6.3	6
Bluebunch wheatgrass	P5_2X	1918	5	52	5	7.8	5
Bluebunch wheatgrass	P7_2X	1706	5	40	5	6.6	5
Crested wheatgrass	CD2	2226	6	30	6	7.3	6
Crested wheatgrass	DOUGLAS	1507	6	46	6	5.5	6
Crested wheatgrass	FAIRWAY	1693	7	39	7	6.0	7
Crested wheatgrass	HXB28	2560	6	41	6	7.8	6
Crested wheatgrass	HYCREST	3858	6	39	6	7.5	6
Crested wheatgrass	I28	2820	7	49	7	7.9	7
Crested wheatgrass	KAZAK_SIB	1471	4	32	5	4.6	5
Crested wheatgrass	NE_AC1	2024	6	37	6	5.7	6
Crested wheatgrass	NE_AC2	2574	7	50	7	6.7	7
Crested wheatgrass	NORDAN	2806	6	48	6	7.7	6
Crested wheatgrass	NORDAN_HYLD_HDMD	2566	5	36	5	6.6	5
Crested wheatgrass	P27	2192	5	46	6	5.7	6
Crested wheatgrass	PUB_SIBERIAN	1514	7	46	7	6.6	7
Crested wheatgrass	ROADCREST	1828	5	39	6	5.2	6
Crested wheatgrass	RUFF_HYLD_HDMD_C	2872	6	49	6	6.8	6
Crested wheatgrass	VAVILOV	2712	6	45	6	6.8	6
Indian ricegrass	NEZPAR_IRG	1130	3	34	6	2.5	6
Indian ricegrass	RIMROCK_IRG	568	2	35	5	2.2	5
Russian wildrye	BOZETET	1076	6	47	6	6.8	6
Russian wildrye	BOZOISKY	929	6	28	6	4.8	6
Russian wildrye	MANKOTA	743	6	31	6	4.0	6
Russian wildrye	ND_SYN_1831_2x	562	6	43	6	4.7	6
Russian wildrye	ND_SYN_1981_2x	1179	5	44	5	6.6	5
Russian wildrye	ND_SYN_1983_4x	915	5	44	5	6.8	5
Russian wildrye	SYNA	1182	3	48	4	6.5	4
Russian wildrye	TETRA1	609	4	43	5	5.6	5
Russian wildrye	TETRACAN	931	6	43	6	6.0	6
Snake River wheatgrass	E21	1436	6	34	6	6.0	6
Snake River wheatgrass	E25	1155	4	33	5	4.8	4
Snake River wheatgrass	E29	1528	6	47	6	5.7	6
Snake River wheatgrass	SECAR	605	3	44	5	3.0	4
Snake River wheatgrass	SECAR_YAKIMA	860	4	34	5	5.4	5

Squirreltail	SANDHOLLOW_ST	1437	6	33	6	5.3	6
Thickspike wheatgrass	BANNOCK	2236	5	57	5	6.4	5
Thickspike wheatgrass	CRITANA	1983	5	50	5	6.8	5
Thickspike wheatgrass	CRITANAXBANNOCK	1891	6	55	6	6.7	6
Thickspike wheatgrass	SODAR	1282	6	48	6	5.8	6
Western wheatgrass	ARRIBA	2085	5	69	5	6.6	5
Western wheatgrass	FLINTLOCK	996	5	62	6	5.2	6
Western wheatgrass	NE_EXP_1	855	5	70	5	4.8	5
Western wheatgrass	RODAN	1447	3	59	5	4.0	4
Western wheatgrass	ROSANA	748	5	61	5	6.2	5

Seed Production:

Seed production fields have been in place since 1999, and first-year harvests from nine locations report yields ranging between 168 to 195 kg ha^{-1}. Mature stands produce between 195 and 328 kg ha^{-1}, although yields as high as 563 kg ha^{-1} have been reported. Bulk seed production of Anatone (170 kg ha^{-1}) exceeded that of a same-age Goldar field (156 kg ha^{-1}) at the Aberdeen NRCS Plant Center, but seed production from much larger and mature fields in central Washington report that Anatone produced only half the rate as established fields of Secar.

Anatone seeds are relative large and easy to clean. Approximately 60 percent of all seeds support a short awn that is easily removed, and does not create problems in harvesting or processing.

Wildland stands of Anatone normally produce some seeds each year. The number of seed stocks that develop are reflective of the conditions of the planting site. Seed stocks were counted from planting sites at Orchard, ID and Nephi, UT at various years but no clear pattern was recognized among collections or annual growing conditions. Anatone plants produced about average number of stocks at the Orchard site in 1997, Table 11. Individual accessions appear to adjust to climatic conditions by reducing vegetative growth and seed stock formation. Plants from the Anatone location were able to produce seed under arid conditions in sufficient amounts to repopulate an existing stand.

Table 10. Seed production of Anatone bluebunch wheatgrass from cultivated plantings in Utah, Colorado, Idaho, and Washington

Planting Location	Hectares Planted	Age of Planting	Yields kg ha^{-1}	Comments
Sanpete Co., UT				
Spring City				
2001	2.2	2 years	168	Weedy site
2002	2.2	3 years	195	Moderate stand
2003	2.2	4 years	240	Mature stand
Ft. Green				
1999	0.6	2 years	294	Mature plants
Utah Co., UT				
Spanish Fork				
2002	1.82	2 years	0	Frost destroyed crop
2003	1.82	3 years	225	
Montezuma Co., CO				
2000	2.0	2 years	226	
2001	38.0	3 years	304	
2002	38.0	4 years	177	Drought problems
2003	42.0.	5 years	328	
Payette Co., ID				
Field 1				
2001	2.83	1 year	140	
2002	2.83	2 year	56	
2003	2.83	3 year	56	
Field 2				
2001	1.6	1 year	141	
2002	1.6	2 year	168	
2003	1.6	3 year	140	
Field 3				
2002	2.88	1 year	337	
2003	2.88	2 year	563	
Bingham Co., ID				
2002		1year	120	Spring frosts
Lincoln Co., WA				
2002	44.5	1 year	123	
2003	58.7	2 year	210	

Table 11. Number of seed stocks per plant for different accessions of bluebunch Wheatgrass and Snake River wheatgrass accessions growing at the Orchard, ID study site, 1997. **Bold print distinguishes Snake River wheatgrass accessions**.

Accession	Origin	Number Seed Stocks
B24	**'Secar'**	**63.0**
B25	'Goldar'	29.0
B27	Crows Nest, ID	71.0
B28	Yuba Dam, UT	71.0
B34	Levan, UT	50.6
B43	Lamoille Cyn., NV	108.4
B45	Snowville, UT	33.2
B50	Wallawa Mtns.,OR	33.0
B51	**Enterprise, OR**	**61.6**
B52	GrandeRonde,WA	112.9
B53	Anatone, WA	76.9
B54	Asotin, WA	46.7
B60	Evanston, WY	39.3
B66	**Colton, WA**	**63.0**
B67	Colton, WA	119.6
B74	Roosevelt, WA	87.4
B79	**Wawawai**	**138.5**
B82	Penawawa, WA	59.7
B83	**Colton, WA**	**103.0**

Areas of Adaptation

Anatone bluebunch wheatgrass demonstrates adaptability to areas outside its native region. From plantings conducted in the northern region of the Snake River Plain and central Utah, the over-all performance of Anatone was better than any other accession including Goldar. DNA studies conducted by scientists at the USDA, ARS Laboratory, Logan Utah, indicate that plant materials from Asotin, Garfield, and Whitmar Counties, Washington; Umatilla, Grant, and Wallowa Counties, Oregon; and Washington County, Idaho are genetically quite similar, Fig 1. Materials from Ada and Idaho Counties, Idaho are closely grouped together, but are also aligned with materials from southeastern Washington/northeastern Oregon/western Idaho. In addition, materials from Humboldt, Elko, Lander, and Eureka Counties, Nevada are also closely grouped together, yet are aligned as a part of a broad group with the Washington/Oregon/Idaho collections. The broad genetic relationship of bluebunch wheatgrass from these geographical regions would suggest plant materials from certain areas within the regions could have wide ecological adaptability. This has been conformed by the broad adaptability exhibited from field plantings of the Anatone selection.

Anatone is adapted to the sagebrush communities, foothill and mountainous regions where mountain brush species are intermixed with bunchgrasses. It persists in open parks and with moderate density of over story shrubs. It is adapted to well-drained and heavy texture soils, including rocky but deep profiles. It naturally grows with numerous other herbaceous species, but does persist and dominates many areas.

Table 12. Collection sites of bluebunch wheatgrass accessions included in DNA trials . Data on file Dr. Steve Larson, USDA, ARS Laboratory, Logan, Utah.

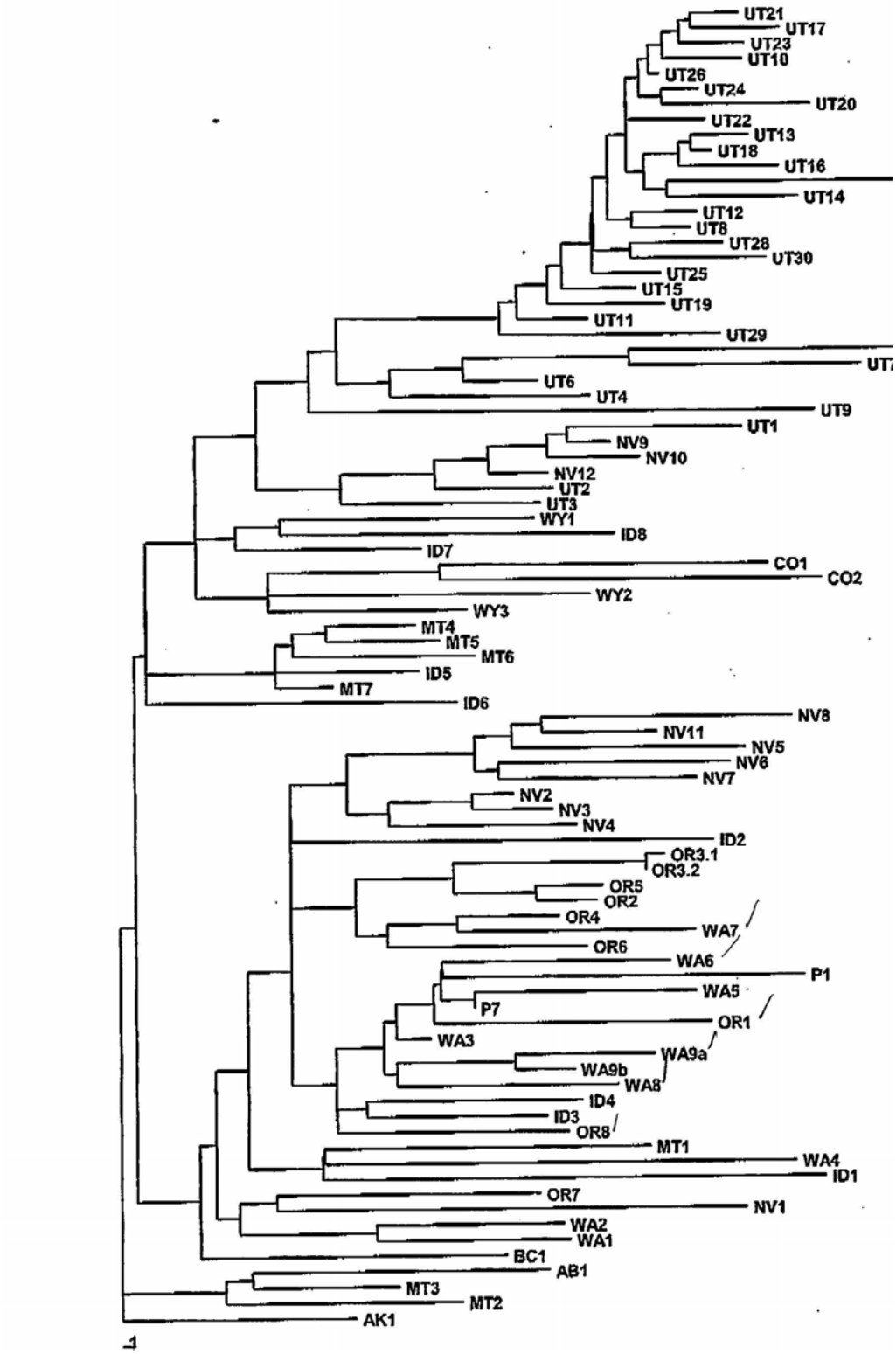
OTU Identification	Seed Origin
AB1	Old man Dam, AB
AK1	Milepost 289, Richardson Hwy
BC1	Slocan, BC
CO1	Poudre Park, Lamar Co., CO
CO2	Black Hawk, Gilpin Co., CO
ID1	Winchester, Lewis Co., ID
ID2	Brownlee Dam, Washington Co., ID
ID3	Hell's Canyon, Idaho Co., ID
ID4	Boise, Ada Co., ID
ID5	Salmon, Lemhi Co., ID
ID6	Magic Reservoir, Blaine Co., ID
ID7	Arco, Butte Co., ID
ID8	Aston Hill, Fremont Co., ID
MT1	Grinnell Glacier, Glacier N. P., MT
MT2	Lolo, Missoula Co., MT
MT3	Drummond-Garrison, Powell Co., MT
MT4	Lewis and Clark Co., MT
MT5	Broadwater Co., MT
MT6	Madison Co., MT
MT7	Livingston, Park Co., MT
NV1	Fish Springs, Washoe Co., NV
NV2	Cottonwood Creek, Humboldt Co., NV
NV3	Winnemucca, Humboldt Co., NV
NV4	Owyhee Desert, Elko Co., NV
NV5	Battle Mt. Lander Co., NV
NV6	Lone Mt., Elko Co., NV
NV7	Elko, Elko Co., NV
NV8	Eureka, Eureka Co., NV
NV9	Toano, Elko Co., NV
NV10	Montello, Elko Co., NV
MV11	Pinto Summit, Eureka Co., NV
MV12	Comins Lake, White Pine Co., NV
OR1	Hermiston, Umatilla Co., OR
OR2	Potamus Point, Marrow Co., OR

Table 12 , continued

OR3.1	Stumbough Ridge, Morrow Co., OR
OR4	Walla Walla RD., Umatilla Co., OR
OR5	Indian Creek, Grant Co., OR
OR6	Wallowa-Minam, Wallowa, OR
OR7	Burns, Harney Co., OR
OR8	Imnaha, Wallowa Co., OR
P1	Unknown
P7	Multiple Origin
UT1	Devil's Playground, Box Elder Co., UT
UT2	Curlew Junction, Box Elder Co., UT
UT3	Pinyon Flat, Box Elder Co., UT
UT4	Cold Water Canyon, Box Elder Co., UT
UT5	Logan Canyon, Box Elder Co., UT
UT6	Mantua, Box Elder Co., UT
UT7	Hardware Ranch, Cache Co., UT
UT8	Ogden Canyon, Weber Co., UT
UT9	Antelope Island, Davis Co., UT
UT10	Chriss Creek, Juab Co.,
UT11	North Tintic, Tooele Co., UT
UT12	Salt Lake City, Salt Lake Co., UT
UT13	Lindon, Utah Co., UT
UT14	Orem, Utah Co., UT
UT15	Paul Bunyan Woodpile, Juab Co., UT
UT16	Hobble Creek, Utah., UT
UT17	Mona, Juab Co., UT
UT18	Springville, Utah Co., UT
UT19	Yuba Dam, Juab Co., UT
UT20	Antelope Mt., Millard Co., UT
UT21	Spencer Fork, Sanpete Co., UT
UT22	Mud Springs, Millard Co., UT
UT23	Levan, Juab Co., UT
UT24	Mayfield, Sanpete Co., UT
UT25	Pigeon Hollow, Sanpete Co., UT
UT26	Ephraim, Sanpete Co., UT
UT27	Salina Canyon, Sevier Co., UT
UT28	Pigeon Water, Duchesne Co., UT
UT29	La Point, Uintah Co., UT
UT30	Antelope Canyon, Duchesne Co., UT
WA1	White Salmon, Klickitat Co., WA
WA2	Roosevelt, Klickitat Co., WA
WA3	Connell, Adams Co., WA
WA4	Steptoe Butte, Whitman Co., WA
WA5	Union Flat-Almota, Whitman Co., WA
WA6	Colton, Whitman Co., WA
WA7	Asotin-Wenaha, Garfield Co., WA

Table 12, continued

WA8	Asotin Co., WA
WA9a	Anatone, Asotin Co., WA
WAb	Anatone, Asotin Co., WA
WY1	Moon Lake, Sublette Co., WY
WY2	Flaming Gorge, Sweetwater Co., WY
WY3	Hiland, Natrona Co., WY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ID4
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OR8
MT1
WA4
ID1
OR7
NV1
WA2
WA1
BC1
AB1
MT3
MT2
AK1

Summary-Justification for Release

Anatone bluebunch wheatgrass is more widely adapted than any released cultivar throughout the broad region where this species naturally occurs. It is particularly adapted to mid and low elevations with more arid climatic conditions. It is superior to Goldar, and compares favorably to Secar at low elevations. Whitmar bluebunch wheatgrass was not included in any of the adaptability and survival studies. This cultivar was selected from a site near Colton, WA that is similar to the Anatone location. It has demonstrated excellent establishment traits and adaptability to arid regions. Only awnless plants were originally collected, and only certain plants within a spaced planting were selected for increase. The extent in which these selection measures may have diminished the germ plasm is not known, but it is apparent that material from this general region has superior traits that should be promoted. The objective of our selection process has been to provide an unaltered cultivar. Attempts were made to retain the genetic integrity of the native material from the Anatone location. The Anatone selection clearly demonstrates superior seedling survival and vigor from all accessions under study. Seeds germinate quickly from cold temperatures, and seedlings are much more vigorous and robust than other selections, comparing favorably with Hycrest crested wheatgrass. Under field plantings, seedling establishment and vigor exceeds accessions of other bluebunch wheatgrass and many other species. This selections provides a bluebunch wheatgrass accession that is much more drought tolerant than any cultivars currently available, and also furnishes an ecotypes with superior seed germination and seedling vigor.

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE, ROCKY MOUNTAIN RESEARCH STATION
PROVO, UTAH

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
BOISE, IDAHO

UTAH DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WILDLIFE RESOURCES
EPHRAIM, UTAH

UTAH STATE UNIVERSITY, AGRICULTURAL EXPERIMENT STATION
LOGAN, UTAH

UNIVERSITY OF IDAHO, AGRICULTURAL EXPERIMENT STATION
MOSCOW, IDAHO

NOTICE OF RELEASE, MAPLE GROVE GERMPLASM LEWIS FLAX SELECTED CLASS NATURAL POPULATION

The United States Department of Agriculture, Forest Service, Rocky Mountain Research Station; United States Department of Agriculture, Natural Resource Conservation Service; Utah Department of Natural Resources, Division of Wildlife Resources; Utah State University, Agricultural Experiment Station; and University of Idaho, Agricultural Experiment Station announce the release of a selected ecotype of Lewis flax (*Linum lewisii* Pursh) for restoration of disturbed sites in the central intermountain west region.

As a Selected Class (Natural Track) release, this plant will be referred to as Maple Grove Germplasm Lewis flax in reference to its collection site origin and in recognition of the distinct taxonomy and biology of this North American native forb in relation to the commonly planted blue flax (*Linum perenne* L.) cultivar 'Appar' with its European origin (Pendleton et al. 1993).

This alternative (pre-variety) release is justified because no named germplasm is currently available for this species and as a result of increasing demands for native forb plant materials to be available for use in restoration of degraded western rangelands and for limited horticultural uses. Although 'Appar' blue flax was originally released as a Lewis flax cultivar (Howard and Jorgensen 1980), recent work has determined that 'Appar' is morphologically and reproductively aligned with accessions of the European species *Linum perenne* (blue flax) which, with 'Appar', have been shown to be collectively distinct from North American Lewis flax collections (Pendleton et al. 1993). Apparently, the South Dakota population that 'Appar' was originally collected from did not represent native germplasm but rather a naturalized population of the European

species. Further justification for release of this germplasm is found in its overall superior performance in drought tolerance, plant longevity, seedling vigor, seed production, and rust resistance when compared with other western North American collections (Kitchen 1995).

Collection Site Information: The original collection of Maple Grove Germplasm was made in 1988 by Dr. Susan E. Meyer on Fishlake National Forest lands approximately 1 km northeast of Maple Grove Campground. Access is by US Highway 50 between the towns of Salina and Scipio, Utah. The Maple Grove Campground turnoff is approximately 20 km northwest of Salina. The collection site is situated on a northeast facing alluvial fan at 1,910 to1,920 m elevation and 10 to 15 percent slope, extending from the east side of the Pahvant Range. The soil at this location is a deep, well drained loam with variable amounts of gravel and cobble. Mean annual precipitation at Scipio (1,615 m) is 300 mm. Although Scipio has a lower elevation than the collection site, the elevational enhancement on precipitation is at least partially offset by a more severe rain shadow effect associated with the collection site. Subsequently, we estimate mean annual precipitation for the collection site to be 330 to 360 mm, two thirds of which occurs from October 1 to April 30. Mountain big sagebrush is the landscape dominant with scattered clones of Gambel oak also present. Common herbaceous associates include bluebunch wheatgrass, muttongrass, needle-and-thread grass, western wheatgrass, gooseberry-leaf globemallow, and mountain buckwheat.

Description: Lewis flax, *Linum lewisii* is a relatively short-lived (5-7 yrs.) perennial forb with few to many ascending stems arising from a woody caudex. Stems are generally un-branched below with alternately-spaced linear to oblong sessile leaves, 4 to 30 mm long distributed throughout. Herbage is glabrous and somewhat glaucous. Perfect flowers are borne in showy cymose clusters on most to all stems. Normal flowers have five petals, sepals, stamens, stigmas, and carpels. Petals vary in length from 12 to 25 mm and in color from deep blue to white. New flowers open daily and the flowering period may last for several weeks. Flowers open early in the day and petals are usually shed within 24 hrs of opening. The fruit is a 10-celled round to ovoid capsule, 6 to 8 mm long, which opens along inter-cell sutures at maturity. The flattened dark brown seeds are relatively small at 360 to 530 per g., or 10,200 to 15,000 per oz., (163,200 – 240,000 per lb.; Kitchen and Meyer 2001) and become mucilaginous when wet. The plant is anchored by a prominent tap root and is not rhizomatous.

Mature plants of Maple Grove Lewis flax are generally 75 to 90 cm tall under cultivation and 30 to 50 cm tall under natural conditions. Leaf, flower, fruit, and seed size and stem number per plant are mid-range for the species. The light blue petal color is also intermediate for the species. Flowering generally begins by mid-May and lasts for 4 to 6 weeks. Fruits ripen from early July to mid August depending upon climatic conditions.

Method of Selection: Maple Grove Lewis flax was selected based on a series of field and greenhouse trials conducted from 1989 to 1993 comparing 19 collections assembled from Utah (13), Nevada (2), Idaho (1), Washington (1), Colorado (1), and South Dakota (1), in comparison with ‘Appar’ blue flax (Kitchen 1995). Containerized stock from G0

seed was planted in a randomized block design near Orchard, ID and Nephi, UT in 1989. Survival and vigor at the two sites were evaluated for 2 and 4 years, respectively. Seed production and rust resistance were evaluated at the Nephi site in 1990 and 1991. Greenhouse trials assessing emergence and survival from deep plantings were established in 1991 to evaluate seedling vigor using G0 seed at the USDA Forest Service, Shrub Sciences Laboratory. Stand establishment and seed production in drill rows was evaluated for the Maple Grove accession of Lewis flax in comparison to 'Appar' blue flax at the Utah Division of Wildlife Resources, Great Basin Research Center, Ephraim, Utah and USDA Natural Resources Conservation Service, Aberdeen Plant Material Center, Aberdeen, ID from 2001 to 2003. Maple Grove was selected for release over other accessions based upon drought tolerance, plant longevity, seedling vigor, seed production, and rust resistance.

Ecological Considerations and Evaluation: This release is of a native species with widespread distribution throughout western North America. The selection is of a species with recognized benefits and no negative impacts on wild or domestic animals. No attempts have been made to alter the genetic makeup of the selection. Seed production fields have revealed no cultural problems using normal agronomic practices. The selection was rated as "OK to release" when evaluated with the "Worksheet for Conducting an Environmental Evaluation of NRCS Plant Releases."

Anticipated Use: Anticipated uses of Maple Grove Lewis flax will include biodiversity enhancement of restoration and reclamation plantings, wildlife habitat improvement, erosion control, and beautification within its zone of adaptation in the intermountain west. It is anticipated that the release will have primary application in restoration seed mixes developed by government and private entities requiring a component of native forbs. Limited horticultural use is also expected including revegetation of highway right-of-ways.

Areas of Adaptation: As a species, Lewis flax is widely distributed in North America occurring from Alaska to Texas and from California to Quebec (NatureServe 2003). The ecological distribution of Lewis flax ranges from salt-desert shrub to sub-alpine meadow and is represented by an unknown number of ecotypes. The breath of ecotypic adaptation (generalists vs. specialists) is also largely unknown.

Maple Grove Lewis flax is potentially adapted to sites receiving 300 to 500 mm annual precipitation typified by pinyon-juniper, mountain big sagebrush, mountain brush, and dry coniferous forest types of the central intermountain region of the western United States (eastern Nevada, Utah, Western Colorado, southern Idaho, southwestern Wyoming). It is best adapted to sites with well-drained to moderately well-drained soils receiving 300 to 400 mm annual precipitation. It is not shade tolerant and has therefore limited application in closed woodland and forested types. Response to variation in soil pH is unknown.

Availability of Plant Materials: G3 seed will be maintained by the Aberdeen Plant Materials Center. Growers may produce two generations (G4 and G5) from the G3 seed.

Prepared by: This notice of release for Maple Grove Lewis flax was prepared by Stanley G. Kitchen, Research Botanist, USDA Forest Service, Rocky Mountain Research Station, Provo, UT; Loren St. John, Team Leader, USDA Natural Resources Conservation Service, Aberdeen Plant Materials Center, Aberdeen ID; Dan Ogle, Plant Materials Specialist, USDA Natural Resources Conservation Service, Boise ID, Stanford Young, Secretary/Manager, Utah Crop Improvement Association, Utah State University, Logan, UT; and Scott Walker, Utah Department of Natural Resources, Division of Wildlife Resources, Great Basin Research Center, Ephraim, UT; as a joint release by these agencies and the Utah State University, Agricultural Experiment Station and the University of Idaho, Agricultural Experiment Station.

References

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Pendleton, R.L., S.G. Kitchen, and E.D. McArthur. 1993. The great escape-a report on the origin of 'APPAR' Lewis flax (Abstract), p. 42-43. In: Published abstracts of the Annual Meeting of the Society for Range Management; 1993; February 14-19; Albuquerque, NM.

SIGNATURES FOR RELEASE OF:

MAPLE GROVE GERMPLASM LEWIS FLAX (SELECTED CLASS NATURAL POPULATION) *Linum lewisii* Pursh

USDA-FS	**Director, Rocky Mtn. Res. Stn.**	**Date**
USDA-NRCS	**Idaho State Conservationist**	**Date**
USDA-NRCS	**Director ESD, Washington DC**	**Date**
State of Utah	**Director, DWR**	**Date**
Utah State Univ.	**Director, Utah Agr. Exp. Stn.**	**Date**
Univ. of Idaho	**Director, Idaho Agr. Exp. Stn.**	**Date**

Environmental Evaluation of Plant Materials Releases

Name of person scoring: L. St. John **Date of scoring:** 2/27/03

Scientific Name: Linum lewisii **Common Name:** Lewis flax

Release Name: Maple Grove (proposed)

Is the plant native to the US? **Yes**

Is the plant native to the area of intended use? **Yes**

Authority used to determine native status: **USFS Shrub Sciences Lab**

What is the intended area of use for this plant? **Intermountain west**

What is the intended use for this plant? **Erosion control, biodiversity, beauty**

Areas in which the release is known to be invasive or has a high probability of being invasive:

Summary of Criteria from Section A	**Score**
Part 1. Impact on Habitats, Ecosystems, and Land Use	**3**
Part 2. Ease of Management	**17**
Part 3. Conservation Need and Plant Use	**6**
Part 4. Biological Characteristics	**39**

Final Determination of Release Based on the Environmental Evaluation:

X---- ☐ **OK to Release**

☐ **OK to Release but qualify use and intended area of use***

☐ **Do Not Release - NPL determines if release is made***

☐ **Do Not Release - document and destroy materials**

I certify that this Environmental Evaluation was conducted with the most accurate and current information possible. /s/ Loren St. John 2/27/03

Signature of Person Scoring Date

Signature of NPL indicating that it is OK to make the release:

National Program Leader, PM **Date**

Section A. Scoring of Criteria for Impact, Management, Need and Biological Characteristics

Circle the appropriate number for each of the following criteria. Add up the scores for each part and record at the end of each part. Comments which clarify answers or provide supporting information may be included in the right margin of the worksheet or attached on a separate sheet of paper.

Part 1: Impact on Habitats, Ecosystems, and Land Use

This section assesses the ability of the species or release to adversely affect habitats, ecosystems, and agricultural areas.

1) Ability to invade natural systems where the species does not naturally occur

a)	Species not known to spread into natural areas on its own	0
b)	Establishes only in areas where major disturbance has occurred in the last 20 years (e.g., natural disasters, highway corridors)	**3**
c)	Often establishes in mid- to late-successional natural areas where minor disturbances occur (e.g., tree falls, streambank erosion), but no major disturbance in last 20-75 years	6
d)	Often establishes in intact or otherwise healthy natural areas with no major disturbance for at least 75 years	10

2) Negative impacts on ecosystem processes (e.g., altering fire occurrence, rapid growth may alter hydrology)

a)	No perceivable negative impacts	**0**
b)	Minor negative impacts to ecosystem processes	2
c)	Known significant negative impacts to ecosystems processes	6
d)	Major, potentially irreversible, alteration or disruption of ecosystem processes	10

3) Impacts on the composition of plant communities where the species does not naturally occur

a)	No negative impact; causes no perceivable changes in native populations	**0**
b)	Noticeable negative influences on community composition	5
c)	Causes major negative alterations in community composition	10

4) Allelopathy

a)	No known allelopathic effects on other plants	**0**
b)	Demonstrates allelopathic effects on seed germination of other plants	3
c)	Demonstrates allelopathic effects to mature stages of other plants	5

5) Impact on habitat for wildlife or domestic animals (aquatic and terrestrial), including threatened and endangered species (coordinate with USFWS and state Heritage Programs as appropriate)

a) No negative impact on habitat, or this criteria not applicable based on intended use for the plant — **0**
b) Minor negative impact on habitat (e.g., decreased palatability; lower wildlife value; decreased value for undesirable animal species) — 2
c) Significant negative impact on habitat (e.g., foliage toxic to animals; significantly lower value for wildlife; excludes desirable animal species from an area) — 5

6) Impact on other land use

a) No negative impacts on other land uses — **0**
b) Minor impacts (plant could invade adjacent areas and decrease its value) — 3
c) Significant impacts (plant may alter the system or adjacent lands significantly enough to prevent certain uses) — 5

Total Possible Points 45

Total Points for Part 1 3

Part 2. Ease of Management

This part evaluates the degree of management which might be needed to control the species or release if it becomes a problem, or eradicate the species or release if it is no longer desirable.

1) Level of effort required for control

a) Effective control can be achieved with mechanical treatment — 0
b) Can be controlled with one chemical treatment — 2
c) One or two chemical or mechanical treatments required or biological control is available or practical — **5**
d) Repeated chemical or mechanical control measures required — 10

2) Effectiveness of community management to potentially control the plant release

a) No management is needed, the plant release is short-lived and will significantly decrease or disappear within 5 years under normal conditions without human intervention — 0
b) Routine management of a community or restoration/preservation practices (e.g., prescribed burning, flooding, controlled disturbance, pasture renovation) effectively controls the release — **2**
c) Cultural techniques beyond routine management can be used to control the release — 4
d) The previous options are not effective for managing or controlling the release — 10

3) Side effects of chemical or mechanical control measures

a) Control measures used on release will have little or no effect on other plants 0
b) Control measures used on release will cause moderate effects on other plants **3**
c) Control measures used on release will cause major effects on other plants 5

**If spreads by seed, or both seed and vegetative means, go to #4
**If spreads by vegetative means only, go to #5

4) Seed banks

a) Seeds viable in the soil for 1 year or less 0
b) Seeds remain viable in the soil for 2-3 years 1
c) Seeds remain viable in the soil for 4-5 years **3**
d) Seeds remain viable in the soil for more than 5 years 5

5) Vegetative regeneration under natural conditions

a) Regeneration from resprouting of cut stumps **1**
b) Regeneration from pieces of the root left in the soil 3
c) Regeneration from root or stem parts left in the soil 5

6) Resprouts after cutting above-ground parts

a) Does not resprout or resprouts but the release is sterile and does not produce seed 0
b) Resprouts and produces seed in future years **3**
c) Resprouts and produces seed in same year 5

Total Possible Points 40
Total Points for Part 2 17

Part 3. Conservation Need and Plant Use

This part evaluates the importance of the species or release to meet a conservation need.

1) Potential Use(s) of the Plant Release

a) Used for low-priority issues or single use 1
b) Has several uses within conservation **2**
c) Has many uses within conservation as well as outside of conservation 4
d) Has high-priority use within conservation 5

2) Availability of Other Plants to Solve the Same Need

a) Many other plants available 1
b) Few other plants available **3**
c) No other plants available 5

3) Consequences of <u>Not</u> Releasing This Plant

a) No impact to conservation practices	0
b) Minor impact on one or more conservation practice	**1**
c) Serious impact on one conservation practice	3
d) Serious impact on more than one conservation practices	5
Total Possible Points	**15**
Total Points for Part 3	**6**

<u>Part 4. Biological Characteristics</u>

This part evaluates the biological properties which indicate the natural ability of the species or release to propagate and maintain itself under natural conditions. Note: these criteria relate to the species <u>under natural conditions</u>, as opposed to the species under managed conditions used to increase the species, i.e. seed increase programs, or specific propagation methods which do not normally occur in nature.

1) Typical mode of reproduction under natural conditions

a) Plant does not increase by seed or vegetative means (<u>skip to #11</u>)	0
b) Reproduces almost entirely by vegetative means	1
c) Reproduces only by seeds	**3**
d) Reproduces vegetatively and by seed	5

2) Reproduction (by seed or vegetative) in geographic area of intended use

a) Reproduces only outside the geographic area of intended use	1
b) Reproduces within the geographic area of intended use	3
c) Reproduces in all areas of the United States where plant can be grown	**5**

3) Time required to reach reproductive maturity by seed or vegetative methods

a) Requires more than 10 years	1
b) Requires 5-10 years	2
c) Requires 2-5 years	3
d) Requires 1 year	**5**

<u>** If reproduces only by seed, skip to #5</u>

4) Vegetative reproduction (by rhizomes, suckering, or self-layering)

a) Vegetative reproduction rate maintains population (plant spreads but older parts die out)	1
b) Vegetative reproduction rate results in moderate increase in population size (plant spreads <3' per year)	3
c) Vegetative reproduction rate results in rapid increase in population size (plant spreads >3' per year)	5

** If reproduces only vegetatively, skip to #11

5) Ability to complete sexual reproductive cycle in area of intended use

a) Not observed to complete sexual reproductive cycle in the geographic area of intended use, but completes sexual reproduction in distant areas of the United States 1

b) Not observed to complete sexual reproductive cycle in the geographic area of intended use, but completes sexual reproduction in adjoining geographic areas 3

c) Observed to complete the sexual reproductive cycle in the geographic area of intended use **5**

6) Frequency of sexual reproduction for mature plant

a) Almost never reproduces sexually 0

b) Once every five or more years 1

c) Every other year 3

d) One or more times a year **5**

7) Number of viable seeds per mature plant each reproductive cycle

a) None (does not produce viable seed) 0

b) Few (1-10) 1

c) Moderate (11-1,000) **3**

d) Many-seeded (>1,000) 5

8) Dispersal ability

a) Limited dispersal (<20') and few plants produced (<100) 1

b) Limited dispersal (<20') and many plants produced (>100) 3

c) Greater dispersal (>20') and few plants produced (<100) **7**

d) Greater dispersal (>20') and many plants produced (>100) 10

9) Germination requirements

a) Requires open soil and disturbance to germinate **1**

b) Can germinate in vegetated areas but in a narrow range or in special conditions 5

c) Can germinate in existing vegetation in a wide range of conditions 10

10) Hybridization

a) Has not been observed to hybridize outside the species **0**

b) Hybridizes with other species in the same genera 3

c) Hybridizes with other genera 5

11) Competitive ability (of established plants)

a) Poor competitor for limiting factors	0
b) Moderately competitive for limiting factors	**5**
c) Highly competitive for limiting factors	10
Total Possible Points	**70**
Total Points for Part 4	**39**

References

Many of the criteria used in this rating system were adapted from the following sources:

Hiebert, Ron D. and James Stubbendieck. 1993. Handbook for Ranking Exotic Plants for Management and Control. US Department of the Interior, National Park Service, Denver, CO.

Randall, John M., Nancy Benton, Larry E. Morse, and Gwendolyn A. Thornhurst. 1999. Criteria for Ranking Alien Wildland Weeds. The Nature Conservancy, Arlington, VA.

Section B. Scoring and Interpretation

Based on the scores from above, circle the points range you scored to determine the appropriate interpretation. The interpretation will be used to determine the course of action for the release.

Part	Points Scored	Interpretation
Part 1. Impacts on Habitats, Ecosystems, and Land Use	0-15	**Low** chance plant is going to affect the environment
	16-25	**Mod**erate chance plant is going to affect the environment
	26-45	**High** chance plant is going to affect the environment
Part 2. Ease of Management	0-20	**Easy** to control
	21-30	**Mod**erate to control
	31-40	**Diff**icult to control
Part 3. Conservation Need and Plant Use	0-5	**Low** need
	6-9	**Mod**erate need
	10-15	**High** need
Part 4. Biological Characteristics	0-25	**Low** chance plant is going to propagate and increase itself
	26-40	**Mod**erate chance plant is going to propagate and increase itself
	41-70	**High** chance plant is going to propagate and increase itself

Release Documentation
For
Maple Grove Lewis Flax

Stanley G. Kitchen, USDA Forest Service, Rocky Mountain Research Station, Shrub Sciences Laboratory
Loren St. John, USDA Natural Resources Conservation Service, Aberdeen Plant Materials Center

Common Garden Studies

Common gardens were established at two sites in the spring of 1989 with greenhouse-reared transplants of Lewis flax and the blue flax cultivar 'Appar' as part of cooperative research studies conducted by the USDA Forest Service, Intermountain Research Station, Shrub Sciences Laboratory and the USDI Bureau of Land Management, Idaho State Office. The primary objective was to evaluate drought tolerance. Lewis flax transplants were grown using seed collected from 14 native populations representing four western states (Table 1). A randomized block design was used with three replications (plots) for each accession planted at each site. Individual plots consisted of four rows of six plants each (24 total). Within and between row spacing was 60 and 120 cm, respectively.

Common garden sites were located near Orchard, ID and Nephi, UT. The Orchard site lies approximately 32 km southeast of Boise at an elevation of 970 m. The soil is a deep sandy loam with good to moderately good drainage and 0 to 2 percent slope. Mean annual precipitation is 280 mm occurring primarily during winter and spring. Native vegetation in the surrounding area is dominated by Wyoming big sagebrush. The second site is located 13 km southwest of Nephi, Utah on the Utah State University Agricultural Station farm. Elevation is 1,590 m. The soil is a deep, loamy clay on a 0 to 2 percent slope. Mean annual precipitation is 340 mm. Native vegetation is dominated by basin big sagebrush. Both sites had been in cultivation and were fallowed prior to planting.

Plants were rated annually for survival and vigor from 1989 to 1992. Individual vigor scores on a scale of 1 (low) to 5 (high) were assigned subjectively to each surviving plant based on abundance and condition of leaves and stems, flower production, and overall succulence. In the spring of 1990 a naturally occurring rust infestation developed in the Nephi plots. Plants were scored on a scale of 0 (no visible evidence of rust) to 5 (visible evidence of infection on more than 90 percent of plant parts). In May 1990 all plants at this site were treated with the systemic fungicide, Plantvax.

Mean transplant survival 5 months after planting at the Orchard site was 19.2 percent (Table 2). Survival of eight Lewis flax accessions was not significantly different than for 'Appar' blue flax. In 1990 mean survival had dropped to 15.7 percent. 'Appar' and five Lewis flax populations were not significantly different at this point. Mean survival after 2 years was less than 5 percent for all accessions. This site is clearly too droughty for long-term persistence of flax accessions tested. Although the Maple Grove accession had a

Table 1-Collection site information for 19 Lewis flax accessions. Studies are: common gardens (1), seed production (2), greenhouse emergence (3), and field seedings (4).

Collect Name	County	State	Elevation	Mean Annual Precip.	Vegetation Type	Studies
			m	*mm*		
Confusion Range	Millard	UT	1,870	220	Desert shrub-grass	1,2,3,4
Potosi	Clark	NV	1,850	250	Pinyon-juniper	1,2,3
Burr Trail	Garfield	UT	2,030	250	Pinyon-juniper	1,2,3,4
Yuba Dam	Juab	UT	1,630	330	Sagebrush-grass	1,3,4
Mona	Juab	UT	1,540	340	Sagebrush-grass	1,2,3
Cove Fort	Millard	UT	1,760	340	Sagebrush-grass	1,2,3
Maple Grove	**Millard**	**UT**	**1,920**	**350**	**Sagebrush-grass**	**1,2,3**
Lava Hot Springs	Bannock	ID	1,460	360	Sagebrush-grass	1,2,3,4
Little Antelope Summit	White Pine	NV	2,270	360	Pinyon-junper-Mtn. brush	3
Black Hills	Custer	SD	1,340	360	Ponderosa pine-Mtn. mahogany	3
Fort Collins	Larimer	CO	1,760	380	Ponderosa pine-Mtn. mahogany	3
Asotin	Asotin	WA	320	380	Palouse grassland	1,2,3,4
Provo Overlook	Utah	UT	1,970	430	Sagebrush-grass	1,2,3,4
Blue Springs Hill	Box Elder	UT	1,570	430	Sagebrush-grass	1,2,3
Hyde Park	Cache	UT	1,540	440	Sagebrush-grass	1,2,3
Richmond	Cache	UT	1,710	470	Sagebrush-grass	1,2,3
Parley's Summit	Summit	UT	2,060	580	Mountain brush	1,2,3
Panguitch Lake	Garfield	UT	2,580	580	Ponderosa pine-bitterbrush	3
Elk Knoll	Sanpete	UT	3,160	710	Subalpine herbland	3
'Appar'	--	--	--	--	--	1,2,3,4

Table 2-Survival and vigor of 14 Lewis flax accessions and 'Appar' blue flax at the Orchard, ID common garden planted March 1989. Survival for all accessions was less than 5 percent in 1991. Plant vigor is on a scale of 1 (low) to 5 (high). Within columns, means followed by the same letter are not significantly different at the $P < 0.05$ level (Student-Neuman-Keuls multiple range test).

Collection	Transplant Survival		Vigor 1990
	1989	1990	
	--------- *percent* ----------		
Confusion Range	33a	31ab	4.1a
Potosi	31ab	28abc	3.4ab
Burr Trail	31ab	26abcd	3.4ab
Yuba Dam	10bcde	10cdef	3.0abc
Mona	26abc	24abcd	3.4ab
Cove Fort	2e	2f	4.0a
Maple Grove	**10bcde**	**8def**	**3.6ab**
Lava Hot Springs	13bcde	10cdef	2.6abcd
Asotin	8cde	7def	2.9abcd
Provo Overlook	25abc	22abcde	3.3ab
Blue Springs Hill	19abcd	15bcdef	1.5cd
Hyde Park	21abcd	9cdef	1.6cd
Richmond	17abcd	7def	1.3d
Parley's Summit	7de	2f	2.0bcd
'Appar'	35a	35a	3.8ab

relatively low 1989 survival rating at this site, its 1990 mean vigor rating (3.6) was greater than the overall mean (2.9) and not significantly lower than any other accession.

Transplant survival at the Nephi common garden during the second growing season (1990) was uniformly high with a mean of 95.3 percent. Considerable among-accession variation in mortality was observed from 1990 to 1992 (Figure 1). Maple Grove survival in 1992 (78 percent) was higher than all but the Asotin, WA accession (96 percent). Mortality was significantly correlated with 1990 mean rust index values ($r^2 = 0.52$) even though visible evidence of rust infection was absent in 1991 (possibly due to the fungicide treatment). Mean rust index varied among accessions from 0.0 ('Appar') to 4.6. Maple Grove mean rust index was 0.4 and was among the lowest for the native Lewis flax accessions. Although mean vigor ratings varied annually reflecting variation in environmental conditions, the four-year mean for Maple Grove germplasm (2.88) was the highest of all flax accessions, 'Appar' included (Table 3).

Individual Plant Seed Production

Flower, fruit, and seed production were determined on an individual plant basis at the Nephi common garden in 1990 and repeated in 1991. Two weeks before flowering, eight

vigorous, non-border plants were selected from the three plots representing each accession. Flower bearing stems were counted after flowering had ceased. Estimates of

Figure 1-Survival of eight representative Lewis flax accessions and 'Appar' blue flax at the Nephi common garden. Greenhouse-reared seedlings were planted in April 1989. Mortality from 1989 to 1992 was significantly correlated with severity of rust infection ($P < 0.05$, $r^2 = 0.52$).

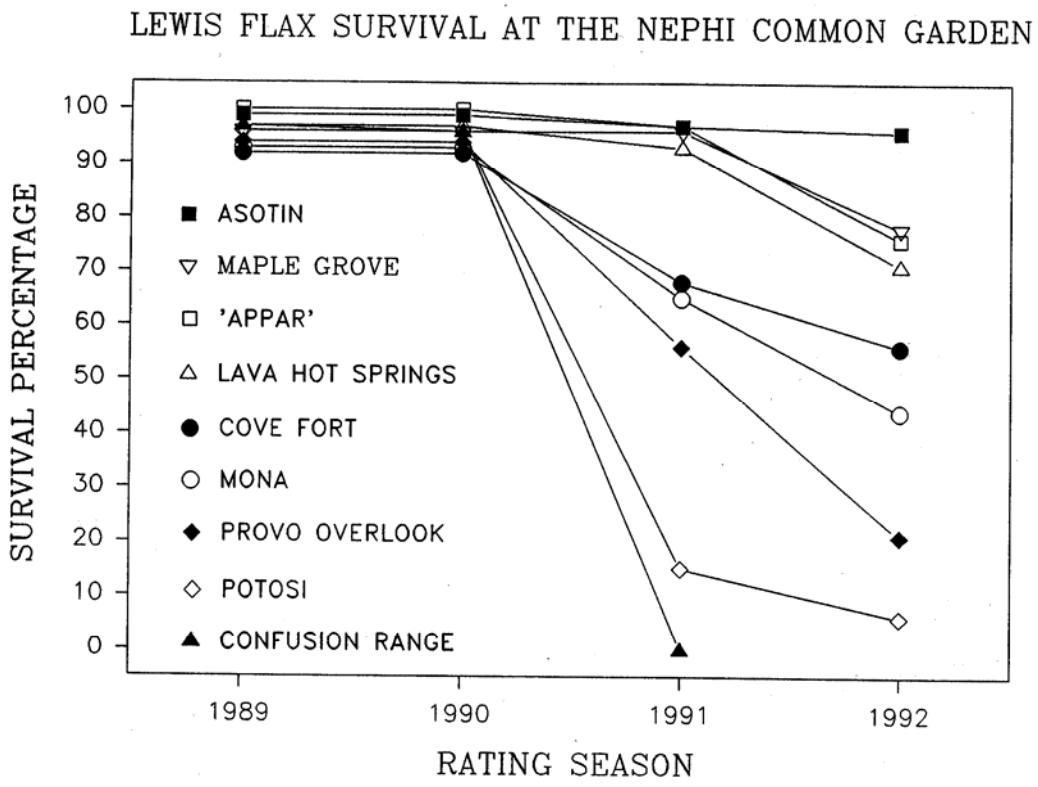

Table 3-Mean vigor ratings and rust indices for transplants of 14 Lewis flax accessions and 'Appar' blue flax at the Nephi common garden. Plant vigor is on a scale of 1 (low) to 5 (high). Rust index values were scored from 0 (no infection) to 5 (visible evidence of infection on more than 90 percent of the plant). Within columns, means followed by the same letter are not significantly different at the $P < 0.05$ level (Student-Newman-Keuls multiple range test).

Collection	Mean Vigor				Mean Rust
	1989	1990	1991	1992	Index (1990)
Confusion Range	2.9a	2.3b	--	--	4.6a
Potosi	2.6abcd	2.2bc	1.4c	2.5abc	1.0d
Burr Trail	2.7abcd	2.0cd	1.6e	2.2abc	1.4c
Yuba Dam	2.9a	2.1cd	1.8e	2.2abc	1.8b
Mona	2.4dce	2.4abc	2.9bcd	2.5abc	1.2c
Cove Fort	2.7abc	2.0cd	2.8cd	2.4abc	1.0d
Maple Grove	**2.9a**	**2.6a**	**3.4abc**	**2.6abc**	**0.4f**
Lava Hot Springs	2.5bcde	2.4ab	2.9cd	2.1abc	0.6e
Asotin	2.2	1.9de	3.3abc	2.9a	0.3f
Provo	2.8ab	2.1cd	2.4d	2.3abc	1.7b
Overlook					
Blue Springs Hill	2.6abcd	2.0cd	3.1bc	1.8bc	1.0d
Hyde Park	2.4de	2.1cd	3.5abc	2.0bc	0.6e
Richmond	2.9a	1.9de	2.9bcd	1.7c	1.0d
Parley's Summit	2.1e	1.7e	3.6ab	2.2abc	0.1g
'Appar'	2.9a	2.1cd	3.9a	2.5abc	0.0g

the mean number of flowers and fruits per stem were determined by counting fruits and aborted flowers on a sub-sample of 20 (1990) or 10 (1991) stems for each study plant. Twenty fruits were harvested from each plant (1990 only) just prior to ripening and harvested seeds were used to estimate mean fruit fill for each plant. Seed weight was determined using four replications of 100 seeds. Estimates of the total number and weight of seeds produced by each plant were calculated from these data. Four accessions of Lewis flax with the highest levels of mortality (apparently related to high rust infection during the previous year) were not samples in 1991.

For both study years, "Appar' blue flax plants produced more flowers and fruits per plant than all Lewis flax accessions tested (Table 4). The number of flower bearing stems per plant and the number of flowers per stem varied considerably among Lewis flax

accessions and between study years. Further studies of the mechanisms that control these variables and the relative importance of these variables in determining whole plant fecundity may provide valuable insight both for agronomic seed production and in understanding the ecology of this species in its varied natural environments. Variation in fruit set percentage was primarily associated with differences in the two study years. The Maple Grove 2-year mean for fruits per plant (2,687) was a close second among Lewis flax accessions.

Table 4-Stem, Flower, and fruit production for 13 Lewis flax collections and 'Appar' blue flax at the Nephi common garden in 1990 and 1991.

Accession	Year	Stems per plant	Flowers per stem	Flowers per plant	Fruit set	Fruits per plant
					%	
Confusion	1990	80	26	2,029	.81	1,644
Range	1991	--	--	--	--	--
Potosi	1990	50	31	1,467	.75	1,072
	1991	--	--	--	--	--
Burr Trail	1990	85	21	1,790	88	1,601
	1991	--	--	--	--	--
Mona	1990	86	29	2,420	67	1,621
	1991	53	25	1,386	51	712
Cove Fort	1990	83	34	2,745	80	2,194
	1991	32	37	1,184	48	563
Maple	**1990**	**65**	**36**	**2,309**	**79**	**1,845**
Grove	**1991**	**56**	**30**	**1,692**	**50**	**842**
Lava Hot	1990	61	34	2,018	76	1,576
Springs	1991	25	38	1,051	50	527
Asotin	1990	36	37	1,293	88	1,125
	1991	45	22	1,192	34	403
Provo	1990	124	20	2,562	62	1,686
Overlook	1991	--	--	--	--	--
Blue	1990	63	36	2,256	86	1,927
Springs	1991	71	31	2,052	39	805
Hill						
Hyde Park	1990	45	33	1,467	79	1,175
	1991	57	37	2,006	49	987
Richmond	1990	51	33	1,601	75	1,193
	1991	40	25	1,043	57	594
Parley's	1990	26	46	1,150	87	1,006
Summit	1991	44	38	1,690	34	581
'Appar'	1990	92	60	5,678	67	3,859
	1991	84	48	4,060	57	2,313

As was expected (due to the high number of fruits produced), per plant seed production for ‘Appar’ blue flax exceeded that of all Lewis flax accessions in 1990 and 1991, both in terms of seed number and seed weight (Table 5). Estimates of fruit fill (mean of 87.5 percent; 1990 only) were similar for all accessions. Lewis flax seed size varied from 343 to 527 seeds per gram. ‘Appar’ blue flax seeds were smallest at 641 per gram. At 452 seeds per gram, Maple Grove seed size was intermediate for that observed for Lewis flax accessions that were tested. The 2-year estimate of total per-plant seed weight produced by the Maple Grove plants (57 g) was 64 percent of that yielded by ‘Appar’ plants (89g) and among the highest observed for the Lewis flax accessions.

Table 5- Seed production per plant for 13 accessions of Lewis flax and ‘Appar’ at the Nephi common garden. Within columns, means followed by the same letter are not significantly different at the *P* < 0.05 level (Student-Newman-Keuls multiple range test).

Accession	Mean seed number per plant		Seeds per	Mean seed weight per plant	
	1990	1991	gram	1990	1991
Confusion Range	15,114b	--	465	33abc	--
Potosi	9,548b	--	343	28bc	--
Burr Trail	14,784b	--	428	35abc	--
Mona	14,466b	7,122b	360	40ab	20b
Cove Fort	18,820b	5,626b	474	40ab	12b
Maple Grove	**17323b**	**8,418b**	**452**	**38ab**	**19b**
Lava Hot Springs	13,788b	5,266b	392	35abc	13b
Asotin	7,544b	4,031b	513	15c	8b
Provo Overlook	14,781b	--	365	40ab	--
Blue Springs Hill	16,865b	8,046b	481	35abc	17b
Hyde Park	10,375b	9,871b	362	29bc	27ab
Richmond	10,582b	5,939b	381	28bc	16b
Parley’s Summit	8,988b	5,805b	527	17bc	11b
‘Appar’	34,012a	23,126a	641	53a	36a

Seedling Emergence and Vigor

Seedling vigor was evaluated for 19 Lewis flax accessions and ‘Appar’ by means of greenhouse seedling emergence trials. A randomized block design was used to partition

variation due to greenhouse position. For each accession, three 70-cm rows of 50 seeds each were planted at a depth of 3.2 cm in a well-drained loamy sand. Row spacing was 6 cm. Water was added periodically so as to not be limiting. Seedling emergence and growth were evaluated weekly for 6 weeks after planting. Emergence percentages were adjusted based upon the results of laboratory germination percentages. Successful emergence varied from 89 to 18 percent. Maple Grove emergence (68 percent) was not significantly different than the highest values observed. Emergence and growth rates were similar for all intermountain collections from semi-arid environments.

Field seedings of 'Appar' blue flax and six Lewis flax accessions were established in the fall of 1991 at both common garden sites and at a third site 13 km north of Dugway, UT. Seeds were planted using a modified garden planter into sets of four parallel furrows 2.5 m in length. Seeding rate was approximately 67 seeds per m of row and seeding depth was 1 to 2 cm. Three of these plots were planted for each accession at each site in a randomized complete block design.

Mean seedling emergence in the spring of 1992 was 18, 23, and 63 percent at the Orchard, Nephi, and Dugway sites, respectively. Among-accession variation was relatively low and not predictable based on performance at any other site or on the greenhouse emergence trial results. Seedlings at the Orchard and Dugway sites failed to survive to the summer of 1993 while plants at the Nephi site were generally vigorous, producing flowers and seed in the second year of growth. Although the Maple Grove accession was not included in these trials, those that were demonstrated the ability of Lewis flax accessions from a variety of semi-arid sites to establish from seed with success similar to that experienced by 'Appar' blue flax.

Cultivated Seed Production

The selection of the Maple Grove germplasm for potential release over other possible Lewis flax accessions was made in 1997 after a review of the data presented above. At that time questions remained regarding the establishment, growth, and seed production of Maple Grove germplasm using established agronomic practices. In addition there was essentially no seed available for increase. Consequently, approximately 200 container stock plants were green-house reared from G0 seed during the winter of 1997-1998. These seedlings were transplanted to the Snow Field Station in Ephraim, UT in May 1998. Seed (G1) was collected from these transplants in 1998 and 1999. Seed of both years was combined and used for establishing drilled seeding trials in 2000 at the Aberdeen Plant Materials Center (PMC) and the Snow Field Station.

On May 24, 2000 two 26 m (84 ft) rows each of 'Appar' blue flax and Maple Grove Lewis flax G1 were seeded in field 15 at the Aberdeen PMC home farm. Seed was planted with a Planet Junior seeder pulled by a tractor. The seeding rate was 82-98 pure live seeds (PLS) per m (25-30 PLS per ft) and rows were spaced 91 cm (36 in) apart. During the establishment year, the Maple Grove accession had the best stand. On September 8, 2000 the plots were evaluated for percent stand, plant height, and vigor. Percent cover for 'Appar' ranged from 40 – 45 percent and plants were 6 – 10 cm tall.

The Maple Grove accession had a 65 – 75 percent stand and plants were 8 – 12 cm tall. Vigor for both accessions was good but the Maple Grove accession clearly had the best vigor.

Observations during the 2001 growing season indicated that the Maple Grove accession appeared to have a slightly better stand than 'Appar' but overall plant health and vigor were equal. On June 1, both accessions were flowering. On July 2, the plots were observed for seed ripeness and both accessions were in the late milk to early dough stage. On July 24, three randomly located 3 m (10 ft) plots were harvested from both accessions for seed yield comparison. All remaining Maple Grove plants were harvested for seed increase. Seed was bagged, allowed to dry, and cleaned.

On May 8, 2002 the trial was evaluated for basal cover and plant height. Maple Grove had 67 percent basal cover and averaged 28 cm tall. 'Appar' had 44 percent basal cover and averaged 31 cm tall. Plots were harvested for seed yield comparison a second time on July 19, 2002 using 2001 protocols. All Maple Grove plants were again harvested for seed increase.

Data in Table 6 show Maple Grove yielded 92 and 119 percent of what 'Appar' produced in 2001 and 2002, respectively. This difference in seed production must be qualified due to the substandard stand of 'Appar' as evidenced by basal cover data. Long-term yield data for Appar is 806 kg per ha (720 lbs per acre). By comparing these yield data for the Maple Grove germplasm (mean 632 kg per ha) to the long-term data of 'Appar', it is estimated that Maple Grove may produce seed yields of 70 to 90 percent of that of 'Appar'.

Table 6-Two-year comparative seed yields for Maple Grove Lewis flax and "Appar' blue flax at the Aberdeen PMC.

	Maple Grove		Appar	
Sample	2001	2002	2001	2002
	---------- kg/ha ----------			
1	636	422	472	162
2	632	504	744	781
3	640	960	852	796
Mean	636	628	689	580
	(568 lb/a)	(561 lb/a)	(615 lb/a)	(518 lb/a)

The total 2001 harvest for Maple Grove germplasm at the Aberdeen PMC (including the sample data) was 1.89 kg of seed. This is equivalent to 404 kg per ha (361 lbs per a), which is 50 percent of the long-term yield of 'Appar'. In 2002, the total seed harvest was 2.18 kg or 465 kg per ha (415 lbs per acre), which is 57 percent of the long-term yield of 'Appar'.

Seed was not harvested from these plots in 2003 because the Maple Grove plants had begun to die out and 'Appar' volunteer plants (from un-harvested seeds on neighboring rows) were becoming established in their place.

Drill rows of Maple Grove and 'Appar' were also planted at the Snow Field Station in 2000. As was the case at the Aberdeen PMC, Maple Grove produced a better stand than did 'Appar' at this site. Seed yields were compared by harvesting four replications of 10 plants from both flaxes for 2 years. Using these sampling protocols, we found that Maple Grove yield was 62 percent that of 'Appar' across 2 years. Seed was harvested 2 to 3 weeks earlier at this site than at the Aberdeen PMC.

Based on these data, we estimate that seed yield for Maple Grove germplasm will vary from 50 to 75 percent of what 'Appar' might yield when comparing similar stands.

Bushel weight of the Maple Grove seed harvested at the Aberdeen PMC in 2001 and 2002 was 18.6 and 18.1 kg (41 and 40 lbs) per bushel, respectively. Long-term bushel weight of Appar is 19.2 kg (47.5 lbs).

Maple Grove seed that was harvested in 2001 at the Aberdeen PMC was seeded on 0.7 ha (1.8 a) in field 3 of the same on May 31, 2002 and has been entered into certification with the Idaho Crop Improvement Association. A good stand was established. Seed yield in 2003 was 279 kg (615 lbs) or 383 kg per ha (342 lb per a). Test results indicate a purity of 99.2 percent and germ of 89 percent resulting in an inventory of 246 kg (542 lbs) pure live seed. Bushel weight was 17.6 kg (38.8 lbs).

Field longevity (sustained productivity) for Maple Grove Lewis flax will be evaluated at the Aberdeen PMC in coming years. The production field at Aberdeen will be replaced as needed using G2 see currently in cold storage (USDA Forest Service, Shrub Sciences Lab) or G1 seed if available. The Forest Service will attempt to recollect seed from the original collection site to facilitate long-term maintenance of the germplasm.

Note 1-Reciprocal crossing trials using 10 North American Lewis flax, 10 European flax, and three 'Appar' flax (certified seed and two putative original collections) accessions were conducted in 1992 as part of a study to determine taxonomic affinities for these flax taxa. Cross-pollination of Lewis flax plants with 'Appar" and European plants produced essentially no viable seeds (high levels of fruit and seed abortion) while 'Appar' and European crosses yielded good levels of fruit set (92 to 100 percent) and fill (65 to 74 percent). An absence of off-types among regenerating seedlings in common garden and seed production sites supports the conclusion that 'Appar' blue flax and North American Lewis flax populations have natural reproductive barriers that insure genetic isolation.

ON-CENTER ACTIVITIES

Foundation Seed Production at Aberdeen Plant Materials Center

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

The following table illustrates seed shipments from the Aberdeen Plant Materials Center for Fiscal year 1996 through 2004:

Release Name	1996	1997	1998	1999	2000	2001	2002	2003	2004	TOTAL POUNDS
					POUNDS PLS					
Anatone bluebunch wheatgrass [2/]	-	-	-	-	-	-	-	-	20	20
Appar prairie flax	455	150	950	115	320	300	470	65	0	2825
Bannock thickspike wheatgrass	215	175	425	610	275	250	550	25	0	2525
Delar small burnet	0	0	550	0	451	150	75	0	1250	2476
Ephraim crested wheatgrass	713	1000	100	50	260	455	696	0	200	3474
Snake River Plains fourwing saltbush	-	-	-	-	-	-	25	5	2	32
Goldar bluebunch wheatgrass	175	200	200	370	175	100	375	250	200	2045
Hycrest crested wheatgrass	1000	1550	0[1/]	0	0	0	0	0	0	2550
Magnar basin wildrye	0	250	180	901	517	1035	490	150	245	3768
Maple Grove Lewis flax [2/]	-	-	-	-	-	-	-	-	240	240
Nezpar Indian ricegrass	0	325	350	100	900	150	75	340	0	2240
P-27 Siberian wheatgrass	250	1000	200	25	150	200	500	0	0	2325
Clearwater Selection Penstemon	0	0	1	0	1	10	1	10	4	27
Richfield Selection Penstemon	0	0	6	5	5	1	7	6	3	33
Paiute orchardgrass	400	250	0	250	101	450	200	0	0	1651
Regar meadowbrome	10	0	305	800	670	1061	207	50	50	3153
Rush intermediate wheatgrass	75	400	1820	1000	215	525	0	0	0	4035
Sodar streambank wheatgrass	0	100	250	100	860	500	500	200	0	2510
Tegmar dwarf intermed. wheatgrass	0	0	200	0	100	0	0	0	200	500
Northern Cold Desert winterfat-	-	-	-	-	-	-	8	3	8	19
TOTAL POUNDS	3293	5400	5537	4326	5000	5187	4179	1104	2422	36,448

[1/] Foundation seed production of Hycrest crested wheatgrass was transferred to Meeker, Colorado Environmental Plant Center.
[2/] Approved for release in 2004.

Aberdeen Plant Materials Center

2004 FIELD ANNUAL PLAN OF OPERATION

HOME FARM

Field	Acres	Crop	Operation
1	1.7	Bannock (2000)	Manage for Foundation Seed production.
2	2.3	Bannock (1999)	Manage for Foundation seed production.
3	1.8	Maple Grove Flax (2002)	Manage for Certified seed production.
4	1.4	Constructed Wetland Ponds (1992)	Manage per constructed Wetland project plan.
5	2.4	Magnar (2000)	Manage for Foundation seed production.
6	2.4	Anatone Bluebunch (2004)	Establish and manage for Certified seed production.
7	3.2	Regar (2003)	Establish and manage for Foundation seed production.
8	3.2	Ephraim (2003)	Establish and manage for Foundation seed production.
9	3.2	Potatoes (2004)	U of I will plant potatoes.
10	3.2	Magnar (1995)	Manage for Foundation seed production.
11	1.1	Anatone Bluebunch (2002)	Manage for Certified seed production. Establish grass road on north side of field.
11	0.2	9067402 Mutton grass (2002)	Manage for increase and potential release.
12	1.4	USFS Forbs (2004)	Establish and evaluate for potential release.
13N	0.1	Penstemon (2003)	Manage for Certified seed production.
13S	1.3	Fallow (2003)	Fallow as needed to control weeds.
14	1.2	Woody Display Nursery (1995)	Maintain display of woody conservation plants. Manage Durar/Covar cover crop.
	-	Penstemon (1996)	Manage for Certified seed production (final year).
15	1.4	Field windbreak (2000)	Maintain Simon poplar field windbreak.
		USFS Flax test (2000)	Maintain and evaluate according to project Plan.
16	1.0	Fallow	Fallow as needed for weed control.
17	0.5	Hybrid Poplars (1998)	Manage and evaluate according to project plan.

Aberdeen Plant Materials Center

2004 FIELD ANNUAL PLAN OF OPERATION (continued)

HOME FARM

Field	Acres	Crop	Operation
18-19	0.9	Fourwing and winterfat (1999)	Manage for Certified seed production.
20	1.5	Grass Display Nursery (2002)	Manage for display.
Headquarters			Maintain buildings and grounds.

Aberdeen Plant Materials Center

2004 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)	Establish permanent yard for pipe storage.
21N	1.3	Bozoisky Cover crop	Maintain as needed for permanent cover.
22W	1.5	Bannock (2003)	Manage for Foundation seed production.
22E	2.6	Goldar (2002)	Manage for Foundation seed production.
22E	1.3	Willow IEP (1984)	Maintain as needed.
23W	2.4	Wildlife Food Plot (2004)	Establish and maintain corn for wildlife use.
23M	--	Windbreak	Maintain and irrigate as needed.
23E	2.2	Wildlife Food Plot (2004)	Establish and maintain wheat for wildlife use.
24	1.1	Windbreaks	Maintain and irrigate as needed.
24W	2.2	Paiute (2001)	Manage for Foundation seed production.
24E	1.5	Durar Cover Crop	Maintain as needed.
25	5.1	Alfalfa (2003)	Establish and manage for hay production and wildlife benefits.
26W	1.0	Wildlife Food Plot (2004)	Establish and maintain wheat for wildlife use.
26E	2.7	Willow Increase Block (1994)	Irrigate according to irrigation plan and control weeds. Maintain Durar/Covar mix between rows for permanent cover.
27	4.4	Wildlife Food Plot (2004)	Establish and maintain corn for wildlife use.
28	5.3	Alfalfa (2004)	Establish and manage for hay production and wildlife benefits.
29W	1.3	Willows (1994)	Irrigate and control weeds according to Wetland Project plan.
29E	3.7	Goldar (2000)	Manage for Foundation seed production.

Aberdeen Plant Materials Center

2004 FIELD ANNUAL PLAN OF OPERATION (continued)

FISH AND GAME FARM

Field	Acres	Crop	Operation
30W	0.7	Windbreak/Guard Row	Maintain and irrigate as needed.
30W	2.5	Potatoes (2004)	University to plant potatoes. University will plant wildlife food plot for mitigation on University Farm.
30E	2.3	USFS Grasses (2004)	Establish and evaluate for potential release.
31	5.1	Alfalfa (1995)	Manage for hay production and wildlife benefits.
32	6.2	Windbreak IEP (1982)	Maintain as needed.

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

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

BREWINGTON FARM (U of I)

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

2004 Progress Report
1998 Hybrid Poplar Initial Evaluation Planting
Field 17, Aberdeen PMC
Loren St. John, Team Leader

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

Five accessions of hybrid poplar considered 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. The replacements were for those plots that did not establish during the first growing season. The evaluation planting is irrigated with a solid-set handline sprinkler system.

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

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

The plots were evaluated on September 17, 2004 and the data is summarized in Table 1. Accession no. 9076418 (OP-367) and 9076421 (52-225) continued to have the best survival. Accession no. 9076418 (OP-367) was the tallest (mean plant height 1148 cm – 452 inches) and also had the largest D.B.H. (mean 22.3 cm – 8.8 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) and Imperial had the best vigor ratings from the original planting. No pests were observed on the plants this year.

Of the plots re-planted in 1999, Robust continued to have the best survival and the tallest average height. Siouxland had the largest mean D.B.H. (15.0 cm – 5.9 inches) of the plots that were re-planted in 1999.

The planting will be pruned early next year during dormancy to reduce side branching and will be evaluated again next fall. The plots will be harvested in 5 years to evaluate wood production.

Table 1.
2004 Evaluation Data
1998 Hybrid Poplar Initial Evaluation Planting

Accession Number	Number Survived	Percent Survival	Plant Height (cm) Minimum	Mean	Maximum	D.B.H. [1/] Mean (cm)	Vigor [2/]
9076418 (OP-367)	8	88.9	896	1148	1461	22.3	2.0
9076419 (184-411)	1	11.1	--	--	502	4.0	4.0
9076420 (50-197)	0	11.1	--	--	753	--	9.0
9076421 (52-225)	7	77.7	95	732	1018	10.3	6.8
9076422 (15-29)	4	44.4	580	672	791	6.3	7.4
Canam	2	22.2	420	716	1012	2.0	6.5
Robust	3	33.3	551	665	760	16.0	5.7
Siouxland	5	55.5	740	996	1186	15.8	4.4
Imperial	5	55.5	795	923	1156	15.0	3.6

Re-planted Hybrid Poplar 1999

Accession Number	Number Re-planted	Percent Survival	Plant Height (cm) Minimum	Avg.	Maximum	D.B.H. [1/] Mean (cm)	Vigor [2/]
9076418 (OP-367)	1	0	--	--	--	--	9.0
9076419 (184-411)	8	12	--	--	580	8.0	8.1
9076420 (50-197)	8	12	--	--	--	--	9.0
9076421 (52-225)	1	0	--	--	--	--	9.0
9076422 (15-29)	4	0	--	--	--	--	9.0
Canam	7	57	350	612	896	8.0	7.4
Robust	6	83	869	1046	1156	14.0	4.7
Siouxland	4	75	680	864	1217	15.0	4.5
Imperial	4	25	--	--	744	14.0	7.8

[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
FY 2003 Annual Report

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

Project Location: NRCS Aberdeen, ID Plant Materials Center

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

Contact Information: Aberdeen Plant Materials Center, P.O. Box 296, Aberdeen, ID 83210. Email - LorenStjohn@id.usda.gov

Plant Materials Specialist, USDA-NRCS, 9173 West Barnes Drive, Suite C, Boise, ID 83709. Email - Dan.Ogle@id.usda.gov

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

Status Report:

Seed Production

Maple Grove Flax - Seeded 1.8 acres field 3 on May 31, 2002. Field swathed July 22, combined July 28 2003. Produced 615 pounds (342 pounds per acre), bushel weight 38.8 pounds per bushel. Seed analysis pending.

Anatone bluebunch wheatgrass - Seeded 1.0 acres field 11 on May 31, 2002. Field direct combined July 11, 2003. Produced 240 pounds (240 pounds per acre), bushel weight 22.1 pounds per bushel. Seed analysis pending.

Snake River Plains Germplasm fourwing saltbush - Produced approximately 98 pounds (seed analysis pending). Shipped 5 pounds Certified seed.

Northern Cold Desert Germplasm winterfat - Produced approximately 15 pounds (seed analysis pending). Shipped 3 pounds Certified seed.

Propagation Studies

Propagation of rooted fourwing saltbush from cuttings

Based upon cutting trials conducted in 2002, four hundred cuttings (320 female and 80 male) were harvested on August 18, 2003. Cuttings were treated with rooting hormone and planted into 40 inch^3 deep pots and placed in the greenhouse. One half of the cuttings were set on heat pads set at 85º F to evaluate the need for bottom heat. Following is a summary of rooting success and growth rates evaluated November 7, 2003:

		Leader length (cm)		
	% rooted	minimum	average	maximum
Female cuttings (bottom heat)	28.75	1.75	5.70	36
Female cuttings (no heat)	20.60	0.50	9.25	38
Male cuttings (bottom heat)	27.50	1.00	9.00	25
Male cuttings (no heat)	7.50	12.00	15.00	23

There appears to be some advantage to bottom heat during root development. The best rooting success (50 percent) was achieved from cuttings harvested August 19, 2002 which was significantly greater than achieved in 2003. In 2002, cuttings were propagated under mist as compared to overhead irrigation used in 2003. It appears there is a need to evaluate irrigation strategies to improve rooting success.

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

As reported in 2002, 75 percent of the seedlings had red stems and 25 percent had white stems at time of transplant. The question arose as to whether or not this phenological difference could be an indication of the sex of the plant. Plants are being maintained to determine if this is possible.

Establishment of Demonstration Planting near Boise

BLM burned site in fall of 2002. Site was sprayed by PMC on May 1, 2003 with Roundup and 2,4-D at 64 oz and 16 oz. per acre respectively. Spot treatment was applied May 13, 2003. Excellent kill was achieved. Due to limited breakdown of dead grass clumps that would inhibit proper seed placement with drill and to ensure a clean seedbed, the decision was made to delay seeding until the fall of 2004. The delay will allow another opportunity to apply herbicide and allow for further breakdown of the dead grass clumps. Seed of 76 accessions were obtained and a planting plan developed.

USDA Forest Service, Region 1
Native Grass and Forb Initial Evaluation
2003-2005
Preliminary Report (July 20, 2004)
Derek J. Tilley, Range Conservationist (Plants)
Loren St. John, Team Leader Aberdeen Plant Materials Center

INTRODUCTION

The purpose of this study is to evaluate native perennial grass and forb collections for use in revegetation 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 fires. Increased fires create the potential for 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.

In 2003, FS R1 collected forty one accessions of five native perennial grass species and eleven accessions of three native forb species which were sent to the USDA-Natural Resources Conservation Service-Plant Materials Center at Aberdeen, Idaho for evaluation. Of these, 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 common yarrow (*Achillea millefolium*), one lupine (*Lupinus* sp.) and one pearly everlasting (*Anaphalis margaritacea*). Appendix 1 lists the accessions collected, the size of each collection and collection location. This is a preliminary report of evaluations conducted in June and July, 2004.

MATERIALS AND METHODS

Harvested plant materials 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 species. Adjustments will have to be made to achieve best seed purity results. 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 greenhouse at the Aberdeen Plant Materials Center from February to March, 2004. The goal of this study was to determine if any accessions emerged quicker or had better seedling vigor than others. No significant differences were detected (data not shown).

The native grass field 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 four replications. Individual plots were 20 feet long and contained one row; rows were planted on three foot centers. Experimental design also contained plots of known industry standards from each species for comparison. Soil at the site is a Delco silt loam with pH of 7.4 to 8.4. Average annual precipitation is 8.75 inches. Ground was plowed in the fall of 2003 and subsequently disked and roller packed in the spring prior to planting.

Plots were seeded on May 10 and 11, 2004. Bluebunch wheatgrass and Idaho fescue were planted using a Planet Jr., while Blue wildrye, Sandberg bluegrass and tufted hairgrass were planted using a belt seeder. Planters were 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). Each species block contained at least two released cultivars to use as standards for comparison. Border rows of 'Tegmar' intermediate wheatgrass (*Thinopyrum intermedium*) were planted on the outside of the blocks to eliminate edge effect. Plots were sprinkler irrigated as needed throughout the growing season. Weeds were controlled with herbicide treatments and between row cultivating.

The first evaluation was conducted on June 14, 2004 when all 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 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 is measured on an ordinal scale of one to nine (one being most healthy and nine being dead). Entire plots were viewed and given a rating based on overall apparent vigor. Data from percent stand and plant density was analyzed for Analysis of Variance (ANOVA) and means were separated using Duncan's Multiple Range Test.

The native forb trial was planted on May 19, 2004 at the Aberdeen Plant Materials Center Home Farm approximately two miles north of Aberdeen. Site information, bed preparation and experimental design are identical to the grass trial. There are two industry standards included in the common yarrow plots, Eagle and Great Northern. There are no releases of lupine or pearly everlasting that would be comparable to our material. 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. A border row of 'Appar' blue flax (*Linum perenne*) was planted on

either side of the trial to reduce edge effect. First evaluation was conducted on July 19, 2004. Plants ranged from two to six leaf stage. Forb plots were evaluated in the same manner as the grass plots.

2004 EVALUATIONS AND DISCUSSION (PRELIMINARY)

Evaluation of blue wildrye showed no significant differences in percent stand. Plant density showed low levels of significance. Accession 9076447 rated highest (39.0%), and Elkton rated lowest at 16.4%. Best vigor was recorded in accessions 9076446, 9076447 and Mariposa (1.8). Poorest vigor rated was 3.8 from 'Arlington' (see Table 1).

One collection of Sandberg bluegrass was compared against four industry releases (Table 2). Evaluations showed high levels of significance in all three categories solely due to the fact that accession 9076465 performed so poorly. Percent stand: worst accession 9076465 (26.5) best Mountain Home Source (95.5). Plant density: worst accession 9076465 (2.4) best Mountain Home (36.8). Seedling vigor: worst accession 9076465 (8.3) best Hanford Source (2.5).

Idaho fescue evaluations showed high significant differences in both rated categories. Accessions 9076469 and 9076437 had the highest percent stand at 75.0%. Industry standard Winchester Source ranked only slightly lower at 73.8% stand (see Table 3). The lowest rating came from accession 9076444 at 16.8%. Accession 9076473 had the highest plant density at 11 plants/foot of row. Lowest density was observed in accession 9076444 with an average 1.8 plants/foot. Best seedling vigor was observed in Winchester (2.8), while accession 9076444 showed the poorest vigor (7.8).

Bluebunch wheatgrass evaluations 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 on top with 14.38 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 of 'Willamette' tufted hairgrass were significantly higher than all other accessions (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). Plant density showed no significant differences (see Table 5).

Yarrow plots failed to show significant differences in percent stand, plant density or seedling vigor. Trends, however, show accession 9076460 first in all but one category, seedling vigor, where it placed second. Lupine and pearly everlasting plots had essentially no germination (data not shown).

This is a preliminary report of evaluations conducted in June and July, 2004. The trial will be evaluated again in late September, and a report summarizing the evaluations conducted during 2004 will be prepared.

REFERENCES

Ogle, D., and B. Cornforth. 2000. Technical Note 35: A Quick Method to Estimate Germination Percentages for Seed Species. USDA-NRCS, Boise, ID. ID-TN35, Mar. 2000. 3p. (9 KB) (ID# 2250)

TABLES

Table 1. Blue wildrye

Accession No.	% Est. viability	% PLS[3/]	% stand 6/14	Density[1/] 6/14	Vigor[2/] 6/14
9076439	79	71.1	92.8[4/]	38.1 a-b[5/]	2.3
9076445	77	69.3	91.5	30.1 a-c	2.8
9076446	80	72	91.5	22.8 b-c	1.8
9076447	72	64.8	93.0	39.0 a	1.8
9076448	66	59.4	72.3	22.6 b-c	3.3
9076449	69	62.1	95.8	36.6 a-b	2.0
9076472	82	73.8	87.5	26.0 a-c	3.0
Mariposa	*	94	95.8	28.4 a-c	1.8
Arlington	*	93	91.5	31.5 a-c	3.8
Elkton	*	92	95.5	16.4 c	3.5
LSD (0.05)			22.1	13.7	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/] No significant difference detected between accessions
[5/] Means followed by the same letter are not significantly different
* Data not available from source

Table 2. Sandberg bluegrass

Accession No.	% Est. viability	% PLS	% stand 6/14	Density 6/14	Vigor 6/14
9076465	40	36	26.5 b	2.4 b	8.3
Sherman	80	75.8	84.8 a	29.1 a	2.5
High Plains	84	75.6	80.8 a	24.6 a	4.0
Hanford	88	85.0	91.5 a	27.5 a	6.0
Mtn. Home	76	74.3	95.5 a	36.8 a	5.0
LSD (0.05)			16.8	12.3	1.2

Table 3. Idaho fescue

Accession No.	% Est. viability	% PLS	% stand 6/14	Density 6/14	Vigor 6/14
9076473	58	52.2	62.5 a-b	11.0 a	3.8
9076431	61	54.9	37.8 c-e	2.5 b	6.5
9076432	76	68.4	50.0 b-c	6.1 a-b	6.0
9076437	61	54.9	75.0 a	7.4 a-b	4.5
9076438	80	72.0	72.3 a	7.4 a-b	5.8
9076443	45	40.5	68.3 a-b	10.5 a	5.0
9076444	13	11.7	16.8 e	1.8 b	7.8
9076453	50	45	69.5 a-b	7.6 a-b	5.5
9076462	30	27	34.8 c-e	2.3 b	6.8
9076467	71	63.9	48.5 b-d	5.1 a-b	6.3
9076469	68	61.2	75.0 a	10.4 a	3.5
9076471	67	60.3	27.8 d-e	3.9 b	6.5
9076427	45	40.5	54.3 a-c	7.3 a-b	5.5
Joseph	*	*	52.8 a-c	5.6 a-b	5.0
Winchester	*	*	73.8 a	9.9 a	2.8
Nezpurs	*	*	37.3 c-e	1.9 b	7.0
LSD (0.05)			19.3	5.0	1.9

Table 4. Bluebunch wheatgrass

Accession No.	% Est. viability	% PLS	% stand 6/14	Density 6/14	Vigor 6/14
9076426	76	68.4	70.8 a-c	9.9 a-b	3.0
9076428	56	50.4	49.8 c	5.8 b-c	5.0
9076433	75	67.5	77.8 a-b	14.4 a	2.5
9076434	69	62.1	61.3 a-c	7.9 b-c	4.0
9076436	69	62.1	81.8 a	8.1 b-c	3.3
9076441	56	50.4	69.5 a-c	6.8 b-c	4.0
9076442	86	77.4	70.8 a-c	7.3 b-c	3.0
9076450	73	65.7	57.0 b-c	6.8 b-c	3.8
9076463	58	52.2	27.8 d	2.5 c	7.0
9076464	65	58.5	64.0 a-c	10.8 a-b	3.0
9076466	64	57.6	66.5 a-c	11.4 a-b	2.8
Goldar	79	81.5	66.8 a-c	8.0 b-c	2.5
Anatone	87	85.4	51.5 c	5.8 b-c	3.5
P-7	85	81.1	66.8 a-c	5.5 b-c	3.0
LSD (0.05)			20.6	5.3	1.9

Table 5. Tufted hairgrass

Accession No.	% Est. viability	% PLS	% stand 6/14	Density 6/14	Vigor 6/14
9076429	49	44.1	68.0 b	19.0[1/]	4.8
9076430	52	46.8	62.8 b-c	17.8	6.5
9076435	55	49.5	53.0 c	6.1	7.8
Willamette	*	81	86.0 a	23.0	5.3
Tillamook	*	81	69.8 b	21.8	5.5
LSD (0.05)			11.6	11.6	1.5

[1/] No significant difference detected between accessions

Table 6. Common yarrow

Accession No.	% Est. viability	% PLS	% stand 7/16	Density 7/16	Vigor 7/16
9076454	84	75.6	37.5[1/]	2.4[1/]	4.8
9076456	73	65.7	32.0	1.5	6.0
9076457	86	77.4	32.0	0.3	5.5
9076458	80	72.0	59.7	2.8	3.8
9076459	91	81.9	47.2	1.3	4.0
9076460	67	60.3	75.0	3.1	3.5
9076474	37	33.3	45.9	2.9	5.8
9076475	71	63.9	45.9	3.0	4.5
Great Northern	93	71.6	45.9	2.3	2.8
Eagle	*	*	33.3	0.5	5.5
LSD (0.05)			33.6	3.3	3.2

[1/] No significant difference detected between accessions

Appendix 1. Collection data

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

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

USDA Forest Service, Region 1
Native Grass and Forb Initial Evaluation
2004 Progress Report
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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 fires. Increased fires 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 is to identify if accessions under evaluation 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 forty one locations and three native forb species from eleven locations which were sent to the USDA-Natural Resources Conservation Service-Plant Materials Center (PMC) at Aberdeen, Idaho for evaluation. From the total 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 common 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 during 2004.

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 quicker or had better seedling vigor. No significant differences were detected (data not shown).

GRASSES

The native grass field evaluation trial is being conducted at the PMC, Fish and Game farm located approximately 5 miles northeast of Aberdeen, Idaho. Experimental design was 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 Delco 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 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. Border rows of 'Tegmar' intermediate wheatgrass (*Thinopyrum intermedium*) were planted on the outside of the blocks to reduce edge effect. Plots were sprinkler irrigated as needed during the growing season. Weeds were controlled with herbicides and between row cultivation.

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 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 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 during 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 inch units. Blue wildrye and bluebunch wheatgrass were rated for percent of plants in flower per plot. Idaho fescue, Sandberg bluegrass and tufted hairgrass had not begun flowering by 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. Seed yield data will be collected beginning in the second growing season (2005). All species except blue wildrye were evaluated for plant density as described above. 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.

All data 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).

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 common 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 two to six leaf stage.

Forb plots were evaluated in the same manner as the grass plots. The first evaluation included data collection for percent stand, density and seedling vigor. The second evaluation was conducted during the week of September 27 and data was collected on percent stand, density, plant volume and percent flower.

This is a progress report of evaluations conducted during 2004, the first year of evaluations. The trials will be evaluated again in 2005, 2006 and 2007, and reports summarizing the evaluations from each subsequent year will be prepared.

2004 EVALUATIONS DISCUSSION (PRELIMINARY)

BLUE WILDRYE

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 (a western Oregon accession) (see Table 1).

During the second evaluation 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 a 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 higher than the rest of the plants in the trial.

Table 1. Blue wildrye

Accession No.		% Est. viability	% PLS[3/]	% Stand 6/14	Density[1/] 6/14	Vigor[2/] 6/14	% Stand 9/29	% Flower 9/29	Plant vol. (in^3) 9/29
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
LSD (0.05)				22.1	13.7	1.8	20.4	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

SANDBERG BLUEGRASS

One collection of Sandberg bluegrass was compared against four industry releases (Table 2). The first evaluation showed high levels of significance in all three categories solely due to the fact that accession 9076465 performed so poorly. The Mountain Home Source had the best stand (95.5%) and greatest density (36.8 plants per foot) and 'Sherman" had the best vigor (2.5) at the first evaluation.

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).

Table 2. Sandberg bluegrass

Accession No.		% Est. viability	% PLS[3/]	% stand 6/14	Density[1/] 6/14	Vigor[2/] 6/14	% Stand 9/29	Density 9/29	Plant vol. (in^3) 9/29
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
LSD (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

IDAHO FESCUE

The first evaluation of Idaho fescue indicated a wide range in stand establishment. 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.

Table 3. Idaho fescue

Accession No.		% Est. viability	% PLS[3/]	% stand 6/14	Density[1/] 6/14	Vigor[2/] 6/14	% Stand 9/29	Density 9/29	Plant vol. (in^3) 9/29
9076473		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
9076427		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
LSD (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

BLUEBUNCH WHEATGRASS

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 production: Goldar, 9076450, 9076466, 9076436, 9076441, 9076463, 9076442, 9076433 and 9076434 ranged from 22.5% down to 2.5% flower production.

Table 4. Bluebunch wheatgrass

				% stand	Density[1/]	Vigor[2/]	% Stand	Density	Plant vol. (in^3)	% Flower
Accession No.		% Est. viability	% PLS[3/]	6/14	6/14	6/14	9/29	9/29	9/29	9/29
9076426		76	68.4	70.8 a-c[4/]	9.9 a-b	3.0	75.0 a-c	4.5 a-c	64 c	65.0 a
9076428		56	50.4	49.8 c	5.8 b-c	5.0	54.2 b-d	3.3c	54.8 c-d	38.8 b-c
9076433		75	67.5	77.8 a-b	14.4 a	2.5	72.2 a-c	5.8 a	31.5 d-e	3.8 d
9076434		69	62.1	61.3 a-c	7.9 b-c	4.0	73.6 a-c	4.1 a-c	22.3 e	2.5 d
9076436		69	62.1	81.8 a	8.1 b-c	3.3	81.9 a	4.1 a-c	64.0 c	11.3 d
9076441		56	50.4	69.5 a-c	6.8 b-c	4.0	66.7 a-c	3.8 a-c	31.5 d-e	11.3 d
9076442		86	77.4	70.8 a-c	7.3 b-c	3.0	77.8 a-b	3.8 a-c	22.3 e	3.8 d
9076450		73	65.7	57.0 b-c	6.8 b-c	3.8	50.0 c-d	3.0 c-d	31.5 d-e	17.5 c-d
9076463		58	52.2	27.8 d	2.5 c	7.0	33.3 d	1.3 d	22.8 e	5.0 d
9076464		65	58.5	64.0 a-c	10.8 a-b	3.0	77.8 a-b	4.0 a-c	64.0 c	37.5 b-c
9076466		64	57.6	66.5 a-c	11.4 a-b	2.8	83.3 a	5.5 a-b	27.0 d-e	11.3 d
Goldar		*	81.5	66.8 a-c	8.0 b-c	2.5	72.2 a-c	3.9 a-c	109.8 b	22.5 c-d
Anatone		*	*	51.5 c	5.8 b-c	3.5	68.1 a-c	3.5 b-c	125.0 a-b	48.8 a-b
P-7		*	*	66.8 a-c	5.5 b-c	3.0	75.0 a-c	3.5 b-c	147.8 a	58.8 a-b
LSD (0.05)				20.6	5.3	1.9	21.7	1.8	27.3	21.5

[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

TUFTED HAIRGRASS

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). Plant density showed no significant differences (see 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.

Table 5. Tufted hairgrass

				% stand	Density[1/]	Vigor[2/]	% Stand	Density	Plant vol. (in^3)
Accession No.		% Est. viability	% PLS[3/]	6/14	6/14	6/14	9/29	9/29	9/29
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
LSD (0.05)				11.6	11.6	1.5	16.4	1.8	49.1

[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/] No significant difference detected between accessions
[5/] Means followed by the same letter are not significantly different
* Data not available from source

COMMON YARROW

Yarrow plots failed to show significant differences in percent stand, plant density or seedling vigor in the first evaluation. Trends, however, show accession 9076460 first in all but one category, 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%. 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%).

Table 6. Common yarrow

Accession No.		% Est. viability	% PLS[3/]	% stand 7/16	Density[1/] 7/16	Vigor[2/] 7/16	% Stand 9/29	Density 9/29	Plant vol. (in^3) 9/29	% Flower 9/29
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
LSD (0.05)				33.6	3.3	3.2	36.8	2.7	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

SUMMARY

Collections showed a wide range of variability for the evaluated traits when compared against industry releases and against each other. Some accessions appear to be competing well and show promise as potential future selected class releases. However, it is not recommended that release decisions be made based on evaluations from a single growing season during the establishment year. Evaluations from season two and beyond will provide more information regarding the long term growth, development, winter hardiness and seed production of the tested accessions. Evaluations planned for next year include: percent stand, plant volume, above ground biomass and seed yield.

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Ogle, D., and B. Cornforth. 2000. Technical Note 35: A Quick Method to Estimate Germination Percentages for Seed Species. USDA-NRCS, Boise, ID. ID-TN35, Mar. 2000. 3p. (9 KB) (ID# 2250)

Appendix 1. Collection data

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

Appendix 1. Collection data (continued)

Accession No.	Species	Date collected	Fresh wt. (lbs)	Cleaned wt. (lbs)	Forest	Location	Elevation (ft)
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

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

FIELD PLANTING, DEMONSTRATION AND DISTRICT SEED INCREASE EVALUATION SUMMARIES

PLANT MATERIALS

2004

IDAHO EVALUATION SUMMARIES

FIELD, DSI and DEMONSTRATION PLANTINGS

IDAHO DIVISION I
PLANT MATERIALS PLANTINGS

FIELD OFFICE: BONNERS FERRY

ID99005 Paul Headings Regar meadow brome - Field Plantings (2). Materials ordered February 22, 1999. Field 1–pure stand of Regar. Field 2-mixed stand of Regar and alfalfa. Purpose – demonstration planting to document growth patterns, production, and forage quality. Site characteristics – MLRA E43b, silt loam soils, 5-10 percent slopes, north aspect, 2300 feet elevation, 24 inch precipitation zone, non-irrigated, T62N R1E NW ¼ Section 2. FY99 planted spring 1999. FY00 due to dry years 1999 and 2000 stand establishment was slow, but excellent stands in each field are establishing. Plantings average 3 tons per acre. FY01 Planting 1 - The "pure" stand of Regar Brome planting averaged 2 ton/acre. A forage analysis indicted the crude protein to be 8.75%. The forage grass for hay is fine leaves and stems. The hay feeds well to animals. In hot dry weather, the "windrows" have to be carefully harvested and cured to avoid damaging brittle leaves and stems. The crop can be "pulverized" easily. The average bale weight was 103 pounds. The owner applied 110 lbs. 40-0-0 to enhance production and will increase application rates up to 200 lbs/acre 40-0-0. There were no second cuttings since the field was planted three years ago due to poor to fair moisture conditions. Planting 2 - The Regar/Agate alfalfa mixture established well. The first cutting has grass present and makes great cattle feed. The second cutting has very little grass within the alfalfa due to slow recovery. This may be due to dry weather conditions. Also, this may be a good attribute for the producer who can sell hay with grass and no grass. FY01 Planting 1 - The "pure" stand of Regar has an excellent stand with 5 plants per square foot, good vigor, and 4000 pounds per acre production. Landowner applied 220 lbs. 40-0-0 in early spring. Planting 2 - Regar/alfalfa mixture has a good stand with 2 Regar/5 alfalfa plants per square foot, fair to good vigor, and 7000 pounds per acre production. FY02 - FY04 no evaluations.

ID99015 Merle Olsen Field Planting – Regar meadow brome/alfalfa. Materials ordered April 9, 1999. Site characteristics – Rubson silt loam soil, 5 percent slopes, south aspect, 1840 feet elevation, 24 inch precipitation zone, non-irrigated, T61N R1E Section 7. FY99 no evaluation. FY00 excellent mixed stand established. FY01 the Regar and alfalfa mixture performed well with good hay quality. This year's crop had reduced yields due to drought conditions. FY02 - FY04 no evaluations.

ID00016 Boundary Creek WRP – cropland area planted to permanent perennial species field planting. A mix of Alkar tall wheatgrass, Greenar intermediate wheatgrass, Ranger alfalfa, birdsfoot trefoil, red clover, Sherman big bluegrass, tufted hairgrass, orchardgrass, and timothy at critical area planting rates was dormant planted on 1000 acres in late fall 1999. A 42 feet air-seeder with fertilizer attachment planted mix with 2000 units per acre of nitrogen, phosphorus, potassium, and sulfur applied 1 inch below and to side of seed. FY00 excellent stand is establishing with some species as tall as 3-4 feet by early July. In October wild oats were present throughout stand. FY01 The permanent wildlife planting mixture established well utilizing the 42-foot air seeder. The drill was calibrated with the producer based upon 14.2 lbs. PLS/acre. A "flush" of wild oats occurred the first year. The stand was seeded the 1st week of November 1999. The "so called dormant planting" resulted in some sprouting of clovers due to a warmer than normal late fall. As a result, some mortality occurred in the clovers. An excellent stand of Alkar tall wheatgrass, Greenar intermediate wheatgrass, birdsfoot trefoil, Ranger alfalfa, Latar orchardgrass, timothy and clover exists. The Sherman big bluegrass is "spotty" due to becoming overpowered by the other species in the mix. There are some ridges in the field with quackgrass, which is good cover. The IDF&G is actively spot spraying the Canadian thistle. They plan to obtain a boom sprayer in order to treat the acreage more uniformly. FY02 The overall stand is good to excellent with the primary species including Alkar tall wheatgrass, Greenar intermediate wheatgrass, Latar orchardgrass and redtop. Some birdsfoot trefoil, clover, timothy, and alfalfa are present in scattered locations. Tufted hairgrass and Sherman big bluegrass were not found. FY03 – FY04 no evaluations.

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

FIELD OFFICE: COUER D'ALENE

None

FIELD OFFICE: PLUMMER

None

FIELD OFFICE: SANDPOINT

ID96029 Lee Johnson wood fiber mulch, Niner sideoats grama, Alma blue grama, annual rye, Durar hard fescue, Durar hard fescue/clover, prairie junegrass, and alpine bluegrass field plantings - tree nursery ground cover trial. Site loam soil (low to mod. permeability/high erosion potential), 5-10% slopes on SE exposure. FY96 planted 5/31/96. 1. Wood mulch is doing excellent job of weed control and no rodent activity to date - mulch was about 10 inches deep when applied 2. Excellent stand of annual rye established, Durar hard fescue plants are very small and establishing beneath cover crop 3. Many young Durar hard fescue plants were establishing, but very few clover plants - soil may have been too loose when seeded and clover seed may be too deep 4. Excellent initial stand of sideoats and blue grama establishing - could not tell which species was doing the best 5. Very few prairie junegrass plants establishing - appears some germination is occurring this fall 6. A lot of alpine bluegrass seedlings - appears germination did not occur until fall. FY97 and FY98 no evaluations. FY99 Treatment 1: Control no cover and normal weed control - 0 percent desirable cover with 50-80 weeds. Treatment 2: Cedar bark mulch 6-8 inches thick – 100 percent desirable cover in rows with 5 percent weeds invading mulch and some evidence of rodents in mulch. Trees near cedar mulch are more chlorotic than other treatments. Treatment 3: Durar hard fescue and annual ryegrass – 50-70 percent desirable cover with up to 20 percent weeds. Fescue blends provide more biomass than other seedings and good cover – almost 100 percent cover if mowed. Treatment 4: Durar hard fescue and Berseem annual clover – 60-80 percent desirable cover and up to 15 percent weeds. Treatment 5: blue grama and sideoats grama – 20-50 percent desirable cover with 30-80 percent weeds. Clearly the worst treatment in trial. Treatment 6: Prairie junegrass – 60-80 percent desirable cover and 10-15 percent weeds. A good alternative since this is a low growing cover. Treatment 7: Alpine bluegrass – 50-80 percent cover with 5-10 percent weeds. Less biomass produced than fescue or prairie junegrass. The alpine bluegrass produced more of a thick sod with seedheads 6-8 inches tall. This would be a better choice for nurseries that are concerned with the shading effect of taller grasses on lower branches. It also covers the ground better once established, especially in shady areas. One potential problem is its ability to spread, including into the tree rows. FY00, FY01, FY02 - FY04 no evaluations.

ID00004 Paul Jayo Regar meadow brome field planting – irrigated/non-irrigated and hay/grazing trial. Seed ordered January 21, 2000 for delivery in early April. Site is 30-acre field with Hoodoo silt loam soil, 0-1 percent slopes, 32-inch rainfall zone, and 2485 feet elevation. FY00 planting was delayed due to dry spring weather. Cooperator plans to plant fall 2000. FY01 - FY04 no evaluations.

IDAHO DIVISION II
PLANT MATERIALS PLANTINGS

FIELD OFFICE: GRANGEVILLE

ID04004 Tony Carlson Field Planting. Sherman big bluegrass, Rosana western wheatgrass, Nezpar Indian ricegrass, Snake River Plains fourwing saltbush and Northern Cold Desert winterfat. Site characteristics: Lickskillat – Tannahill soil complex, 20 percent slopes, 1960 feet elevation, SW exposure, 14-16 inch precipitation, and non-irrigated. Seed ordered January 12, 2004. FY04 species were planted into a site that was sprayed with Roundup, raked, broadcast planted and raked again. Soil moisture was above average at planting time. During evaluation (7/9/04) Sherman big bluegrass and Nezpar Indian ricegrass were present. Site was quite weedy and it is too early to complete establishment evaluation.

ID04008 Gary Crea field planting (winter feed area trial). 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. Seed ordered March 8, 2004. Site characteristics: Ferdinand – Riggins – Flybow soil complex, west aspect, 3300 feet elevation, 22-24 inch precipitation, non-irrigated, T31N R1E SW1/4 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. Gary plans to exclude livestock until late fall and will spray for weeds next spring.

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 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.

ID04010 Marcia Heaton riparian planting. 9023733 redosier dogwood, 9023739 redosier dogwood, 9023740 redosier dogwood, Laurel willow, White willow, Coyote willow, and Golden willow. Cuttings ordered March 5, 2004. Site characteristics: Wilkems silt loam soil, 2980 feet elevation, 24 inch precipitation, non-irrigated, T31N R3E NE1/4 Section 34. FY04 – approximately 60% survival for all willow species and about 20% survival for dogwood species.

FIELD OFFICE: LEWISTON

ID82001 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.

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

wheatgrasses performing the best with Rush intermediate a particular standout. Rosana western wheatgrass is the most aggressive spreader. FY01 and FY02 no evaluation. **FY04 planting cancelled.**

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.

ID96009 Dau Rush intermediate wheatgrass, Luna pubescent wheatgrass, and Bozoisky Russian wildrye field planting (3 individual plantings) for star thistle control. Seed ordered 12/8/95. FY96 – FY03 no evaluations. **FY04 planting cancelled.**

ID98007A Mike Miller willow planting. Aberdeen willows (Laurel, White, Streamco, Coyote, Geyer) and Meeker willows (Coyote, Yellow 3 accessions, Scouler, Whiplash 2 accessions, Booth 3 accessions, Drummond 3 accessions, Geyer 2 accessions) and Pullman shrubs (Dogwood 3 accessions). Materials ordered 2/9/98. FY98 survival Meeker willows 832 10/10, 823 10/10, 820 9/10, 826 9/10, 826 9/10, 847 7/10, 834 7/10, 827 10/10, 835 6/10, 825 10/10, 828 7/10, 822 0/10, 829 5/10, 819 ?/10. Survival of Pullman dogwoods 740 3/5, 733 5/5, 739 5/5. FY99 no evaluation. FY00 80 percent survival of 820 Pacific willow (local standard). 20 percent survival of 827 Booth willow, 828 Drummond willow, 822 Geyer willow, 829 Drummond willow and 834 Yellow willow. 10 percent survival of 832 Geyer willow. 823 Coyote willow, 826 Booth willow, 847 Drummond willow, 825 Yellow willow, 819 Yellow willow, 739 dogwood, 733 dogwood, 740 dogwood, and 835 Yellow willow failed. Competition, insects and browse damage are factors affecting survival. FY01 survival 822 Geyer 10%, 828 Drummond failed, 825 Yellow 10%, 829 Drummond 10%, 820 Pacific 80% (all died back to base – sprouting about 3 feet high this years growth), 823 Sandbar failed, 832 Geyer 20%, 826 Booth 10%, 847 Drummond failed, and 827 Booth 50%. **FY04 planting cancelled.**

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

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

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

ID98016 Fred Kaufman Hycrest crested wheatgrass, Vavilov Siberian wheatgrass and Sherman big bluegrass field planting. FY98 and FY99 no evaluations. FY00 excellent stands of Hycrest and Vavilov established. FY02 excellent stand with excellent vigor for each cultivar. Hycrest crested wheatgrass suppressing cheatgrass better than Vavilov Siberian wheatgrass. FY04 excellent stand and vigor of Vavilov, Hycrest and Sherman. Stands are doing good job of suppressing weeds, providing erosion control and very good habitat for upland game birds (pheasants and quail).

ID04014 City of Lewiston – Mike Bowman Delar small burnet field planting. Seed ordered April 6, 2004. Site characteristics: MLRA B9, 4 acres, Tainey silt loam soil, 5-10 percent slope, west to north aspect, 3000 feet elevation, 26-28 inch precipitation zone, non-irrigated. FY04 no evaluation.

FIELD OFFICE: MOSCOW
None

FIELD OFFICE: NEZPERCE
None

FIELD OFFICE: OROFINO
ID99010 Ray Geidl field planting. Species include Coyote willow, Geyer 435 willow, Geyer 448 willow, Geyer 483 willow, Geyer 491 willow, Snowberry, Elderberry, Dogwood 733, Dogwood 740, and Chokecherry. FY99 and FY00 and FY01 no evaluations. FY02 Plantings are located in area with heavy reed canarygrass competition. Good survival for all willow and dogwood accessions with 4 of 5 cuttings for each still surviving, fair vigor for each, 40 inch height for all willows and 20 inches height for all dogwoods. Snowberry, Elderberry and chokecherry failed. FY03 – FY04 no evaluations.

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 no evaluation.

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 no evaluation.

ID04013 Paul Schroder Project. 9067541 peachleaf willow, 9067546 peachleaf willow, 9067 549 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 no evaluation.

IDAHO DIVISION III
PLANT MATERIALS PLANTINGS

FIELD OFFICE: CALDWELL

ID98022 Bill Baird Rush intermediate wheatgrass and orchardgrass field planting - irrigated pasture. Seed ordered May 14, 1998. Planting scheduled for mid May through mid June. FY98 irrigated pasture planted in mid May with poor stand establishing. Bill plans to replant in spring of 1999. FY99 good stand density establishing with 5 plants per foot squared and fair vigor. Plants reached 6-8 inch height this establishment year. Nitrogen, phosphorus, potassium, and sulfur were applied. This is a very course-gravelly soil requiring irrigation every 4-5 days. FY00 and FY01 no evaluations. FY02 very course-gravelly soils that require frequent 3-4 day irrigation. Stand has good density with about 6 plants per square foot, good vigor in spite of droughty infertile soils. Individual plants are increasing in size and are competitive with weedy species. Cooperator is please with performance. FY04 – fair stand and vigor for both Rush intermediate wheatgrass and Orchardgrass on gravelly soils where frequent irrigation is required.

ID02001 CB River Springs Ranch WRP field planting. Vavilov Siberian wheatgrass, Bannock thickspike wheatgrass, Magnar basin wildrye, Northern Cold Desert winterfat, and Snake River Plain fourwing saltbush. Seed ordered 3/26/01 for shipment in early March 2002. Site characteristics: Felthom fine sandy loam soil, 3-12 percent slopes, NE aspect, 2100 feet elevation, 11 inch rainfall, cheatgrass community to be sprayed 2-3 times (spring and fall 2001) prior to early spring (2002) interseeder planting. FY02 this year's precipitation is below average. Field was sprayed for cheatgrass control in May 2001 and March 2002. Field was planted on April 9, 2002 using a grass seeding drill and a rain of 0.3 inches occurred immediately following planting. No appreciable rain fell during the rest of the year. A field check on May 16 showed excellent seed germination. Field was sprayed for broadleaf control in June 2002. Field check on November 19, 2002 - was unable to determine success of planting. FY03 no evaluation. **FY04 planting failed – cancel.**

FIELD OFFICE: EMMETT

ID02023 Little Farms Rush intermediate wheatgrass, Vavilov Siberian wheatgrass, Covar sheep fescue, and Sodar streambank wheatgrass critical area planting. Seed ordered December 14, 1998 for delivery about August 1, 1999. FY02 seed transferred to Little Farms. FY03 and FY04 no evaluations.

FIELD OFFICE: MARSING/GRANDVIEW

ID04001 Matt and Jean Barney demonstration plots. Bannock thickspike wheatgrass, Sodar streambank wheatgrass, Magnar basin wildrye, Nezpar Indian ricegrass, Snake River Plains fourwing saltbush, Northern Cold Desert winterfat, Vavilov Siberian wheatgrass, Critana thickspike wheatgrass, Rimrock Indian ricegrass, 9019219 bottlebrush squirreltail, PI434231 plains bluegrass, 9005460 alkali bluegrass, High Plains Sandberg bluegrass, 9063520 Ruby Valley pointvetch, 9005617 strawberry clover, 9016134 Gardner saltbush, Trailhead basin wildrye, Bozoisky Russian wildrye, Secar Snake River wheatgrass, Schwendimar thickspike wheatgrass and Sherman big bluegrass ordered April 17, 2003. Seeding planned of October - November 2003. **Site Characteristics:** Owyhee County, MLRA B11, Soil Map Unit 100 fine sandy loam, weak salinity, 1-7% slope, south aspect, 3300 feet elevation, 8-10 inch precipitation zone, non-irrigated, NE 1/4 Section 29 T4S R1W. Plots were planted late fall of 2003. FY04 no evaluation.

FIELD OFFICE: MERIDIAN

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

No grass establishment. Observations on herbicide treatments: 2 ounce rate very similar to control (no herbicide treatment) with very little cheatgrass or six-weeks fescue control; 4-12 ounce rates resulted in good cheatgrass control; 8-12 ounce rates controlled Sandberg bluegrass, but it appears that there was little control of six-weeks fescue. Trial will be evaluated for at least one more year. **Droughty conditions since 2001 has caused stand failure – cancel.**

FIELD OFFICE: MOUNTAIN HOME
ID03004 Pat Bennett field planting. Topar pubescent wheatgrass, Regar meadow brome, and Garrison creeping foxtail seeding mixture. Seed ordered October 24, 2002. Seeding planned for November 2002. Site is in MLRA 10A on Houk silty clay loam soil with 0-1 percent slope, 16 inch precipitation zone, 5000 feet elevation, and non-irrigated. NW1/4 Section 33 T1S R11E. D6 caterpillar was used to scalp site, breach existing embankments, and construct earthen plugs prior to planting. Seed was broadcast planted in December 2002 onto dry seedbed. Good winter moisture (snow cover) by late December. FY03 no evaluation. **FY04 – drought since planting has caused stand failure – cancel.**

FIELD OFFICE: PAYETTE
None

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

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.

ID94026 Weber Goldar bluebunch wheatgrass, Rush intermediate wheatgrass, Luna pubescent wheatgrass, Secar Snake River wheatgrass, Greenar intermediate wheatgrass, Schwendimar thickspike wheatgrass, Bozoisky Russian wildrye, Bannock thickspike wheatgrass, Delar small burnet, Firecracker and Alpine penstemon, Sherman big bluegrass, Wytana fourwing saltbush, and Rincon fourwing saltbush demo plots. Site is stony clay loam soil, non-irrigated, 16 inch ppt, 3200 feet elevation, 0-2% slopes. Seed ordered July 1994. FY94, FY95, and FY96 due to drought conditions, seeding not planted. FY97 seeded May 16, 1997 with good rains following planting. Weed competition is high. In general initial establishment was good for wheatgrasses, fair for wildryes and poor for forbs. FY98 rainfall was 150 percent of average this year resulting in a flush of weeds. All plots except forbs were sprayed for broadleaf weed control and were shredded to reduce overstory competition. The most successful plants include: GRASSES Rush is by far the superior plot from standpoint of vigor, total growth, and total production. Luna is rated second and Reliant is rated third. Other grasses are only marginally successful to non-existent due to possibly saturated soils and weed competition during the establishment year. FORBS Delar is doing very well and appears very hardy and adapted to wet soil conditions. Penstemons and Lupine did not establish. SHRUBS Rincon is taller (10-15 inches) than Wytana (4-6 inches). FY98 no evaluations. FY99 Weeds and saturated soils are a problem on this site. Most successful plants – grasses: Rush intermediate wheatgrass followed by Luna pubescent wheatgrass, and Reliant intermediate wheatgrass, with others only marginally successful; Forbs: Delar small burnet is performing very well and no other forbs established; Shrubs: Rincon fourwing saltbush is superior to Wytana fourwing saltbush on this site. FY00 no evaluation. FY01 following two years of extreme drought Greenar intermediate wheatgrass was the most productive and vigorous followed by Reliant intermediate wheatgrass and Luna pubescent wheatgrass. Rush intermediate wheatgrass, Mankota Russian wildrye, and Manska pubescent wheatgrass did not grow much this year. Magnar basin wildrye was superior to Trailhead basin wildrye in production and survivability. Thickspike wheatgrass and Russian wildrye accessions grew very slowly. Delar small burnet plants are not handling drought well and are dying. Rincon fourwing saltbush is better than Wytana fourwing saltbush with some plants to 18 inches in height. Weeds are infesting site. FY02 was a very dry growing season. Intermediate wheatgrasses - Greenar is producing more forage than any other species, Greenar is not spreading as fast as Rush or Reliant which is probably an advantage on this droughty site, Luna is the best pubescent wheatgrass, but not producing as much as Greenar. Basin wildryes - Magnar and Trailhead are nearly identical in production with Magnar slightly higher with more vigor than trailhead. Russian wildrye - Bozoisky is by far the best performer of the R. wildryes. Small burnet - Delar is no longer present. Fourwing Saltbush - Rincon is a little better than Wytana, but they lack vigor. Thickspike wheatgrass - all accessions are barely surviving. **Next evaluation scheduled for FY05**.

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.

ID97023 Schwenkfelder Rush intermediate wheatgrass District Seed Increase. Site is silty clay loam soil, 14-16 inch ppt, irrigated, 2700 feet elevation, 0-2% slopes, and north exposure, T15N R2W SW1/4 NE1/4 Section 16. Seed ordered March 24, 1997. FY97 spring planted May 29, 1997 into excellent firm seedbed. By July 3, 1997 adequate rain had occurred for good germination so no irrigation was required. There were still a few seedlings emerging on this date. Cooperator plans to spray for broadleaf weeds and will fertilize this fall to prepare for seed production. FY98 excellent stand and vigor with plants averaging 60 to 72 inches in height on June 23 with seedheads up to 15 inches long. Harvested in mid August with 550 to 600 pounds per acre estimated yield. Baled forage yield was 7000 to 8000 pounds per acre. The hay is fed to range cattle early in the feeding season and utilize it readily. FY99 produced 300 lbs/ac seed this year. Producer is very happy with production and utilizes residue to feed beef cows. Hay yield was about 3 tons per acre. Producer fertilized with 43-lbs/ac nitrogen and 104-lbs/ac phosphorus in late October 1999. FY00 no evaluation. FY01 producer decided to graze this field this year due to drought and reduced seedhead production. Vigor was reduced because of drought. FY02 producer choose to irrigate (twice) this field and harvest (July 10th) for hay. Production was 7500 pounds per acre (3.76 tons/acre). Field was irrigated again and used for fall grazing. **Next evaluation scheduled for FY05**.

ID98019 Royce Schwenkfelder Bannock thickspike wheatgrass Field Planting. Seed ordered March 16, 1998 for April delivery. FY98 because of spring rains, this seeding did not go in until mid June. Seedbed preparation was excellent, but only 20 percent of plants emerged due to soil crusting. Additional seed was obtained and this seeding will be replanted. FY99 - FY04 producer has not planted due to severe drought conditions the past three years.

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.

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 and FY04 no evaluations.

ID02014 Mink Land and Livestock Riparian Planting. 9067549 Peachleaf willow - Prairie City source and local source coyote willow, 2002 for shipment in late March 2002. To be planted with waterjet stinger. FY02 Peachleaf willow survival 50% and Coyote willow survival 10%. Planting depth (soils were very dry for most of season) was probably too shallow and plant perhaps should have been completed sooner. FY03 Peachleaf willow 80 percent survival with 48 to 96 inch height. Coyote willow local cuttings have 65 percent survival with 24 to 36 inch heights. FY04 no evaluation.

ID02017 Jim Eckhardt Field Planting - Plateau Herbicide Trial (4 oz, 8 oz, 12 oz, Control 4 oz, 8 oz, 12 oz). Seed ordered March 20, 2002 for shipment in early October. Species include: Magnar basin wildrye, Trailhead basin wildrye, Bozoisky Russian wildrye, Mankota Russian, Bannock thickspike wheatgrass, Critana thickspike wheatgrass,

Goldar bluebunch wheatgrass, High Plains Sandberg bluegrass, Vavilov Siberian wheatgrass, CD-II crested wheatgrass and Hycrest crested wheatgrass. Site Characteristics: MLRA B10, Deshler-Devon silty clay loam soil, 2-5 percent slope, south aspect, 2600 feet elevation, 12 inch rainfall zone, T11N R6W NE 1/4 NW1/4 Section 1. FY02 Plateau was applied (4, 8 and 12 ounce rates) March 27, 2002 by Joe Vollmer. Did not control salsify, fiddleneck or sunflower. Planted November 4, 2002 under dry/cold conditions with a rangeland drill at 12-inch spacing. FY03 three planted species established this year: 1) Vavilov Siberian wheatgrass had the best stand and was the most vigorous. It did not grow in the untreated control plot – established well in the 4 and 8 ounce treatments – did not establish in the 12 ounce treatment; 2) CD-II crested wheatgrass was not as vigorous as Vavilov and had fewer plants established. It had no establishment in the no treatment - some establishment in the 4 ounce treatment – good establishment in the 8 ounce treatment – no establishment in the 12 ounce treatment; 3) Hycrest crested wheatgrass was the least vigorous of the establishing species with 30-35 percent fewer plants than Vavilov and CD-II. It had no establishment in the untreated plot - spotty establishment in the 4 and 8 ounce plots – no establishment in the 12 ounce plots. At this evaluation the 8 ounce treatment appears to be the best rate for Plateau herbicide. FY04 – The best stands include: Vavilov Siberian wheatgrass with good stand with good vigor; CD-II crested wheatgrass with fair stand with fair vigor; Hycrest crested wheatgrass with fair stand with fair vigor. All other planted species appear to have failed. The best cheatgrass control rate was 8 ounces/acre of Plateau herbicide. 4 ounces is not enough and 12 ounces effects perennial plant growth. The Plateau application has helped existing bottlebrush squirreltail. Conservationist would not recommend this method seedbed preparation because he does not feel the additional expense warrants the limited vegetation produced.

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 and FY04 no evaluations.

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 and FY04 no evaluations.

ID96028 East Cassia SCD Hycrest crested wheatgrass, Sodar streambank wheatgrass, Bannock thickspike wheatgrass, and Appar blue flax field planting and Hycrest II (CD-II) crested wheatgrass, Sodar, Bannock, and Appar field planting. FY96 planting planned for fall of 1996. FY97 no evaluation. FY98 fair stand of all species except Appar, which failed. FY99 poor stands of Hycrest, CDII, and Flax. Bannock and Sodar failed. Crested wheatgrass can be rowed in very heavy stands of cheatgrass. FY00 fair stand of Hycrest and CD-II, poor stand of Bannock, and Sodar and Appar failed. Both Hycrest and CD-II are thickening up and starting to crowd out cheatgrass. Some Bannock is present, but Sodar and Appar were not observed. FY01 no evaluation. FY02 planting has been mowed resulting in poor opportunity to evaluate planting. FY03 and FY04 no evaluations.

ID97005 Hawker Field planting for medusahead wildrye control. Sherman big bluegrass, Covar sheep fescue and Garnet (905308) mountain brome. Site is very stony loam soil, non-irrigated, 14 inch ppt, 5800 feet elevation, 4% slope on south exposure. Seed ordered 10/17/96. FY97 new seeding and difficult to determine establishment. FY98 good stand of Sherman and Covar establishing and fair stand of mountain brome establishing. FY99 due to severe grasshopper population, it is impossible to determine stand composition. FY00 due to drought planted species were not found – evaluate in spring 2001.FY01 site was heavily grazed early this year and no regrowth occurred. FY02 cattle have been in field most of the summer and field is overgrazed. Planting evaluation could not be performed. FY03 and FY04 no evaluations.

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 and FY04 no evaluations.

ID00009A Warren Yadon willow field planting. 9067561 Lemmon willow (12), 9067548 Drummond willow (12), 9067436 Yellow willow (12), 9067375 Peachleaf willow (15), and 9067376 Peachleaf willow (14) were ordered on March 1, 2000 for shipment April 10, 2000. FY00 willow evaluations will be performed next year. FY01 this planting is overgrown with woods rose, stinging nettle and weeds. Cuttings are alive, but very difficult to evaluate this late in the year. Recommend evaluating earlier next year. FY02 12 Drummond and 6 Yellow willows were alternately planted with 2 Yellow willows 6-8 feet tall still surviving. 6 Yellow willows planted into the face of a 4-5 feet cutbank on the west side of stream, all have survived and are 2-4 feet tall with limited branching. 14 Peachleaf 376 were planted with 4 6-8 feet tall plants surviving. 15 Peachleaf 375 were planted with 12 2-10 feet tall plants surviving. 12 Lemmon willows were planted, but could not be located. FY03 and FY04 no evaluations.

FIELD OFFICE: GOODING/FAIRFIELD

ID98018A Bill Simon Farms Rush intermediate wheatgrass District Seed Increase. Seed ordered March 16, 1998 for mid April delivery. FY98 Rush seeded in April 1998 into twin rows on 30-inch centers. The 55 acre field was formerly in alfalfa (1996 and prior) and fallowed in 1997. Excellent stand established by the fall of 1998 with plants fully bunched and vigorous. Stand was sprayed with formula 40 2, 4-D in late June or early July. Producer did not fertilize stands in the fall. FY99 approximately 25 percent of production was lost to shatter due to strong winds prior to harvest. The 55-acre field produced approximately 180 lbs/acre. On droughtier hilltops and ridges producer noted that seed production was lacking and suggested that wider row spacing would be desirable. FY00 Rush stand remain strong and Bill Simon feels it is the best grass on the Prairie. The dry year took its toll on seed production, however. Harvested the third week of August 2000 and the 55-acre field produced 91 pounds/acre clean seed. The 55-acre field was in alfalfa prior to seeding to Rush, and this field has more weeds. FY01 spring frost damaged reproductive stems - no seed production. FY02 unfavorable moisture year - 50 pounds per acre seed production. FY03 good stand and vigor, however field was not harvested this year for seed due to very low seed production. The low production may have been due to spring frost (May 19 - 16^0, May 20 – 21^0, June 23 – 26^0), low precipitation, and very hot summer. Some very light seed fill on ridges – no seed fill in swales and other low spots. FY04 no seed production – producer grazed field. Stand is 6 years old and plants are spreading into the interspaces between rows. Producer does not cultivate planting between rows, so seed production would not be expected beyond 5 year old stand. Planting will be maintained for grazing. **Cancel**

ID98018B Bill Simon Farms Rush intermediate wheatgrass District Seed Increase. Seed ordered March 16, 1998 for mid April delivery. FY98 rush seeded in April 1998 into twin rows on 30-inch centers. The 85-acre field was formerly in small grain. Excellent stand was established by the fall of 1998 with plants fully bunched and vigorous. Stands were sprayed with formula 40 2, 4-D in late June or early July. Producer did not fertilize stands in the fall. FY99 approximately 25 percent of production was lost to shatter due to strong winds prior to harvest. The 85-acre field produced approximately 110 lbs/acre. On droughtier hilltops and ridges producer noted that seed production was lacking and suggested that wider row spacing would be desirable. FY00 Rush stands remain strong and Bill Simon feels it is the best grass on the Prairie. The dry year took its toll on seed production, however. Harvested the third week of August 2000, the 85-acre field produced 81 pounds/acre clean seed. Weeds in the 85-acre field are not a problem, since prior to seeding to Rush the field was in 2 years of wheat, and prior to that 5 years of Regar meadow brome, providing a clean field. FY01 unfavorable moisture year - 40 pounds per acre seed production. FY02 unfavorable moisture year - 23 pounds per acre seed production. FY03 good stand and vigor – field produced 49 pounds per acre this year probably due to spring frost (May 19 - 16^0, May 20 – 21^0, June 23 – 26^0), low precipitation, and very hot summer. FY04 – harvested approximately 70 pounds clean seed per acre. Stand is 6 years old and plants are spreading into the interspaces between rows. Producer does not cultivate planting between rows, so seed production would not be expected beyond 5 year old stand. Planting will be maintained for grazing. **Cancel**

ID98020 Bill Simon Bannock thickspike wheatgrass District Seed Increase. Seed ordered April 10, 1998 for mid April delivery. FY98 Bannock seeded on 12-inch centers. Evaluation in November 1998 indicated a slow start with weak plants at the end of the first full growing season. Weeds do not appear to be a problem, but soils are somewhat gravelly and it appears to be a difficult site to establish a stand. Field was fertilized with about 20 units of nitrogen in the fall. FY99 plants remain narrow and spindly, but fertilizer did contribute to improved plant health. Harvest of approximately 80 lbs/acre was completed early while plants were still green, but seed was mature and beginning to shatter. FY00 this is the first-to-ripen grass in Bill's portfolio, interfering with his alfalfa hay harvest on the Prairie. This year the Bannock was harvested the first week of August, and produced 110 pounds/acre clean seed, which is higher than last year's yield despite the dry year. The field was fertilized with 40 units of ammonium sulfate about May 1, 2000, and later sprayed with Formula 40 2,4-D. Cheatgrass is increasing in the field and will need to be controlled in 2001. FY01 unfavorable moisture year - 100 pounds per acre seed production. FY02 unfavorable moisture year - 65 pounds per acre seed production. FY03 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 45 pounds of clean seed per acre. Planting is deteriorating and cooperator will destroy stand this fall. **Cancel**

ID00005 Camas SCD (Koonce) formerly ID86010 Koonce multiple species demo plots. FY99 field evaluation determined these plots to be contaminated and planting was destroyed, site cleaned-up and fallowed during 1999, and was replanted in the spring of 2000. Plots replanted May 1, 2000. Plots will be irrigated the first growing season. **FY00** plots were irrigated until mid June, and then discontinued. Most of the wheatgrasses sprouted in the central and northern portions of the plot, but remained small at evaluation time due to dry season. Plot remains relatively weed-free except the southernmost 15 feet of the plot (sheep fescue area) which is a solid stand of globe mallow. The fescue is sprouted underneath the large mallow leaves. This is a particularly difficult weed to control once established. Special attention needs to be directed here in spring 2001. **FY01** the plots have been subjected to two seasons of unfavorable plant growth (dry springs) and one of the lowest winter snowpacks recorded on the Camas Prairie. Still, all varieties exhibit some level of success except for the following varieties which could not be found for observation: Durar hard fescue, Nezpar Indian ricegrass, 9043501 Salina wildrye, and Thurber's needlegrass. These varieties did not establish at all or remain yet as dormant seed due to drought. Some of the absent species may have germinated but died unnoticed due to drought. Weed competition most likely is not a factor of establishment difficulties in the plot. Possible exceptions may be in the Covar sheep fescue area that had significant amounts of common mallow in 2000 but is now under control due to spot spraying. Scouringrush is invading in the Bighorn sheep fescue and Magnar basin wildrye areas and may be a factor there. The entire demo plot was spot-sprayed in 2001 twice (last of June and first of August) with 2, 4-D/Banvel. At the time of this evaluation the plot did not contain weed problems significant to grass establishment. The wheatgrasses are performing the best. The highest performing wheatgrasses include Rush and Reliant intermediate wheatgrasses, Manska and Luna pubescent wheatgrasses, CDII and Nordan crested wheatgrasses, Bannock thickspike wheatgrass, and Pryor slender wheatgrass. Weak wheatgrass performance was observed with Arriba western, Whitmar beardless wildrye, San Luis slender wheatgrass, Critana thickspike wheatgrass, Ephraim crested wheatgrass, Douglas crested wheatgrass, and P27 Siberian wheatgrass. Bozoisky and Mankota Russian wildrye performed moderately, but the other wildryes either did poorly (Volga Mammoth and Magnar) or did not establish (Salina and Trailhead). Manchar and Liso smooth bromes have done well considering the drought with moderate performances, but Garnet and Bromar mountain bromes and Regar meadow brome did not fare so well and have overall weak ratings. The fescues, needlegrasses, orchardgrasses, ricegrasses, timothy, and foxtail are currently performing weakly or did not establish. Sherman big bluegrass had low establishment density but the existing plants have good vigor with many seedheads produced. **FY02** drought continues. Excellent plots include: Rush, Greenar, Reliant, Topar, Manska, Luna, Bozoisky, CD-II, Hycrest, and Nordan. Good plots include: Rosana, Manchar, Regar, Alkar, Jose, Liso, Oahe, Tegmar, 238, Goldar, P-7, Mankota, Secar, Pryor, Bannock, Schwendimar, Sodar, Sherman, Vavilov, and Magnar. Fair plots include: Latar, Garrison, Arriba, Climax, Covar, Volga, Whitmar, San Luis, Critana, Ephraim, Douglas, P-27, Rimrock, High Plains, and Trailhead. Poor plots include: Paiute, Garnet, Bromar, Durar, 902484, and 9040137. Failed plots include: Salina and Nezpar. **FY03** plants with best density, vigor and seed production include: Rush, Reliant, Manska, Bozoisky, CD-II, Nordan, Arriba, Greenar, Topar, P7, Mankota, Hycrest, Vavilov, Alkar, Jose, Oahe, Tegmar, Luna, Ephraim, and P27. Generally, the wheatgrasses are out performing the fescues, wildryes, needlegrasses, bromes, bluegrasses, timothy and orchardgrass. Plants that have failed include: Paiute, Rimrock, 9040137 needlegrass, Nezpar, Volga, 9043501 Salina wildrye, Bighorn sheep fescue. **FY04** wheatgrasses as a group dominate as the best adapted species for this site. Intermediate (Rush and Reliant) wheatgrass, pubescent (Manska and Luna) wheatgrass, Sherman big bluegrass and Trailhead basin wildrye improved over last year despite

unfavorable conditions. All other plots remained static or declined in performance. Garnet and Bromar mountain brome and San Luis slender wheatgrasses (all short-lived perennials) died out this past year.

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.

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.

ID01011 Bill Simon District Seed Increase High Plains Sandberg bluegrass test plots. Seed ordered in September 2001. FY02 and FY03 seed not planted due to drought.

ID02015 Bob Josaitis Field Planting. 905439 switchgrass (Bridger PMC) and Blackwell switchgrass (Manhattan PMC) were ordered March 15, 2002 for shipment about April 1, 2002. Purpose: portion of seed mix for wildlife nesting cover. Site Characteristics: MLRA 11a, Harsand fine sandy loam soil, 0-2 percent slope, 3700 feet elevation, 11 inches precipitation, full irrigation, T6S R15E Section 4. FY02 - FY04 seed not planted due to drought and field change. Seeding planned for spring 2005.

FIELD OFFICE: JEROME

ID99012 Tom Davis Critical Area Planting on pond embankment/dike. Hycrest crested wheatgrass and Vavilov Siberian wheatgrass seed ordered March 30, 1999. Planting planned for early April 1999. FY99 spring planting failed due to lack of rainfall. Cooperator planted (broadcast and harrowed) in November 1999 under dry conditions. FY00 good stand in areas where sprinkler semi-irrigates - poor to fair stand establishing in dry areas due to extremely droughty conditions. 2 plants per square foot, good vigor, 12-inch height. Expect stand to improve with better rainfall this fall-winter. FY01 good stand with 3 plants per foot square, and good vigor. FY02 good stand with 4 plants per square foot. FY03 no evaluation. FY04 good stand with good vigor. **Cancel**

ID99014 Tom Davis irrigation pivot corner field planting. Vavilov Siberian wheatgrass ordered March 30, 1999 with delivery about September 1, 1999. Planting planned for late October 1999. FY00 planted (broadcast and harrowed) in November under dry conditions. Good stand in areas where sprinkler semi-irrigates - poor to fair stand establishing in dry areas due to extremely droughty conditions. 2 plants per square foot, good vigor, 12-inch height. Expect stand to improve with better rainfall this fall-winter. FY01 good stand with 3 plants per foot squared and good vigor. FY02 fair stand with 2 plants per square foot. FY03 no evaluation. FY04 good stand with good vigor. **Cancel**

FIELD OFFICE: RUPERT

ID02016 Cooperator Unknown critical area planting - roadside. Seed ordered March 6, 2002 (100 pounds Topar). FY02 - FY04 no evaluations. **Cancel**

FIELD OFFICE: SHOSHONE/HAILEY

ID01003 Cooperator Unknown willow field planting. 10 cuttings each of 9067548 Drummond willow, 9067435 Geyer willow, 9067491 Geyer willow, 9067437 Booth willow, 9067469 Booth willow, and 9067478 Booth willow. FY01 no evaluation. FY02 - FY04 no evaluations. **Cancel**

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.

ID02008 Hot Creek Riparian Planting. 9067541 Peachleaf willow - Baker source, 9067549 Peachleaf willow - Prairie City source, and 9067560 Peachleaf willow - Deer Creek source. Cuttings ordered February 11, 2002 for shipment April 1, 2002. FY02 - 9067541 12 percent survival with poor vigor - 9067549 24percent survival with poor vigor - 9067560 56 percent survival with poor vigor. Survival impacted by continuously saturated soils. Success primarily related to different site conditions. FY03 planting failed - **Cancel**.

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

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.

	Stand		Vigor			
Species	2003	2004	2003	2004	Adapted	Comments
Irrigated Perennial Cover						
Sherman big bluegrass	good	fair	exc.	fair	no	over watered/leaf rust/moderate weeds
Talon Canada bluegrass	good	exc.	exc.	exc.	yes	short/best weed control
Foothills C. bluegrass	exc.	exc.	exc.	exc.	yes	taller/moderate weeds
Durar hard fescue	fair	exc.	exc.	exc.	yes	major improvement/moderate weeds
Semi-Irrigated Perennial Cover						
Covar sheep fescue	poor	fair	fair	good	yes	needs full irr. to est./moderate weeds
Quatro sheep fescue	poor	good	fair	good	yes	needs full irr. to est./moderate weeds
Newhy hybrid wheatgrass	poor	failed	fair	v. poor	no	needs full irr. to est./severe weeds

Roadcrest c. wheatgrass	good	good	good	good	yes	short/moderate weeds
Ephraim c. wheatgrass	exc.	fair	good	fair.	no	thin stand/moderate weeds
Sodar s. wheatgrass	good	poor	fair	poor	no	poor stand/severe weeds
Paiute orchardgrass	fair	fair	fair	fair	yes	needs full irr. to est./moderate weeds
Dryland Perennial Cover						
Vavilov S. wheatgrass	good	exc.	good	exc.	yes	best stand/best weed control
Bozoisky R. wildrye	poor	v. poor	fair	poor	no	severe weeds
Sherman big bluegrass	v. poor	v. poor	poor	v. poor	no	needs irr. to est./severe weeds
Rosana w. wheatgrass	fair	good	good	good	yes	short/filling in nicely/moderate weeds

Recommendations based on initial two evaluations

Irrigated – Talon Canada bluegrass, Foothills Canada bluegrass or Durar hard fescue.

Semi-irrigated – Quatro sheep fescue, Covar sheep fescue, or Roadcrest crested wheatgrass.

Dryland – Vavilov Siberian wheatgrass mixed with Rosana western wheatgrass.

ID04003 Steve Schuyler field planting – windbreak. Souixland 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.

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. Site characteristics _____. 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.

ID04007 Perinne Coulee 319 riparian woody planting. Not planted – schedule for FY05 and reorder materials.

IDAHO DIVISION V
PLANT MATERIALS PLANTINGS

FIELD OFFICE: AMERICAN FALLS/ABERDEEN
None

FIELD OFFICE: BLACKFOOT
ID02006 Paul Ricks Demonstration Planting. Seed ordered February 11, 2002 for shipment to Aberdeen PMC by March 4, 2002. FY02 Planting completed in May 2002. August 27, 2002 initial evaluation indicated at least some establishment of all seed plots. FY03 evaluated 12/9/03. FY04 evaluated and clipped 6/23/04. 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, Bannock thickspike wheatgrass, Rimrock Indian ricegrass, Trailhead basin wildrye, Critana thickspike wheatgrass, Shoshone creeping wildrye, High Plains Sandberg bluegrass, Secar Snake River wheatgrass, Sherman big bluegrass, Schwendimar thickspike wheatgrass, Joseph Idaho fescue, Nezpurs Idaho fescue Winchester germplasm Idaho fescue, Needle and Thread grass. Seed ordered September 30, 2002. Planting completed early November 2002. FY03 no evaluation. 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). All other species were planted in the spring of 2004 and not evaluated this year.

ID03005 Shoshone-Bannock High School field planting. Common Camas bulbs. Bulbs ordered January 14, 2003. Site - MLRA B11b, 10-12 inch precipitation, sub-irrigated wet to semiwet bottomlands, non-irrigated. FY03 no evaluation. FY04 Camas bulbs were planted in the fall of 2003 and no evaluation has been completed.

FIELD OFFICE: MALAD
ID04005 Hybrid poplar study – Don Buhler field planting. Robust polar, Carolina poplar, Siouxland poplar, Simon poplar, OP367 poplar and 52-225 poplar cuttings were ordered March 5, 2004. Site Characteristics: Zukom silt loam soil, 7.4-8.4 soil pH, very wet site in early spring, 0-1% slopes, south aspect, 18-20 inch precipitation, non-irrigated, 5180 feet elevation. FY04 - Robust polar 20 percent survival with fair vigor. Carolina poplar 13 percent survival with fair vigor. Siouxland poplar failed. Simon poplar 53 percent survival with good vigor. OP367 poplar 20 percent survival with poor vigor. 52-225 poplar 13 percent survival with poor vigor.

FIELD OFFICE: MONTPELIER
None

FIELD OFFICE: POCATELLO
None

FIELD OFFICE: PRESTON
ID95036 Franklin County Bannock thickspike wheatgrass and Sodar streambank wheatgrass critical area planting. Site is landfill, Wheelon/Collonston soil, non-irrigated, 14-15 inch ppt, 5000 feet elevation, 12-20% slopes on north exposure. Seed ordered 5/5/95. FY95 seed planted 5/17/95 in good clean seedbed. Fall evaluation indicated good stand establishing for both species. FY96 good stands of both species with 3 plants/ft2 and spreading. Species are providing good erosion control. FY97 and FY98 no evaluations. FY99 good stand of each specie with 3-4 plants per square foot, good vigor, good ability to spread, and good erosion control under these conditions. Weed infestation of planting is very low. FY00 Bannock and Sodar stands are good with good vigor and 4 plants per square foot. FY01 - FY04 no evaluations.

FIELD OFFICE: SODA SPRINGS
None

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	FY04	FY04	FY04	FY04	FY04 6/23/04	FY04 6/23/04	
		Initial Est. 2nd Year	Stand	Vigor	Spread	Weeds	Growth Stage	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	FY04	FY04	FY04	FY04	FY04 6/23/04	FY04 6/23/04	
		Initial Est. 2nd Year	Stand	Vigor	Spread	Weeds	Growth Stage	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	FY04	FY04	FY04	FY04	FY04 6/23/04	FY04 6/23/04	
		Initial Est. 2nd Year	Stand	Vigor	Spread	Weeds	Growth Stage	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	---	

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 no evaluation.

FIELD OFFICE: DRIGGS

ID91006 Fair Grounds Multiple Species Demo Plots. FY92 planted spring 1992 excellent survival on all species except trefoil, mountain brome and cicer milkvetch which will have to be replanted. FY93 Remont, Bromar, Lutana planted spring of 1993. Remont is not tolerant of frequent irrigation. Bozoisky exhibits poor seedling vigor, Goldar has poor plant vigor, Canbar not recommended for pure stands, Magnar not adapted to shallow soils, Newhy lacks seedling vigor, Manchar exhibits poor summer regrowth, Whitmar is not tolerant of excessive moisture, and Garrison adapted to wet soils. Magnar, Bromar, Rush, and Lutana are all doing poorly. Ordered Rush, P27, Magnar, Canbar, and Bozoisky on 3/17/94 to be included in plots. FY94 all plots good to excellent stand except Lutana, Remont and Delar. These plots are all irrigated so evaluations for drought, flood, salt and acid tolerance not possible. This planting does provide excellent trials for irrigated varieties in high mountain valleys. FY95 best performers are Hycrest, Critana, Alkar, Tegmar, Luna, Greenar, Topar, Rush, Regar, Manchar, Latar, Paiute, Sodar, Newhy, Durar, Sherman, Canby and Delar. Complete evaluations are available on request. FY96 not evaluated. FY97 Durar and Delar good to excellent stands with high vigor; Regar, Amur, Manchar, Latar, Paiute good stands with excellent vigor; Rush fair stand with fair vigor; Sodar, Goldar, Cascade, Appar poor stands with fair vigor; Hycrest, Critana, Alkar, Tegmar, Luna, Greenar, Topar, Lutana, Garrison, Whitmar, Secar, P27, Bromar, Magnar, Bozoisky, Canbar, Sherman, Kalo, very poor to failed stands. All plots are subject to turfgrass encroachment. February 9, 1998 ordered Hycrest, CD-II (Hycrest II), Sherman, Newhy, Critana, Bannock, Garrison, and Bozoisky for plots. FY98 species with good to excellent stands include Amur, Rush, Manchar, Latar, Durar, Cascade, and Delar. Species with poor to fair stands include Alkar, Luna, Topar, P27, Bromar, Paiute, Magnar, Appar, and Bozoisky. Failed stands include Hycrest, Critana, Tegmar, Greenar, Secar, Whitmar, Garrison, Lutana, Regar, Sodar, Newhy, Kalo, Sherman, Canbar, and Goldar. FY99 - FY04 no evaluations.

ID99018 SCD field planting – leafy spurge competition study. Species include Rush intermediate wheatgrass, Luna pubescent wheatgrass, Regar meadow brome, Bromar mountain brome, Durar hard fescue, Bozoisky Russian wildrye, and Climax timothy. Seed ordered April 28, 1999 for shipment about May 17, 1999. FY99 Roundup was applies on June 10th to leafy spurge plots with up to 200 stems per 9.6 square foot hoop. Grass was drilled into plots on July 1, 1999 using a Brillion drill. Evaluation of germination and establishment will be performed in the spring of 2000. Replicated plots will be installed in May of 2000. FY00 - FY04 no evaluation.

ID02019 Lowel Curtis field planting. Species include Garrison creeping foxtail, Regar meadow brome and Johnstone tall fescue. Seed ordered April 8, 2002. FY02 and FY04 no evaluations.

FIELD OFFICE: IDAHO FALLS

ID94020 Winterfeld Magnar basin wildrye and Trailhead basin wildrye vegetative terraces field planting. Seed ordered 3/94. FY94 planted 5/94. Good initial stand establishment with good vigor. FY95 excellent stand establishment with over 3 plants/ft2. Plants average 24" height. Grouse are using basin wildrye for nesting cover. Working well for erosion control. FY96 excellent stands with excellent vigor Trailhead and good vigor Magnar. Excellent wildlife use by game birds, deer, owls, and coyotes. Both species are very good for snow catchment and field windbreaks. FY97 100% survival, Trailhead spreading a little faster than Magnar. Plant height about 96 inches for each. Cooperator notes that Trailhead is more drought tolerant and Magnar is more robust. FY98 100 percent survival for both species. Cut for seed this year with 140 pounds of clean seed per acre. FY99 excellent stands: Magnar 96 inches tall with little to no spread; Trailhead 84 inches tall with good spread via seed shatter. FY00 excellent stands with excellent vigor for both Magnar and Trailhead. Magnar is more robust with 96 inches height. Trailhead is spreading rapidly, is more drought tolerant, and approximately 84 inches tall. FY01 excellent stand and vigor with 96 inch height. Seed production was

approximately 100 pounds per acre. Straw yield was 1.6 tons per acre. FY02 Trailhead plowed out. Magnar excellent stand with excellent vigor, 72 inch height, and 4000 pounds per acre production. FY03 no seed crop due to insect damage.FY04 – excellent stands with excellent vigor and each accession was approximately 96 inches tall this year. Trailhead is spreading beyond original planting.

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.

ID99016 Winterfeld Goldar bluebunch wheatgrass District Seed Increase. Seed ordered April 15, 1999. Site characteristics – Tetonia silt loam soil, 1- percent slopes, north aspect, 5400 feet elevation, 18 inch precipitation zone, non-irrigated, T2N R43E NW1/4 Section 26. FY99 planted spring 1999 with good stand establishing. FY00 excellent stand and vigor. Seed production unknown at evaluation date. Good regrowth in spite of very droughty conditions. FY01 excellent stand and vigor. 150 pounds per acre cleaned seed production (some problem with silver top). 900 pounds of straw per acre. FY02 - excellent stand with excellent vigor, 36 inch plant height and 100 pounds per acre cleaned production. Regrowth is excellent and field experiences a lot of wildlife use (elk). FY03 excellent stand produced 100 pounds per acre in unfavorable moisture year. FY04 excellent stand and vigor with approximately 250 pounds of bulk seed produced this year.

ID01012 Winterfeld Regar meadow brome – Foundation. FY01 good stand establishing with fair vigor due to drought conditions. FY02 - excellent stand with excellent vigor and 36 inch height. Drought year production 55 pounds per acre cleaned. FY03 excellent stand produced 125 pounds per acre under severe drought conditions. FY04 planting destroyed – **Cancel.**

ID01013 Winterfeld Sodar streambank wheatgrass – Foundation. FY01 excellent stand establishing with excellent vigor under severe drought conditions. FY02 - excellent stand with excellent vigor and 24 inch height. Drought year production 38 pounds per acre cleaned. FY03 excellent stand produced 35 pounds per acre under severe drought conditions. FY04 planting destroyed – **Cancel.**

ID03007 Winterfeld San Juan penstemon - Demonstration planting. Seed ordered February 10, 2003. Seed shipped February 18, 2003. FY03 planted fall of 2003. FY04 fair stand and vigor – plants are about 12 inches tall

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.

FIELD OFFICE: REXBURG

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

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

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

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

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

FIELD OFFICE: RIGBY/TERRETON

ID96019a Mud Lake Willows and cottonwood demo planting Laurel, Coyote, White, Robusta poplar, Siouxland poplar, and Carolina poplar. Cuttings ordered 2/20/96. Planted May 8, 1996 using fabric mulch material and drip irrigation. FY96 Water application, started July 5th with willows receiving 7 gallons/week and poplars receiving 12 gallons/week. Flood irrigation by Park officials resulted in over-irrigation and drip system was cut back. 100% survival of all species except coyote which had 70% survival. Good vigor for all species except Carolina poplar which had fair vigor. Growth: Carolina 3.2 feet; Siouxland 5.7 feet; Robust 5.5 feet; Laurel 2.7 feet; White 3.7 feet; Coyote 4.0 feet. FY97 Irrigation: 3 gallons/tree from May through September. Survival/Vigor/Height: Carolina poplar 75%/good/10.5 feet; Siouxland poplar 100%/excellent/14 feet; Robust poplar 100%/fair/7 feet; Laurel willow 100%/excellent/7.5 feet; White willow 100%/excellent/9 feet; Coyote willow 67%/fair/ 4.5 feet. FY98 Survival/ Vigor/Height: Carolina poplar 75%/good/15 feet; Siouxland poplar 100%/excellent/ 20 feet; Robust poplar 100%/fair/12 feet; Laurel willow

100%/excellent/10.5 feet; White willow 100%/good/14 feet; Coyote willow 70%/good/6.5 feet. FY99 Carolina poplar 75% survival with good vigor and 21.2 feet height. Siouxland poplar 100% survival with excellent vigor and 26.4 feet height. Robust poplar 100% survival with poor vigor (yellow leaves) and 16.6 feet height – seedlings are vigorous with good color and suspect Aberdeen stock may have disease. Laurel willow 100% survival with good vigor and 12.4 feet height. White willow 100% survival with good vigor and 18.5 feet height. Coyote willow 70% survival with fair vigor and 6.9 feet height. FY00 Flood irrigated every two weeks with drip irrigation 6-10 gal/week. Carolina poplar 75 percent survival with excellent vigor and 320 inch height. Siouxland poplar 100 percent survival with excellent vigor and 354 inch height. Robust poplar 100 percent survival with poor vigor (disease) and 216 inch height. Laurel willow 100 percent survival with excellent vigor and 180 inch height. White willow 100 percent survival with fair vigor and 240 inch height. Coyote willow 66 percent survival with fair vigor and 90 inch height. FY01 6-year-old planting was flood irrigated every two week this year. Carolina poplar (10-15 feet spacing recommended) - 75% survival, excellent vigor, 36 feet height, 16 feet crown width, and 5.5 inch DBH. Siouxland poplar (10-15 feet spacing recommended) – 100% survival, excellent vigor, 38 feet height, 15 feet crown width, and 5 inch DBH. Robust poplar (10-15 feet spacing recommended) – 100% survival, poor vigor, 25 feet height, 9 feet crown width, and 3.5 inch DBH. Laurel willow (8-10 feet spacing recommended) – 100% survival, good vigor, 17 feet height, 12.5 feet crown width, and 2 inch DBH. White willow (10-12 feet spacing recommended) – 100% survival, fair vigor, 20 feet height, 12 feet crown width, and 2 inch DBH. Coyote willow (3-5 feet spacing recommended) – 70% survival, fair vigor, 8 feet height, and 3 feet crown width. FY02 Carolina poplar 75% survival, excellent vigor, 439 inch height, and 5.75 dbh. Siouxland poplar 100% survival, excellent vigor, 455 inch height, and 17.5 inch dbh. Robusta poplar 100% survival, fair vigor, 319 inch height, and 4 inch dbh. Laurel willow 100% survival, good vigor, 211 inch height, and 2.25 dbh. White willow 100% survival, good vigor, 235 inch height, and 2.25 inch dbh. Coyote willow 66% survival fair vigor, and 139 inch height. FY03 100 percent survival of Carolina poplar (good vigor – 40 feet height), Souixland poplar (good vigor – 44 feet height), Robust poplar (fair-good vigor – 25-25 feet height), Laurel willow (good vigor – 22 feet height – lower limbs dieing), and White willow (excellent vigor – 16 feet height – good density). 50 percent survival of Coyote willow (fair-good vigor – 21 feet height). Souixland best choice of poplars – White willow best choice of willows. **Next evaluation 2007.**

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

ID98013 Jefferson County Landfill Field planting 1) Ephraim crested wheatgrass, Sodar streambank wheatgrass, and Bannock thickspike wheatgrass; 2) Covar sheep fescue, Schwendimar thickspike wheatgrass, and Secar Snake River wheatgrass. Seed ordered Feb 9, 1998. Site is silty clay loam soil, 0-1 % slope, east aspect, 4785 feet elevation, 10-12 inch ppt, non-irrigated, T6N R33E SEl/4 Section 14. FY98 initial evaluation showed very poor to no establishment of Covar, Schwendimar, Secar, Sodar, and poor to very poor establishment of Ephraim and Bannock. The clay soil portions of the seeding crusted and the sandy soil portion of the seeding may have been too dry. Site should be evaluated one more season before a decision to reseed is made. FY99 Covar – fair stand with poor vigor and .2 plants per square foot. Schwendimar – very poor stand with poor vigor and .1 plants per square foot. Secar – very poor stand with poor vigor and .1 plant per square foot. Bannock fair stand with poor vigor and 1 plant per square foot. Sodar –

poor stand with poor vigor and .1 plants per square foot. Ephraim – fair stand with fair vigor and 1 plant per square foot. FY00 Planting Mix 1 – fair stand of Ephraim/Sodar/Bannock is establishing with fair vigor and stand is limiting weed growth. Planting Mix 2 – poor stand of Covar/Schwendimar/Secar is establishing with fair vigor. Secar and Schwendimar failed in planting for the most part, but Covar is establishing slowly. Stand is dominated by kochia weed. Planting 3 – Bannock has good stand with fair vigor. Windbreak planting (drip irrigated) is irrigated once per week for 12-16 hours, is doing very well, and trees are uniform – Russian Olive 5-8 feet height with 5 feet crown width; Rocky Mountain Juniper 3-5 feet height with 3 feet crown width; Siberian Peashrub 4-7 feet height with 4 feet crown width. FY01 the Ephraim-Bannock-Sodar mix and Bannock only plantings are increasing and spreading. Covar in the Covar-Schwendimar-Secar mix is also increasing. Grass densities of 2+ plants per foot squared occur on more favorable sandy soils. The hard packed clayey areas have few grass seedlings established. The windbreak planting is doing very well with 100% survival and very good maintenance for water (drip irrigation system) and weed control. Russian olive is averaging 9 feet tall and 7 feet crowns on sandier soils and 5-6 feet tall with 5 feet crowns on clayey hard packed soils. Junipers and Siberian peashrub are not affected as much by varied soil conditions with Junipers averaging 5 feet tall with 4 feet crowns on sandy soils and 4.5 feet tall with 4 feet crowns on clayey soils. The Siberian peashrub is averaging 6 feet tall with 5 feet crowns on sandy soils and 5.5 feet tall with 5 feet crowns on clayey soils. FY02 grass planting are doing very well and spreading with over 3 plants per square foot. FY03 planting is doing well. **Next evaluation 2006**.

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

FIELD OFFICE: SALMON/CHALLIS

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

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

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

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

Accession	Stand	Plants/ft2	Vigor	Comments
B1574 crested wheatgrass	50%	0.5	good	
P27 Siberian wheatgrass	60%	0.75	excellent	
Sodar streambank wheatgrass	80%	1.25	excellent	
AB447 crested wheatgrass	65%	0.5	good-exc.	

Secar Snake River wheatgrass	50%	0.25	good-exc.	High residue problems
AB764 winterfat	20%	0.15	poor	
AB585 winterfat	1%	<0.1	very poor	
AB922 fourwing saltbush	3%	0.1	very poor	
AB942 fourwing saltbush	2%	<0.1	very poor	
Immigrant forage kochia	3%	0.1	fair-good	
Bozoisky Russian wildrye	70%	0.5	excellent	
Vinall Russian wildrye	70%	0.7	excellent	

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

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

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

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

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

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

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

Accession	Stand	Plants/ft2	Vigor	Comments
RS1 wheatgrass cross	85%	1.5	fair	
RS2 wheatgrass cross	85%	1.5	fair	
Fairway crested wheatgrass	85%	1.5	fair	
Immigrant forage kochia	50%	2.0	excellent	many young plants
Ephraim crested wheatgrass	75%	1.0	good	
Barton western wheatgrass	<5%	0.1	poor	
Whitmar beardless wheatgrass	70%	1.0	fair	
P27 Siberian wheatgrass	90%	1.5	good	

Goldar bluebunch wheatgrass	30%	0.3	poor
Secar Snake River wheatgrass	80%	0.75	fair-good
Vinall Russian wildrye	70%	1.0	good-exc.
Bozoisky Russian wildrye	85%	0.75	excellent

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

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

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

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

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

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

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

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

Accession	Stand	Plants/ft2	Vigor	Comments
Nordan crested wheatgrass	5%	0.1	fair-good	
Bozoisky Russian wildrye	10%	0.2	poor-fair	
Vinall Russian wildrye	10%	0.3	fair	
Sherman big bluegrass	95%	1.5	fair-good	
Greenar intermediate wheatgrass	2%	<0.1	very poor	
P27 Siberian wheatgrass	1%	<0.1	very poor	
Ephraim crested wheatgrass	3%	<0.1	poor	
Durar hard fescue	85%	2	good	

Covar sheep fescue	80%	2	fair-good
Manchar smooth brome	50%	0.5	fair
Baylor smooth brome	20%	0.25	fair
Fairway crested wheatgrass	5%	0.1	fair

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

FIELD OFFICE: ST. ANTHONY

ID02020 Mae Lake Trust field planting. Species include Rush intermediate wheatgrass, Bannock thickspike wheatgrass, Nezpar Indian ricegrass, and Maybell antelope bitterbrush. Seed ordered April 8, 2002. FY03 no evaluation. FY04 planting failed – **Cancel.**

PUBLIC INFORMATION

ACTIVITIES

United States Department of Agriculture

NRCS Natural Resources Conservation Service

Plant Materials Center

2003
Aberdeen Plant Materials Center
Progress Report of Activities

Issued January, 2004

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

Aberdeen Plant Materials Center office and greenhouse

Who We Are

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

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

Program Emphasis

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

- Plant releases, seed and plant production
- Rangeland in poor ecological condition
- Riparian and wetland degradation
- Windbreak demonstration
- Technology transfer and education

This document highlights some of the major activities at the PMC during 2003. For detailed information, contact the staff at the PMC or the Idaho-Utah Plant Materials Specialist.

Integrated Restoration Strategies for Weed Control on Western Rangelands

The PMC is cooperating with the University of Nevada Reno, Oregon State University, Utah State University, Rocky Mountain Research Station, USGS, ARS and BLM to plant and evaluate common studies across the Great Basin to test management strategies for controlling cheatgrass and other annual weeds. A major goal of the project is to increase the ecological understanding of why restoration techniques succeed or fail.

The PMC was responsible for gathering and packaging seed for test plots, the modification of a Truax Roughrider Rangeland Drill for planting the plots, and staff expertise in planting the plots.

A total of 1200 plots were planted in Idaho, Oregon, Nevada and Utah in late October and early November with technical guidance provided by the PMC. The seedings will be repeated next year to help validate the plant testing work. In addition to the drilled plots, the PMC packaged and provided seed to other researchers to test alternative strategies for restoration.

Native Plant Testing

During the summer of 2003, the PMC began a cooperative project with the USDA Forest Service, Region 1 to evaluate six native species for potential use in restoration on Forest Service land in Idaho and Montana. The PMC provided technical assistance to the Forest Service in seed collection procedures. Forest Service personnel collected a total of 52 accessions of bluebunch wheatgrass, Idaho fescue, blue wildrye, tufted hairgrass, Sandberg bluegrass and western yarrow. These collections are currently being cleaned and will be planted at the PMC this coming spring. We will evaluate the collections to determine which collections show promise for restoration work on Forest Service land. The Forest Service has also procured some small-lot seed cleaning equipment for the PMC to use in this project.

Anatone bluebunch wheatgrass seed production field

Upcoming Plant Releases

The PMC is cooperating with the Forest Service, Shrub Sciences Laboratory and the Bureau of Land Management to release Anatone bluebunch wheatgrass and Maple Grove Lewis flax. Anatone was originally collected by the Shrub Sciences Laboratory and appears to have better seedling vigor than 'Goldar' which was released by the PMC in 1989. Anatone may be better suited to drier conditions than Goldar which typically needs at least 12 inches of annual precipitation to establish.

'Appar' blue flax was released in 1980 and has been widely recommended as a component of seed mixtures to provide diversity and beauty. It was originally identified as a native species to North America but was later determined to be introduced from Europe. Maple Grove, originally collected in central Utah shows great promise as a native replacement for Appar.

Seed production fields of Anatone and Maple Grove have been established at the PMC and seed was harvested in 2003. Seed will be available to the commercial seed industry pending official release.

Breeder and Foundation Seed Production

The PMC is responsible for Breeder and Foundation seed production of 17 plant releases. During 2003, Foundation seed fields of 'Magnar' basin wildrye, 'Goldar' bluebunch wheatgrass, Anatone bluebunch wheatgrass, 'Nezpar' Indian ricegrass, 'Paiute' orchardgrass, 'Bannock' thickspike wheatgrass, Richfield Selection firecracker penstemon, Clearwater Selection Venus penstemon, Maple Grove Selection Lewis flax, Northern Cold Desert Selection winterfat and Snake River Plains Selection fourwing saltbush were in production. New fields of 'Regar' meadow brome and 'Ephraim' crested wheatgrass were also established.

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

Interagency Riparian/Wetland Plant Development Project

The Interagency Riparian/Wetland Plant Development Project was established in 1991. NRCS and several federal, state, local, and private organizations decided 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

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 popular demand, has been 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: Carson City, NV, Alturas, CA, Panquitch, UT, Santa Maria, CA, Elko, NV, Grand Forks, ND, and Grand Teton National Park, WY.

To get the best engineering information on rivers to the workshop participants, Jon Fripp, Stream Mechanics Civil Engineer at the USDA NRCS National Design,

Construction, and Soil Mechanics Center in Ft. Worth, TX, Tom Moody, Civil Engineer, Natural Channel Designs, Flagstaff, AZ, and Stephanie Yard, Civil Engineer, Natural Channel Designs, Flagstaff, AZ have helped with the organization of the course and presentation of materials at the workshops.

Conferences and Symposia

The project presented a number of technical papers at the following conferences and symposia:

- Idaho State University Wetland Conference Poster Paper, *Wetland Plant Releases*, 100 people, Pocatello, ID
- Conservation of Natural Resources class, *Wetlands and wetland vegetation*, 19 students, Idaho State University, Pocatello, ID
- Society of Ecological Restoration Annual Meeting presentation, *Wetland Seed Collection and Processing*, 75 people, Portland, OR
- Society of Ecological Restoration Annual Meeting presentation, *Waterjet Stinger: a new method for establishing unrooted dormant cuttings using water*, 150 people, Portland, OR
- Riparian Ecology Class presentation, *Discussion of riparian areas, restoration techniques, and riparian vegetation*, 10 students, USU, Logan, UT
- Coalbed Methane Summit presentation, *Constructed Wetland Systems to treat water from coalbed methane mining*, 77 people, Sheridan, WY
- Native American Plant Summit presentation, *Wetland Seed Collection and processing*, 32 people, Grand Coulee, WA
- Society of Soil and Water Conservation Annual Meeting, *Riparian Streambank soil Bioengineering Workshop*, 27 people, Spokane, WA

Technical Assistance to NRCS Field Offices and other agencies

- Medicine Lodge Creek Bioengineering assessment and plan development, Dubois, ID
- Bank Stabilization discussion of Coeur d' Alene River Basin, 20 people, Coeur d' Alene, ID
- Technical Assistance in Teton River Canyon after flood analysis, 5 people, Driggs, ID
- Lapwai Creek SVAP effort, Lewiston, ID

Restoration of Fox Creek, a tributary of the Teton River, near Driggs, ID

Fox Creek is a spring-fed stream in the Teton Valley that was dredged and widened in the past. Riparian vegetation was significantly reduced because of this history of construction, spraying and improper grazing management. The Creek has a steady flow with a relatively small increase in flow during spring runoff. The landowners are interested in restoring Fox Creek and have teamed up with the Corps of Engineers, a group called the Friends of the Tetons, and Gillilan Associates, Inc. from Montana. The project objectives are to decrease the stream width and to reestablish woody vegetation. Work completed this fall included constructed pools. The spoil materials from this construction are being used to narrow the channel. This spring, the stabilization of streambanks through planting of riparian woody and herbaceous species and installation of bioengineering treatments will begin. The design for the next treatment section of the Creek downstream will also be completed.

Spring fed streams are much different to work on than typical snow melt streams and the information gathered about the planning and installation of treatments will be helpful throughout the West.

Wetland Restoration, Enhancement, and Management publication

Check out the new publication, Wetland Restoration, Enhancement, and Management, by the USDA NRCS Wetland Sciences Institute. This publication comes with a searchable CD that has a number of papers written on wetland restoration and enhancement techniques, Ecological monitoring, wetland maintenance, and papers on individual invasive, noxious, and problem plant species. It also has regional issues that will help the reader with specific problems identified in various parts of the country.

Aberdeen Plant Materials Center Website

The Plant Materials Program web page at http://Plant-Materials.nrcs.usda.gov/ has further information on plant releases, publications, current studies, and service area for all 26 PMCs in the United State.

For information specifically about the Aberdeen Plant Materials Center, go to http://www.plant-materials.nrcs.usda.gov/idpmc/.

The Interagency Riparian/Wetland Plant Development Project has produced a large number of publications on wetland plant species, transplanting techniques, propagation protocols, and management techniques. It has also produced a number of publications on riparian plants (mainly woody species), harvesting techniques, planting techniques, and how to use riparian plants in Streambank Soil Bioengineering treatments for streambank erosion control. These publications can be downloaded from the Interagency Riparian/Wetland Plant Development Project website located at http://www.plant-materials.nrcs.usda.gov/idpmc/riparian.html

TECHNICAL NOTE

USDA-Natural Resources Conservation Service
Boise, Idaho and Bozeman, Montana

TN PLANT MATERIALS NO. 1 **December 2003**

PLANT MATERIALS COLLECTION GUIDE

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INTRODUCTION

The collection of seed or vegetative plant parts of potential conservation plant species is the basis for plant selection and improvement, and for the revegetation of disturbed areas. This Technical Note provides information on the proper procedures for collecting various types of plant materials.

Planning is crucial to the success of providing appropriate, adapted materials to conservation problems and needs. Plant improvement goals and species need to be identified well in advance of the collection process. A "wish list" of potential species should be prioritized to identify the most appropriate plants for a given revegetation project. Little information is known about the germination, establishment and culture of many native plants. Once project goals are determined and background information gathered, geographic distribution and collection locations need to be identified. When appropriate sites supporting viable populations of a target species are located, the plants should be monitored regularly to determine the optimum stage of maturity. Allow adequate time and material resources to monitor plant growth and development in order to successfully collect seeds or other reproductive plant parts at the optimum stage of development.

LOCATING COLLECTION SITES

Collection sites should be accessible so collectors can get to the site and move around to make collections. Natural plant populations on unstocked or rested rangeland, forestland or riparian exclosures are excellent sites to make collections. Areas burned by wildfire may also be good sites for seed collection for several seasons after the fire. If a goal of the revegetation effort is to restore the site, plant materials should be collected as close to the target planting area as possible. It may also be advisable to identify several sites with various elevations, aspects, or soils from which to collect. Areas with heavy weed infestations should be avoided to prevent the unintentional gathering of weed seeds that could contaminate the collection. Do not collect from sites that have been previously planted, research areas, or from areas with threatened or endangered plants. Always obtain permission from the landowner on private lands and obtain collection permits on public lands prior to making collections.

Plant Collection Information Form NRCS-ECS-580, (see Figure 1) must be completed and accompany each collection. This form provides critical information for each collection including plant and collection site information. If possible, use Global Positioning System (GPS) coordinates to locate collection sites. Each collection that is sent to a Plant Materials Center must have this data in order to track the collection through the evaluation, seed increase, and potential release process. The plant materials center will assign a unique accession number to establish the identity of each viable collection. This process also allows for returning to the original site to collect additional plant material if needed.

PARENT PLANTS

Verify that the plant material being collected is the species desired. Confirmation may require the assistance of a botanist, range scientist, or other plant expert. Positive identification may require that plants be examined during flowering and may also require examination of the entire plant, including flowers, seed, stems and leaves, as well as roots. Avoid mixing multiple species in a single collection because it is virtually impossible to separate species during the processing stage.

Collecting from many parent plants will help to capture inherited and environmental variation and ensure genetic diversity. For each collection site, randomly collect seed from at least 50 to 100 individual plants. If this is not possible, collection should take place from a larger area. However, choose sites carefully so that they are reasonably similar. Collections from different sites should be kept separate. The decision to mix collections from different sites can be made after they are evaluated and factors of difference or similarity can be made. Also, avoid collecting just the big plants. The plant that looks small in one year may be the plant with important genes for disease resistance, while the big plant may be trading disease resistance for size. This sampling approach will provide a higher level of sampling confidence within and among populations. If the collection is to be used directly for re-vegetating a site, seed collection from at least 200 plants may be required to ensure a representative sample of the genetic material of the population. Do not collect seed or other vegetative reproductive material from diseased or insect-infested plants.

PLANT MATERIALS COLLECTION PROCEDURES

Seed Collections

The timing of seed collection is crucial to ensure that the seeds collected are viable and have good germination vigor. Collection of immature seed results in low seed viability. Delayed harvesting may result in seed loss from shatter or dispersal after ripening. Plant phenology (the sequence of plant development) must be judged to determine the stage of maturity for the proper timing of seed collection.

Plants with determinate inflorescence are those in which the terminal or central flower is the oldest and blooming and seed maturation is downward, outward, and fairly uniform. Determinate flowering is common in many crop plants. Indeterminate flowering is a common trait in wildland plant species. With this type of maturation, the basal or outer flower is the oldest with blooming and seed maturation occurring in an upward or inward pattern. Indeterminate plants generally have many different stages of flowering on the same stalk with the most mature near the base or outer regions of the stalk which can make seed collection of viable seeds more difficult.

Flowering, which is the first stage of seed phenology is obvious for many herbaceous and woody plant species that have colorful petals, bracts or sepals. Flowering in grasses is more difficult to observe and careful attention is required to identify the flowering stage (anthesis) of grasses when pollen is being shed. In cross-pollinated grasses, the male and female flowering structures are visible and need only close inspection to determine when pollen is being shed. In self-pollinated grasses, both sexual structures are contained within the palea and lemma, and the floret must be dissected to assess the stage of anthesis. Generally, grass seed is mature and ready to harvest 4 to 6 weeks after flowering is completed. Seed fill can be checked by cross-sectioning several seeds with a knife of fingernail clipper to observe the presence of endosperm.

For plants with fleshy fruits, changes in color, taste, odor, or texture often signal seed ripening. Changes in color from green to red, blue, purple, or white often indicate seed maturity. Other fruits, whose seeds are wind-dispersed, usually change from green to brown or straw color. Some woody species (pine, juniper) require two years to reach maturation.

Grass seed progresses through a sequence of developmental stages following flowering:

1) Milk stage - Seeds squeezed between the thumb and forefinger exude a milky substance. These seeds have no viability.

2) Soft-dough stage - Seeds squeezed between the thumb and forefinger exude a soft, dough-like endosperm. These seeds have low to no viability.

3) Hard-dough stage - Seeds squeezed between the thumb and forefinger do not exude endosperm. The endosperm is firm and retains its shape when squeezed or rubbed. Seed collection should begin at the transition from the soft-dough to hard-dough stages. At this stage, the amount of plump, fully matured seed can be increased by <u>not</u> stripping the seed from the plant. Cutting seed heads (inflorescences) with the stem attached allows maturation to continue as the collected plant material dries.

4) Mature - Seeds are usually very hard. Unfortunately, maturity and seed shatter often occur simultaneously.

By starting seed collection efforts at lower elevations and following maturation up slope the optimum seed collection period can be extended. If seeds of the target species have shattered on south- or west-facing slopes, seed of the same species may still be available for collection on north- or east-facing slopes.

Grass seeds can be harvested by stripping seed off the stem or by clipping the seed culm (stem) just below the spikelet. The seeds of many broadleaf herbaceous plants can be collected by holding a bag or tray under the plant and shaking seeds from the plant. For species that dehisce explosively, the entire inflorescence must be cut before maturity and allowed to dry in mesh bags. Pods from species having spike-type inflorescences (lupine

and penstemon) may be stripped in the same manner as grasses. The pappused (parachute-type) seeds of many species in the Composite (sunflower) family can be swept or brushed into bags if timing of collection is ideal. For very small annual plants, the simplest method may be pulling the entire plant and bagging in cloth or paper bags. Seeds of many woody, non-fleshy-fruited plants are collected by holding a tray or bag under the branches and flailing the branches with a stick or tennis racket, knocking the seed into the receptacle.

It is important to use paper or cloth bags to store non-fleshy seed collections. The moisture content of freshly collected seed is quite high and plastic or other nonporous containers trap moisture and cause spoilage of the seed. Seed should be spread out to dry in a ventilated, well-lit room, but avoid prolonged temperatures greater than 90º F because desiccation and high temperatures will kill the seed. The layer should be only a few inches thick to provide adequate airflow through the drying plant material, reduce heat buildup and to minimize the incidence of mold. To speed the drying process, turn the material occasionally (once or twice daily). If materials are dried outdoors, it may need to be brought indoors or covered at night to prevent re-hydration of the material from higher nighttime humidity and dew. The material may also need to be protected from rodents and wind. If the seed collection is small and fits in a paper grocery sack, the material can be arranged into a donut shape around the sides of the bag with a hole created in the middle to allow air circulation. Ship dried seed to the PMC as soon as possible.

Fleshy fruits spoil quickly if not stored properly after collection. Place containers of fleshy seed in a cool, shady place while collecting. Overheating can kill seed. Place non-dried fleshy fruits into a non-porous plastic bag and chill prior to shipment. When ready to ship, place the plastic bag into a heavy cardboard box. Material must be shipped to the Plant Materials Center within 24 hours. Avoid shipment late in the week that might result in weekend storage in a post office.

If dried seed must be stored for an extended time (usually less than 5 years), it should be stored in cool, dry conditions that remain relatively constant. A rule of thumb used to determine if conditions are adequate for long term storage is: (º F + % relative humidity < 100). If the sum of temperature in degrees F and percent relative humidity is less than 100, then conditions are probably adequate for long term storage for most grasses. However, a good example of a species that does not store well for extended periods is winterfat *Kraschenninnikovia lanata.* Storage life for winterfat is limited to no more than about 2 years, even under ideal storage conditions.

Vegetative Collections

Asexual or vegetative propagation is the reproduction of complete plants from the vegetative parts of the original plant. These include pieces of stems, rhizomes, tubers, corms, bulbs, leaves, or roots. There may be situations when it is impossible to collect or use seeds for plant production. These include: 1) the plant does not produce seeds or produces seeds infrequently; (2) the seeds are not viable; (3) the seeds have already been

dispersed from the plant prior to collection; and, (4) insects or animals have consumed or damaged the seeds. Vegetative propagation may be desirable to avoid long periods of juvenility; control growth form; produce a large plant within a relatively short period of time; avoid long, seed-dormancy-breaking periods; and decrease the cost of certain bioengineering practices on riparian corridors.

There also may be a need to clonally reproduce some specific attribute that is unique to an individual plant, which could be lost through sexual reproduction. In these situations it is often possible to make collections from the vegetative portions of plants and then propagate them asexually. Asexual regeneration is commonly used for redosier dogwood *Cornus sericea* spp. *sericea*, willow *Salix* species, and cottonwood *Populus* species in conservation work. It is also used in agriculture and horticulture when the exact performance or appearance of a particular plant is desired. A limitation of asexual propagation is the potential to restrict the genetic expression of a plant population. Adequate population sampling is particularly important when the goal of the project includes maintaining the genetic diversity of a given plant community. Another drawback of vegetative propagation is that it is generally more expensive than propagation from seed.

Types of Vegetative Collections

Vegetative collections include the following:

A) Whole Plants

It is possible to transplant entire wildland or cultivated plants and then grow them under cultured conditions in a container or production field. Transplanting of wildland plants is often unsuccessful for one or more reasons. Wildland plants are often found growing under stress conditions and cannot recover from transplanting shock as well as cultivated plants. Wildland plants often contain smaller, coarser root systems than their cultivated counterparts. Successful transplanting requires experience, skill, proper handling, ideal temporary storage, and proper care. Transplanting of wildland plants is most successful with herbaceous species grown under relatively ideal conditions, such as deep, moist soils along a riparian corridor. Successful transplanting typically increases as plant size decreases, and is most successful when the plants are fully dormant in fall or late winter. Transplanting of large shrubs and trees is usually unsuccessful.

B) Divisions

Grasses and forbs may be propagated by splitting the foliage and corresponding root system into multiple pieces and then transplanting. This process works with rhizomes, stem tubers, and tuberous roots. The entire plant may be removed and then divided, or part of the mother plant removed and the rest left in place to continue growing. Transplanting, transport, temporary storage, and growing conditions are the same as those described for whole plants.

C) Cuttings

Cuttings can be made from true stems, modified stems (rhizomes, tubers, corms, and bulbs), leaves, leaf-buds, or roots. Stem cuttings can be categorized by various parameters including the part of the plant from which they are taken, the time of year that they are harvested, and the physiological condition of the tissue at the time of removal. Stock (donor or parent plants) should be healthy, free from serious insects or diseases, of moderate vigor, and of a known identity. The following types of cuttings are most commonly used in conservation work.

1) Stem Cuttings

(a) Hardwood or dormant hardwood – These are the preferred type of perennial woody plant cuttings because they are rugged, transport and store well, are less perishable than active tissue, and are the easiest to prepare. Donor plants should be healthy, turgid, moderately vigorous and growing in nearly full sunlight. Avoid excessively rank growth (characterized by long internodes) or small, thin, weak stems. Dormant, hardwood cuttings are taken from non-active stems after leaves have dehisced and before bud break in the spring, usually in the late fall to late winter. Approximately 8-inch long cuttings are taken from the terminal end of branches and should contain at least two internodes (buds or bud pairs). Longer sections of stems may be taken and later trimmed into multiple cuttings. The size of the basal end of the cutting is important, and should measure at least 0.25 to 0.40 inches in diameter. The basal cut is made 0.5 to 1 inch below a node. The cuttings should be stored in plastic bags in a cooler during transport and prior to sticking in the propagation bench. Long term storage should be in a cooler maintained at 33 to 37°F and 80 to 95 percent relative humidity. Cuttings stored for more than several days should be treated with a broad spectrum fungicide prior to cold storage.

(b) Semihardwood or greenwood – Semihardwood cuttings are taken from actively growing and partially matured tissue of perennial, woody plants. Semihardwood cuttings break when bent into a "U" shape, in contrast to softwood cuttings that that will bend without breaking, or must be bent more severely to cause breakage. Semihardwood cuttings tend to root better than hardwood cuttings of the same species, but are more perishable; requiring careful handling, transport, temporary storage, and shipping. Cuttings should be taken in the cool early morning hours of the day and kept out of direct sun. Cuttings should be 3 to 5 inches long, contain two or more nodes, and have a basal diameter as large as possible given the size of the current season's growth. Semihardwood and softwood cuttings are normally shorter than hardwood cuttings because they typically consist only of the current season's growth. The basal cut should be made below a

node. The cuttings should be placed in a zip lock bag moistened with water and then placed in the cooler with ice in a shaded location. Use a towel or other insulating material between the ice and cuttings to prevent freezing. Ideal temporary storage is between 33 to 37°F with relative humidity 90 percent or more. Do not allow the cuttings to heat up or become desiccated during transport to the propagation facility. Attempt to minimize the interval between removal from the donor plant and arrival at the propagation facility.

(c) Softwood – Softwood cuttings consist of actively growing tissue (current season's growth) at the terminal end of stems prior to full maturity. They are removed relatively early in the growing season. Immature softwood tissue can be bent in a "U" shape without breaking, although it is at the optimum stage of maturity for use as cuttings when it snaps when bent sharply. Many species of difficult-to-root woody plants root faster and better from softwood cuttings. A limitation of softwood cuttings is that they are highly perishable and easily damaged during handling. Softwood cuttings are taken, handled, temporarily stored, transported, and shipped as described for semihardwood tissue - under cool, moist conditions. Storage should be minimized to assure viability. These cuttings should be delivered as quickly as possible to the production facility to guarantee success. Same day delivery is best although overnight express is often adequate.

(d) Herbaceous - Many herbaceous forb (wildflower) species can be propagated from leafy cuttings taken during active growth in late spring to late summer. Flowering stalks and leafy stems with large basal diameters (>0.25 in) work best. This material is also highly perishable, and should be considered more delicate than softwood cuttings from perennial woody plants. Handle, temporarily store, transport, and ship as described for semihardwood and softwood tissue - under cool, moist conditions.

2) Leaf Cuttings

Many herbaceous species, primarily tropical plants, can be propagated from leaf cuttings. Leaf cuttings include the leaf blade, or leaf blade and petiole. This technique is seldom used to propagate northern temperate species, and limited information is available on the successful use of this technique for other than tropical species.

3) Leaf-Bud Cuttings

A leaf-bud cutting consists of a leaf blade, its petiole, and a short piece of stem with an attached axillary bud. This technique has been used successfully for the propagation of several species including some perennial woody plants found growing in northern temperate climates (*Rubus* species). This technique is

valuable when cutting material is limited, producing more plants per unit of cutting material than stem cuttings. Softwood, greenwood, and herbaceous stem cuttings can be taken and then prepared into leaf-bud cuttings at the propagation facilities. These perishable cuttings are taken during the growing season and are handled, stored, transported, and shipped in the same manner as softwood and herbaceous cuttings.

4) Root Cuttings

This type of cutting material is generally less preferred than stems because of the limitations imposed by their growth in the soil. Although most vegetative propagation is from stem cuttings, there are several northern temperate species that propagate well from root cuttings (aspen *Populus tremuloides,* apple *Malus* species, *Phlox* species, white poplar *Populus alba,* flowering almond *Prunus glandulosa,* sumac *Rhus* species, rose *Rosa* species, blackberry *Rubus* species, lilac *Syringa vulgaris,* and others). Root cuttings are best taken from young donor plants in late winter or early spring prior to new growth. Avoid taking root cuttings during active growth. It is helpful to make a straight cut at the end of the root cutting nearest the crown and a slanted cut on the other end of the cutting so that the propagator will know how to properly orient the cutting during propagation. Long lengths of root can be taken and later trimmed at the propagation facility. Root cuttings are handled, stored, transported, and shipped in the same fashion as dormant hardwood stem cuttings.

D) Scions and Buds for Grafting

Scions (stem cuttings) and buds can be grafted onto appropriate rootstocks to clonally reproduce a given parent plant. Although this technique requires specialized skill, collecting scions and buds is simple and similar to making vegetative stem cuttings. Since the rootstock must be in the proper physiological state at grafting time, close coordination is needed with the propagator.

Use the following guidelines when making vegetative collections:

1) Given the perishable nature of vegetative collections, be sure to coordinate timing of collection with the production facility to assure that facilities, supplies, equipment, and labor are readily available once vegetative collections are harvested.
2) Scout plants in advance of harvesting material. Use only healthy, turgid, moderately vigorous, and adequately sized material.
3) Sample from enough individual plants to assure adequate population sampling. Depending on sample size, 25 to 50 percent of the population or from 50 to 100 individual plants should be collected.
4) Make sure the basal ends of stem cuttings are at least 0.25 inches in diameter, if possible.

5) Keep vegetative materials cool and moist. Collect in the cool early morning hours. Minimize handling and storage.
6) Be able to properly identify each mother plant. Verify the species and attach a permanent label and/or use GPS technology to verify the location of each donor plant. Keep collections in separate bags by parent plant. Place a label inside the sack and label the outside of the sack to verify identity.
7) Avoid unhealthy, low vigor, or stressed plants.
8) With dioecious species (male and female flowers on separate plants), make sure to sample both male and female plants if seed production or on-site plant reproduction is a project goal.

The following Technical Notes provide detailed information on collection, storage, treatment, and planting procedures of many species that are established from vegetative collections:

Plant Materials Technical Note No. 23. How to Plant Willows and Cottonwood for Riparian Rehabilitation

Plant Materials Technical Note No. 32. Users Guide to the Description, Propagation and Establishment of Native Shrubs and Trees for Riparian Areas in the Intermountain West

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

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Plant Materials Technical Note No. 28. Procedure for Vegetative Collections of Herbaceous Plant Materials. Larry K. Holzworth. NRCS, Bozeman, MT. 1981.

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Figure 1. Plant Collection Information Form

United States Department of Agriculture
Natural Resources Conservation Service

NRCS-ECS-580
(4/98)

Plant Collection Information
(seed or vegetative)

PLANT INFORMATION	COLLECTION INFORMATION
Scientific Name	Date Collected
	Collector's Name
Common Name	
Cultivar/Release	Collector's Headquarters
Plant type:	
Number of Plants from which collected (minimum population of 30 plants is preferred)	
☐ Seed ☐ Vegetative Material	

COLLECTION SITE INFORMATION

State	Section	N. Latitude	
County	Range	W. Longitude	
Township	Site Location (ie. landmarks, roads, etc.)		MLRA
Elevation (ft or m)	Slope (%)	Exposure (N,S,E,W)	Precipitation (in or mm)

Plants Growing in Association

Soils Information

Soil Series & Texture	Soil Survey Sheet #	Soils Mapping Unit Symbol

Remarks

Please complete the above form as completely as possible, following the instructions below for collecting and handling seed and vegetative material.

Watch for superior plants that display unusual characteristics and record observations. Seed or cuttings from an individual plant or from several plants in the same colony can constitute a collection if warranted. Make separate collections of the same species if the growing site or location is different.

Use the back of this sheet to sketch the collection area or record additional information.

Be sure to label each collection as it is made so collections do not get mixed up. Send seed to the Plant Materials Center serving the state, unless other specific instructions are provided.

Seed Collection: Check each collection for filled seed and then attempt to get the equivalent of one-fourth pound of seed. Collection should be from a minimum population of 30-50 plants if possible. Mature seed is typically dry and hard and has separated from the rachis (grasses) or loosens easily from the pods, capsules, or flower heads. Do not collect unripe seed. Fleshy seed from woody species should be enclosed in a plastic bag and kept in a cool place out of direct light.

Vegetative Material Collection: Collect only good healthy material. Use a sharp knife, scissors or pruners for cutting vegetative material. Root cuttings should be a minimum of 6" in length. Stem cuttings should be 6-8" or longer and have a minimum of 2 nodes. Wrap roots or cuttings with moist paper or cloth. Place material in a plastic bag with a few small holes in it. Refrigerate or keep cool until shipped. Material should be shipped or delivered as soon as possible so that it does not dry out.

TECHNICAL NOTE

USDA-Natural Resources Conservation Service
Boise, Idaho – Bozeman, Montana

TN PLANT MATERIALS NO. 9 (revised) **JANUARY 2004**

PLANTS for SALINE to SODIC SOIL CONDITIONS

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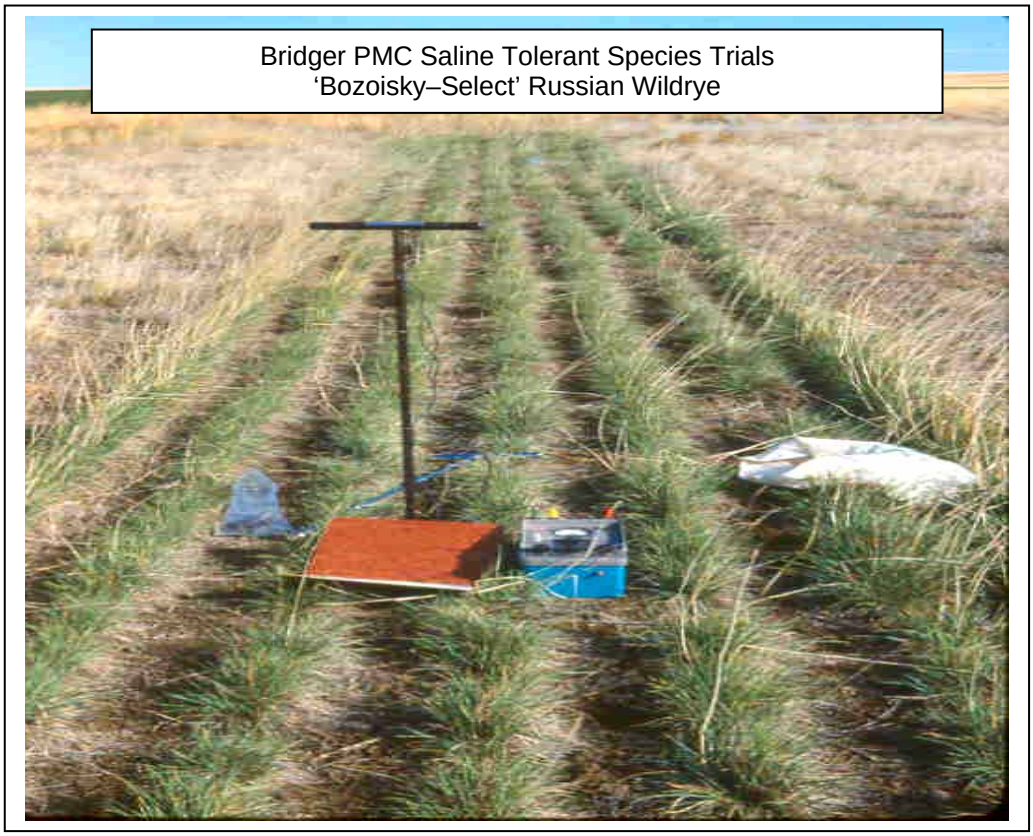
This Technical Note provides information on: characterization of saline and sodic soils; effect of salinity on plants; management of salinity problems; planting in saline-sodic soils; and species selection for salt affected areas. Tables provide data on common plants that grow in salt affected areas, recommended species and seeding rates for saline-sodic soils, relative salt tolerance of selected grasses, forbs and legumes and relative salt tolerance of selected trees and shrubs.



PLANTS for SALINE to SODIC SOIL CONDITIONS

Salt tolerance is the relative ability of a plant to endure the effects of excess salts in the soil rooting medium in order to produce a satisfactory stand or yield. The mode of tolerance can vary. Most plants avoid salinity, some evade or resist salinity, and a few actually tolerate salinity.

Salt avoidance is usually accomplished by limiting germination, growth and reproduction to specific seasons of the year when salt concentrations are lower, by growing roots into non-saline soil layers or by limiting salt uptake. Salt evasion can be achieved by accumulating salts in specific cells or by secretion of excess salts. Salt tolerance is attained only in plants in which the protoplasm functions normally and endures a high salt content without apparent damage.

Salt tolerance of plants varies greatly during plant development and different growth phases of the plant. Sugar beets, a species with fairly high salt tolerance during vegetative growth, is more sensitive to salinity during germination than corn, which is salt-sensitive during growth. The salt tolerance of barley during grain production is half as low as compared to its tolerance during vegetative growth stages.

Characterization of Saline and Sodic Soils

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.

This table lists some of the more common plants that grow on salt affected soils

Common Name	Scientific Name	Tolerance Level
Black greasewood	*Sarcobatus vermiculatus*	
Inland saltgrass	*Distichlis stricta*	
Nuttall's alkaligrass	*Puccinellia airoides*	
Beardless wildrye	*Leymus triticoides*	Very High
Shore arrowgrass	*Triglochin maritima*	
Red glasswort	*Salicornia ruba*	
Seepweed	*Suaeda depressa*	
Pickleweed	*Salicornia spp.*	
Alkali cordgrass	*Spartina gracilis*	
Slender wheatgrass	*Elymus trachycaulus*	
Spear saltbush	*Atriplex patula variety hastate*	
Alkali bluegrass	*Poa juncifolia*	High
Alkali sacaton	*Sporobolus airoides*	
Foxtail barley	*Hordeum jubatum*	
Cinquefoil species	*Potentila spp*	
Curley dock	*Rumex crispus*	
Poverty weed	*Iva axillaries*	
Kochia	*Kochia scoparia*	
Plains bluegrass	*Poa arida*	Moderate
Western wheatgrass	*Pascopyrum smithii*	
Thickspike wheatgrass	*Elymus lanceolatus*	

Effect of Salinity on Plants

Soil salinity can affect plant growth both physically (osmotic effect) and chemically (nutritient and/or toxicity effect). As the salt content of the soil increases, it becomes more difficult for plants to take up water. Sensitive plants appear drought-stricken even at fairly low levels of salt concentration. There is usually a progressive decline in growth and yields as salinity levels increase. The slower growth caused by salts may cause forage to be tougher and less palatable. This has been observed in tall wheatgrass and tall fescue. Some plants are affected by salinity more at one stage of development than at another. Barley and wheat are affected during early seedling growth but not as much during germination or at later growth stages. Even when salinity decreases the plant size of barley and wheat up to 50%, little to no decline in grain yields have been noted. Corn, alfalfa and bean yields decrease almost proportionally to the decrease in plant size. Germinating sugar beets die when the salinity level is high, but mature plants are very tolerant of the same salinity level.

Yield reductions are not always comparable for individual species. For example, crested wheatgrass yields are reduced 25% at 10 mmhos/cm, while tall wheatgrass yields are reduced only 10% at the same level. Yet, yields of both species are reduced about 50% at 20 mmhos/cm. Salinity problems are more severe under hot and dry conditions than under cool and humid conditions for almost all plants.

Occasionally the interaction of various salts further influences the effect of total salts. High concentrations of calcium ions in the soil solution may prevent the plant from absorbing enough phosphorus, potassium or other essential ions. Other ions may affect the uptake of calcium ions.

High concentrations of specific ions can cause disorders in mineral nutrition. For example, high sodium concentrations may cause deficiencies of other elements, such as potassium and calcium, and high levels of sulfate and chloride diminish the rate of nitrate absorption. Specific ions such as sodium and chloride may have toxic effects on plants, reducing growth or causing damage to cells and cell membranes. This is commonly characterized by leaf tip burning, leaf margin scorch, chlorosis (turning yellow), and premature leaf drop. Chlorosis deficiencies can sometimes be corrected with chelated iron or sulfur fertilizers.

Management of Salinity Problems

Soil salinity is strongly linked to water movement through the soil profile. When sub-soil moisture, containing salts, moves upward and evaporates, salts are precipitated at or near the soil surface. Soil salinity problems can result from improper land management practices. Dry cropland systems where crop-fallow is used to store soil moisture sometimes result in a condition known as saline seep where excess stored soil moisture is perched on an impermeable soil layer (commonly clay hardpans or shale subsoil) and then flows to an area where it surfaces and evaporates leaving salts behind on the soil surface. Improper irrigation water management can result in similar salinity problems. The solution to salinity problems lies in the prevention of upward salt movement. This may require cropping and management systems to capture and utilize excess soil moisture through perennial cropping rather than crop-fallow systems, selection of deep rooted crop species such as alfalfa or installation of drainage systems in order to prevent soil moisture and salt movement through the soil

Salts can be leached out of the soil if the soil is deep, permeability is good and there is no water table near the surface. A good water source and good soil drainage are necessary for effective salt leaching. It may be necessary to tile a field, dig drainage ditches or pump out the ground water to provide the necessary drainage. Adequate water must be applied to drain through the rooting depth of the planned crop. Continuous ponding is not effective in removing salts and uses excessive amounts of water. **Caution: Care should be taken to ensure compliance with wetland rules and regulations and to avoid contamination of ground water and surface water sources.**

Seedbed preparation and irrigation management can reduce the effects of salts. Sloping beds with seed rows between the peaks or flat double row beds with a salt wick peak in the center can cause salts to migrate away from the planted area. In addition the crowns of peaked areas can be knocked away from seeded rows following pre-irrigation to remove salts that have accumulated. Planting every other row, and then irrigating every other row, will help push salts toward the non-irrigated furrow and away from the seeded row.

Saline areas with a 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 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, retards 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 maintaining soil structure.

Every saline site is unique in the kind and amount of salt, soil type, available moisture and climatic conditions. Most soil amendments will not correct a high salt concentration problem. A proper soil analysis (0-6 inches) will help determine the nature of the problem and if soil amendments can be recommended. Soils with an EC greater than 25 mmhos/cm or Sodium Adsorption Ratios (SAR) in excess of 12 in high salinity soils, or 25 in low saline soils, should not be seeded until amendments, leaching or drainage has reduced the hazard. Insufficient leaching after the use of a soil amendment may make a salinity problem worse.

Soil amendments such as gypsum, calcium chloride dehydrate and sulfuric acid have been used for reclamation of saline-sodic soils. These amendments generally involve the replacement of exchangeable sodium with calcium. For amendments to be effective, the displaced sodium must be leached out of the plant rooting zone. This is not always possible because of water availability and/or poor drainage from the salinized site. However, even without leaching, amending with gypsum will reduce surface crusting and improve moisture infiltration into the soil.

Planting in Saline-Sodic Soils

The optimum period to complete seedings for forage and cover type species in wet-saline soils is late fall (mid October to December) or during a snow-free period during the winter. 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 desiccating 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 ¼ to ½ inch.

An alternate method of establishing 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.

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.

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 seedheads 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 seeded in species mixtures at a rate of about 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. If these species are desired, they should generally be planted by themselves.

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.

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). Meadow 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. 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 (see Relative Salt Tolerance of Selected Grass, Forb and Legume Species Table – Wet/Saturated or Irrigated Sites).

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.

Commercially Available Species for Seeding in Saline-Sodic Soils

Common Name	Cultivar(s)	Tolerance Rating	Seeds/Lb.	Seeding Rate[1]
Beardless wildrye	Shoshone	Very High	150,000	10 lbs/ac[2]
Tall wheatgrass	Alkar, Jose, Largo	Very High	78,000	15 lbs/ac
Altai wildrye	Prairieland, Eejay, Pearle	Very High	73,000	15 lbs/ac
Hybrid wheatgrass	Newhy	Very High	139,000	12 lbs/ac
Slender wheatgrass	Pryor, Revenue, San Luis	Very High	135,000	12 lbs/ac[3]
Russian wildrye	Bozoisky-Select, Swift, Mankota	Very High	170,000	9 lbs/ac
Tall fescue	Johnstone, Kenmont, Fawn, Goar, Alta	High	205,000	8 lbs/ac
Western wheatgrass	Rosana, Arriba, Rodan, Walsh	High	115,000	9 lbs/ac
Fairway c. wheatgrass	Fairway, Ephraim, Douglas, Roadcrest	High	175,000	8 lbs/ac
Crested wheatgrass X	Hycrest, CD-II	High	165,000	8 lbs/ac
Standard c. wheatgrass	Nordan, Summit	High	165,000	8 lbs/ac[4]
Siberian wheatgrass	Vavilov, P-27	High	160,000	9 lbs/ac[4]
Strawberry clover	Salina	High	300,000	6 lbs/ac
Creeping foxtail	Garrison	Moderate	750,000	5 lbs/ac
Meadow brome	Regar, Fleet, Paddock	Moderate	93,000	15 lbs/ac
Smooth brome	Manchar, Lincoln	Moderate	145,000	9 lbs/ac
Pubescent wheatgrass	Luna, Manska	Moderate	80,000	12 lbs/ac
Intermediate wheatgrass	Rush, Oahe, Reliant	Moderate	80,000	12 lbs/ac
Thickspike wheatgrass	Bannock, Critana, Sodar	Moderate	135,000	9 lbs/ac
Yellow sweetclover	Madrid	Moderate	262,000	6 lbs/ac[3]
Cicer milkvetch	Lutana, Monarch, Windsor	Moderate	130,000	11 lbs/ac

[1] These rates are Critical Area Planting (Standard 342) Pure Live Seed (PLS) seeding rates - 1.5 times normal seeding rates

[2] Beardless wildrye requires over-wintering in soil for seed stratification and must be dormant fall planted

[3] Recommended in mixtures with up to 2 lbs of slender wheatgrass or 1 lbs of yellow sweetclover per acre

[4] Standard crested wheatgrass and Siberian wheatgrass are more drought tolerant than Fairway or crested wheatgrass crosses

Relative Salt Tolerance of Selected Grass, Forb and Legume Species

The salt tolerances given in this table compare the relative tolerances of various species. It provides an upper salinity limit above which plants will usually not germinate. The production column indicates the level at which yields become affected. Source: Plant Materials for Saline-Alkaline Soils. 1996. USDA, NRCS, Bridger PMC, Montana TN 26.

Crop	EC (mmhos/cm) Production Affected	Upper Limit	Tolerance Rating
Barley	8	16	High
Sugar beets	7	13	Moderate
Safflower	6	10	Moderate
Wheat	7	8	Low
Oats	4	8	Low
Corn	3	6	Low
Beans	1	2	Low
Forage –Wet/Saturated (water table w/in 3 feet of soil surface) or Irrigated (well drained) Sites			
Beardless wildrye	13	26	Very High
Tall wheatgrass	13	26	Very High
Newhy hybrid wheatgrass	13	26	Very High
Slender wheatgrass	10	22	Very High
Altai wildrye	10	20	Very High
Tall fescue	8	18	High
Western wheatgrass	6	16	High
Strawberry clover	6	16	High
Creeping foxtail	5	12	Moderate
Smooth brome	5	10	Moderate
Meadow brome	4	10	Moderate
Cicer milkvetch	4	10	Moderate
Birdsfoot trefoil	5	8	Low
Orchardgrass	3	8	Low
Reed canarygrass	3	5	Low
White clover	3	4	Low
Alsike clover	2	3	Low
Red clover	2	3	Low
Ladino clover	2	3	Low
Forage - Dry (10 inch + precipitation and water table below 3 feet of soil surface) Sites			
Russian wildrye	13	24	Very High
Tall wheatgrass (12 inch+)	13	24	Very High
Slender wheatgrass	10	20	Very High
Crested wheatgrass	6	16	High
Siberian wheatgrass	6	16	High
Pubescent wheatgrass (11 inch+)	6	12	Moderate
Intermediate wheatgrass (12 inch+)	6	12	Moderate
Yellow sweetclover	5	10	Moderate
Alfalfa (12 inch+)	4	8	Low
Small burnet (14 inch+)	2	3	Low
Native Grasses			
Nuttall's alkaligrass	14	30	Very High
Alkali sacaton	14	26	Very High
Beardless wildrye	12	26	Very High
Alkali cordgrass	12	24	Very High
Alkali bluegrass	12	24	Very High
Slender wheatgrass	10	22	Very High
Plains bluegrass	10	20	Very High
Western wheatgrass	6	16	High
Thickspike wheatgrass	6	14	Moderate
Streambank wheatgrass	6	14	Moderate

Relative Salt Tolerance of Selected Tree and Shrub Species

Source: Tree Planting, Care and Management. 2002. USDA. Natural Resources Conservation Service. Boise, Idaho TN No. 43.

Species	EC (mmhos/cm) Upper Limit	Tolerance Rating
Trees and Shrubs		
Ash, Green	12	Moderate
Aspen, Quaking	3	Slight
Boxelder*	3	Slight
Buckthorn, Sea	15	Moderate
Buffaloberry, Silver	14	Moderate
Cherry	3	Slight
Chokecherry	9	Low
Cotoneaster*	3	Slight
Cottonwood	3	Slight
Crabapple	3	Slight
Current, Golden	13	Moderate
Dogwood	3	Slight
Douglas-Fir	3	Slight
Elm, American	3	Slight
Elm, Siberian*	13	Moderate
Fir, Balsam	3	Slight
Hawthorn	13	Moderate
Honeysuckle, Freedom*	9	Low
Juniper, Rocky Mountain	12	Moderate
Larch, Siberian	9	Low
Lilac, Common	12	Moderate
Linden, Little Leaf	3	Slight
Mountain-Ash	3	Slight
Pine, Austrian	11	Moderate
Pine, Ponderosa	12	Moderate
Pine, Scotch	9	Low
Plum, American	3	Slight
Poplar, Hybrid	3	Slight
Rose	3	Slight
Russian Olive*	14	Moderate
Siberian Peashrub	13	Moderate
Silverberry*	15	Moderate
Spruce, Blue	9	Low
Sumac, Skunkbush	12	Moderate
Viburnum	3	Slight
Walnut, Black	3	Slight
Willow, Laurel	3	Slight

* Potentially invasive – species has ability to spread under proper environmental conditions

Tree and Shrub species differ in the stages at which they are most sensitive to salinity. Generally trees and shrubs are most sensitive during establishment. To partially avoid this sensitive period, older bare root stock and/or potted trees and shrubs are recommended for plantings in saline-alkaline soils.

Plant stress related to salinity may be evident at levels lower than those listed in table. The listed values generally refer to the level at which major portions of a population show considerable mortality, reduced biomass or reduced growth rates. Trees and shrubs appear less salt tolerant when grown in a hot, dry climate than a cool, humid climate.

Select species most tolerant to salinity that meet the landowner's objectives. Manage the soil surface around each plant to minimize soil water evaporation and concentration of salts. Practices such as scalp planting and mulching, with either fabric or organic mulches, are effective in keeping the soil surface moist and discouraging salt accumulation near the young establishing tree or shrub.

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TECHNICAL NOTE

USDA-Natural Resources Conservation Service
Boise, Idaho

TN PLANT MATERIALS NO. 13 **DECEMBER 2003**

HARVESTING, PROPAGATING, AND PLANTING WETLAND PLANTS

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HARVESTING, PROPAGATING, AND PLANTING WETLAND PLANTS

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INTRODUCTION

Sedges (*Carex spp.*), spikerushes (*Eleocharis spp.*), bulrushes (*Scirpus spp.*) and rushes (*Juncus spp.*) are used extensively in riparian and wetland revegetation because of their aggressive root systems. They also provide wildlife habitat for a variety of terrestrial and aquatic species. They form buffer zones that remove pollutants from surface runoff. The above ground biomass provides roughness that causes stream velocity to decrease and sedimentation to occur. The thick humus developing in those areas breaks down organic compounds and captures nutrients (Carlson 1993).

Wetland plant root systems are important means of stabilizing degraded sites. Manning et al. (1989) found that Nebraska Sedge (*Carex nebrascensis* Dewey) produced 212 ft/in^3 (382.3 cm/cm^3) of roots in the top 16 in (41 cm) of the soil profile and Baltic Rush (*Juncus balticus* Willd) had 72 ft/in^3 (134.6 cm/cm^3) of roots. An upland grass like Nevada bluegrass only has 19 ft/in^3 (35.3 cm/cm^3) of roots. The root system is the basis for soil bioengineering. Soil bioengineering increases the strength and structure of the soil and thereby reduces streambank erosion. Most soil bioengineering applications emphasize the use of woody riparian plants. However, herbaceous wetland plants provide more fibrous root systems that in combination with the larger woody plant roots do a better job of tying the soil together (Bentrup and Hoag 1999).

Wetland plants are also used for constructed wetland systems (CWS). A CWS is a wetland that is constructed in an area that has no previous history of wetland hydrology for the purpose of improving water quality. Water purification is a natural function of wetlands. The wetland plants provide suitable sites for colonizing microbial populations to establish on. The microbial populations live on the plant roots and breakdown various nutrients found in the water. The

above-ground biomass serve as nursery sites for periphyton that also break down various nutrients.

DIRECT SEEDING OF WETLAND PLANTS

Many wetland plants are very difficult to seed in the wild. Wetland plant seeds usually need three things to germinate: 1) heat, 2) water, and 3) light. The need for light means that wetland plant seeds need to be seeded on the surface and they can not be covered with soil (Grelsson and Nilsson 1991, Leck 1989, Salisbury 1970). Drilling the seed with a drill will cover the seed especially if packer wheels or drag chains are used.

Many species have a very hard seed coat that takes up to one year or longer to break down enough for the embryo to germinate. Many species require special stratification treatments to prepare the seed for planting. These treatments include everything from acid wash to mechanical scarification, from pre-chilling to extremely high temperature soil conditions. Occasionally, dormant seeding (seeding during the late fall or winter after the plants have gone dormant) can be successful, but it depends on the species.

Not having absolute control of the water going into the wetland or riparian area is the most common mistake that occurs when seeding wetland plants. Without good water control, when water enters the system the newly planted seeds will float to the water surface and move to the water's edge where wave action will deposit the seed in a very narrow zone. The seed will germinate here and the stand will generally be quite successful as long as the hydrologic conditions are maintained for the various species deposited there (Hoag and Sellers 1995). With good water control, the seeds, for the most part, will stay in place and the stand will cover the wetland bottom instead of just around the fringe.

Some species when seeded in a greenhouse setting need a cold-hot stratification environment for successful germination. This means that the seeds are placed in cold storage at 32-36º F for 30-60 days and then they are planted in moist soil containers at about 100º F. Heat is one of the essential requirements for germination and growth. (Hoag et al. 1995)

Based on these difficulties, using direct seeding of herbaceous plants as the primary means of revegetating a site will require more attention to planning and control of site hydrology during the establishment period to be successful. It also means that you will need to know what specific germination/stratification requirements (if any) that the targeted species require. Successful establishment of herbaceous vegetation by direct seeding is possible and examples of these successes range from the establishment of Tufted Hairgrass (*Deschampsia caespetosa*) wetlands in Oregon to multiple species herbaceous depression wetlands in Delaware. Typically; however, direct seeding of herbaceous species is not used as the primary means of active revegetation, but it is a method to increase the overall species diversity in a wetland, especially around the perimeter, and to establish populations of specific target species.

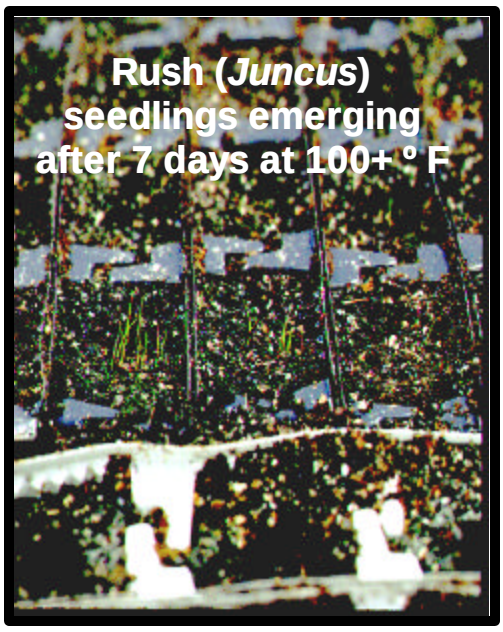
Revegetating a site with herbaceous species plugs of greenhouse grown material has shown a much higher establishment rate than with seeding or collections of wildlings (plugs collected

from wild populations) (Hoag and Sellers 1995). The remainder of this paper discusses the use of seedlings of wetland plants as a means of actively revegetating herbaceous vegetation on restored and enhanced wetlands.

COLLECTION AND PROPAGATION OF WETLAND PLANTS

Woody shrubs, grasses and wetland plants are often grown in small containers or plugs [volumes less than 22 in^3 (361 cm^3)]. Plugs are used in bioengineering designs when the water is too deep or persistent to get woody plants established in other ways. Transplanting wild plants ("wildlings") is sometimes used but small volume containers have been shown to have higher establishment rates and to spread faster and further (Hoag 1994). There are two basic procedures for obtaining wetland plant plugs: growing them or harvesting wildlings from a donor site.

Greenhouse Propagation: As previously stated, when growing wetland plants from seed, three things are required: 1) water, 2) heat, and 3) light. The need for water is fairly straightforward especially when one thinks about conditions in a natural wetland. Light, however, is not as obvious. Covering wetland plant seeds with even a thin covering of soil will significantly decrease germination of some species. Heat is also less obvious. Natural wetlands are generally very hot and humid. Our research has found that greenhouse temperatures in the range of 100ºF or higher will increase germination and growth.



Seeds of most of the wetland plants except rushes need to be stratified. Stratification is essentially "fooling" the seeds into germination mode by mimicking the environmental conditions that they would be subject to had they remained outside during the winter. The seeds are stratified in small plastic containers that are filled with distilled water. We add about 0.3 oz (8 g) of loose sphagnum moss to the water in the bottom of the cup. The seeds are put into a coffee filter and the filter is nestled down into the moss. The containers are

placed in a dark cooler for 30 days at 32-36ºF. At the end of 30 days, the seeds are removed from the stratification medium.

When planting wetland plant seeds in the greenhouse, we use special propagation tanks and Rootrainers$_{tm}$ with a 1:1:1 soil mix of sand, vermiculite, and peat. Rootrainers$_{tm}$ have a large hole in the bottom that needs to be covered so the soil does not wash out when water is added to the tanks. A single sheet of paper towel crumpled up and shoved into the mouth of each cell will prevent this. The seeds are placed on the soil surface of the cells in each Rootrainer $_{tm}$ after the surface has been firmly packed. A 2 x 2 in (5 x 5 cm) wooden tamp works well and can pack the soil to a sufficient density that a finger will barely make an impression in the soil surface. About 5 to 10 seeds are put on a finger and pushed on to the soil surface. The seeds need to be in good contact with the soil surface.

After the stratified seeds are planted on the soil surface, the tanks are filled with water to within about one inch of the soil surface. The seeds should be illuminated for 24 hours a day with 400-watt metal halide lamps for the first month. After one month the lights can be turned off. Covering the propagation tanks with clear plastic while the seeds are germinating helps keep the environment warm and humid. If you find that you have a problem with damping off of the seedlings, try flooding the soil. Leave the soil completely submerged under about 1/4 to 1/2 in (6.4 to 12.7 mm) of water for about two weeks. After this period lower the water level. This procedure will subdue the fungus and may also stimulate more stubborn seeds to germinate. Do not flood the soil if the seeds have not germinated or they will float and move out of the cells.

With this method, 22 in^3 (361 cm^3) plants can be grown from collection to full size in less than 100 days. Plugs can be held in the greenhouse if necessary for extended periods of time with minimal maintenance. Several crops can be raised throughout the year because of the short turn around time.

If growing the plants is not an option and they must be purchased, several things need to be considered. It is important to find a grower who is willing and able to grow wetland plants that can be difficult to propagate. The grower must understand the special propagation requirements and be able to accomplish them. Make sure the grower understands the project plant requirements in terms of height and size at the time that the contract is signed. When determining whether to accept the plant materials, look at the roots in addition to the tops. The tops and roots should be about the same in terms of density. Always remove several plants from their containers to look at the roots. The roots should extend to the bottom of the container, but they should not be root bound (wound around the inside of the container). If they are root-bound, the grower did not transplant them to larger containers in a timely manner. The roots should have several well-developed rhizomes in addition to hair roots. The tops should be vigorous and as tall as the contract called for. Remember if the tops are too short, the plants will be in danger of drowning if planted in water that is too deep. The aerenchyma should be well started in the bottom third of the above ground biomass. Determine the planting date

before going to the grower so that he knows when the plants need to be ready. Check in with the grower occasionally especially early to make sure that he has been able to get beyond the germination stage. If problems occur, there might still be time to go to another grower or to adjust your planting date.

Wildlings or (Wild Transplant Collection): Wetland plants because of their tremendous root systems are readily transplanted and the remaining plants will fill in the harvest hole rapidly. One rule of thumb is to dig no more than 1 ft^2 (0.09 m^2) of plant material from a 4 ft^2 (0.4 m^2) area. It is not necessary to go deeper than about 5 to 6 in (13 to 15 cm). This will get enough of the root mass to ensure good establishment at the project site. It will also retain enough of the transplants' root system below the harvest point to allow the plants to grow back into the harvest hole in one growing season assuming good hydrology and some sediment input (Bentrup and Hoag 1999). Transplants can be taken at almost any time of the year. Collections in Idaho have been taken from March to October with little or no difference in transplant establishment success. If plugs are taken during the summer months, cut the tops down to about 4 to 5 in (10 to 13 cm) above the potential standing water height or 10 in (26 cm) which ever is taller. Research at the Aberdeen Plant Materials Center has shown that covering the cut ends with water will not necessarily kill the plant, but will significantly slow its establishment rate (except if left for longer periods of time) (Hoag et al. 1992). Cutting the tops will also increase the survival rate of transplants that are transported long distances.

Generally, leaving the soil on the plug will increase the establishment success by about 30%. Beneficial organisms that are typically found on the roots of the wetland plants that are important in the nitrogen and phosphorous cycles can be moved to the new site which often will not have the organisms. However, there will be an increase in the volume of material that needs to be transported. In addition, if collections are made from a weed

infested area, there is a good chance that weed seeds could be transported in the soil. Washed plugs can be inoculated with mycorrhizae purchased from dealers if the project objectives call for it. The collection location will also help determine whether the soil should be left on the plugs or washed off.

If a total of 1 ft^2 (0.09 m^2) of plant material is harvested, it is possible to get 4 to 5 individual plants plugs from the larger plug. The plugs can either be chopped with a shovel very rapidly or the plugs can be cut relatively accurately with a small saw so they can easily fit into a predrilled, set diameter hole. To get the right length of plug, lay the large plug on its side on a sheet of plywood and use the saw to cut the bottom off level and to the desired length. After this, stand it up and cut smaller plugs off like a cake.

Make sure the length of the plug is related to the saturation zone at the planting site. The bottom of the plug needs to be in contact with the saturation zone. Match the amount of water with the wetland plant species. Ogle and Hoag (2000) display a hydrologic planting zone diagram that outlines the various hydrologic regimes. They also include a series of tables that specify which zones various species will tolerate.

Wetland Transplant Planting

Natural wetland systems have high species diversity. When selecting plant species for the project wetland, try to copy a nearby natural wetland. Identify the particular hydrology in areas where the individual plant species are growing. Make note of how deep the water is. Try and imagine how long the plants will be inundated. Determine if the plants are in flowing or relatively stagnant water. Rarely will a natural wetland be totally stagnant through time. Generally, there is water flowing into the wetland from somewhere either above ground or from groundwater. Spring and fall overturn, as well as wind mixing, also help to circulate the water.

Next, prepare the planting area. The easiest way to plant the plugs is by flooding your planting site. Standing water is much easier to plant in than dry soil (this also ensures that your watering system, what ever it may be, works before you plant). Make sure the soil is super saturated so that you can dig a hole with your hand. This is more successful with fine soils than with coarse soils. Take the plug trays and place them in a Styrofoam cooler (you will not need the lid). Try to cover most of the roots with water while in transit. At the planting site, drain off most of the water so the cooler will float. Use the cooler to move the plugs around the wetland as you plant. Select a spot in your wetland to put a plug, reach into the water with your hand and dig out a hole deep enough for the plug to fit all the way into. Push the plug into the hole and pack around it with your hand. Make sure all of the roots are covered with soil. Be careful to not dislodge the plug and expose the roots when moving around. Start at one end of the planting site and work toward the opposite end.

Spacing of the plugs is a common question. Our research has indicated that many wetland plants will typically spread about 9 to 12 in (23 to 30 cm) in a full growing season. We plant on 18 in (46 cm) centers. Even though it takes fewer plants to plant an area at a wider spacing, we have found that plantings at wider spacing have less overall success than those planted at closer

spacing. The exact reason for this is unknown, but it could be a sympathetic response to plants of the same species. If the project budget does not allow for the purchase of enough plants to cover the wetland bottom, plant the plugs on 18 in (46 cm) centers but plant them in copses or patches that are about 10 ft (3 m) square. Space the copses about 10 ft (3 m) apart. The copses can be planted to different species according to the hydrology. Over time, the plants will spread out into the unplanted areas.

The planting window for wetland plants is quite long. At the Aberdeen Plant Materials Center, Idaho we have planted plugs from April through late October. Planting plugs in the fall and winter has resulted in frost heaving of the plugs so that only about 1/3 of the plug remained in the ground. The availability of water is critical. Remember wetland plants like it hot and wet. They tend to spread faster with warmer temperatures. If you plant in the spring, it will take the plants a while to get going, but they will have a longer establishment period. Fall planting will generally result in lower establishment success because of the shorter growing season and frost heaving damage.

The plants can be successfully established in a wide variety of soil textures. We have successfully established wetland plants in areas that are clay with no organic matter all the way up to gravels. The biggest problem is digging the holes. The soil texture will often limit the equipment available to dig the holes. In clay bottoms, we have used a small bulldozer or tractor with a ripper tooth to dig lines across the bottom about 8 in (20 cm) deep.

In general, fertilizer is not necessary. However, it really depends on the site and the soils. If during construction, the bottoms have been cut down to the subsoil and all of the naturally present nutrients have been removed, fertilization will probably be necessary unless the water coming into the wetland has a high nutrient load.

After planting, release the water into the site slowly. Remember that the young plants have not fully developed the aerenchymous material necessary for them to survive in anaerobic soils and standing water. After the initial planting, be careful not to raise the water level to more than about 1 in (2 to 3 cm) above the substrate. Too much water at this time may stress the new plants. Maintain the water at about 1 in (2 to 3 cm) for about one week, this will inhibit the germination and growth of any terrestrial species that may be present in the restored wetland. The water level can then be lowered to the substrate surface for 15 to 20 days. This will expose the mud surface, stimulating any wetland seeds that were brought in with your transplants to germinate as well as increase the rate of spread of the transplants. You can then raise the water level 1 to 2 in (3 to 5 cm). for another week. Then lower the water to the substrate surface for another 15 to 20 days. After this period, slowly raise the water level to 4 to 6 in (10 to 15 cm). for 3 to 5 days. Continue to gradually increase the water depth to 6 to 8 in (15 to 20 cm). Remember that the aerenchymous tissues in the plant shoots are what supply the roots with oxygen so be careful not to raise the water over the tops of the emergent vegetation. If the plants are not showing any stress, continue to carefully raise the water level to 12 to 20 in (30 to 50 cm) if possible. These suggested water level depths must be modified based upon the species used. Some species will not tolerate inundation at these suggested depths or durations. When in doubt, defer to the hydrology conditions on natural reference sites where the species occurs. 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 2 to 3 in (5 to 7 cm)(Hammer 1992). 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. The key thought here is to fluctuate the water level. Natural wetlands rarely have a constant water level. Many species cannot tolerate a constant water level and will begin to die out. Species more tolerant to standing water will increase. The plant diversity that was so carefully planned for will be lost

Management during the establishment year is important to ensure that the plants do not get too much water or too little. Weed control is important especially during the establishment year because of the low water levels and exposed, unvegetated areas. A good weed control plan needs to be in place before planting. Monitoring the planting for 3-5 years after the establishment year will help maintain the planting and it will provide useful information for future plantings.

Recommendations:

- Always match the plant species to the hydrology associated with that species.
- In general, purchase the largest plugs you can afford. Planting technique will often determine the size of the plugs and the ease of planting.
- Plant the plugs on 18 to 24 in (46 to 61 cm) centers.
- Plant in patches rather than wider spacing.

- Fertilizer is generally not necessary unless the water coming into the site is relatively clean or the construction has cut into the subsoil.
- The plants tend to spread faster under saturated soil conditions rather than standing water. However, terrestrial weeds will move in to saturated soils much faster than flooded soils. Fluctuating the water level will help the plants spread and decrease terrestrial weed establishment.
- Water control is extremely important during the establishment year.
- Weed control needs to be planned and budgeted for at the beginning of the project.
- Monitoring is essential for the success of the project. Monitoring needs to have time and money allocated in the budget and it needs to have a specific person identified to carry it out.
- Successful wetland plantings take significant planning and a good understanding of the hydrology at each site.

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TECHNICAL NOTE

USDA-Natural Resources Conservation Service
Boise, Idaho and Spokane, Washington

TN PLANT MATERIALS NO. 18 **July 2004**

BASIC BIOLOGY, DISTRIBUTION AND VEGETATIVE SUPPRESSION OF FOUR KNAPWEED SPECIES

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BASIC BIOLOGY, DISTRIBUTION AND VEGETATIVE SUPPRESSION OF FOUR KNAPWEED SPECIES

Mark Stannard, PMC Manager, Pullman, Washington

Well established stands of perennial vegetation can minimize the spread of many weeds. Knapweeds like other weeds function to fill voids. These voids may be actual bare ground or may be a missing key species in a plant community. It is extremely important that these voids be filled with desirable vegetation. If not, knapweed will simply colonize the site.

Vegetative suppression is a vital component in the weed control arsenal. A quick review of the knapweed research will indicate:

- It is important to understand a few biological facts about the knapweed and the species to be used for suppression before implementing a program.
- There is no plant species which will suppress a knapweed species on all sites at all times. The "silver bullet plant" simply does not exist.
- Suppression species must remove a significant amount of moisture from the soil during periods when knapweeds are most vulnerable, i.e. the seedling stage.
- Knapweeds severely compete with seedlings of other species and need to be controlled prior to establishing vegetation for suppression.
- Vegetative suppression alone will not provide lasting knapweed control. Lasting control requires an integration of chemical control, biological control, proper land management, and vegetative suppression.

This review relays some information that pertains to the basic biology, distribution, and vegetative suppression of knapweeds.

INTRODUCTION

A 1987 Washington weed survey showed yellow starthistle, spotted, diffuse, and Russian knapweed occupied over 590,000 acres which resulted in an annual loss of forage valued in excess of $950,000 (Roche and Roche 1988). Knapweeds can reduce biomass production of neighboring plants as much as 90% and also can greatly reduce the species diversity of a site (Watson and Renney 1974, Myers and Berube 1983, Rice et al. 1992, Tyser and Key 1988, Watson 1980).

Knapweed impact is not restricted to only the plant community. Soil loss occurring in a spotted knapweed community was nearly three times the loss occurring on an adjacent grass community in a simulated rainfall experiment (Lacey et al. 1989). Fisheries will be impacted by increased sediments from erosion. Spoon et al. (1983) predicted that 220 head of elk would be lost annually on the Lolo National Forest due to loss of forage caused by knapweed displacement.

Vegetative suppression may entail filling voids left by successful knapweed control or secondly, occupying a site with desirable vegetation before knapweed invades. Unless filled by desirable species, voids created in the plant community by successful knapweed reduction will simply be replaced by other and possibly more serious weeds (Story 1989).

YELLOW STARTHISTLE (*Centaurea solstitialis*)

Biology - Yellow starthistle is a winter-annual. Seeds germinate in the fall with the onset of fall moisture and grow as a small rosette. Little aboveground growth occurs during the winter but root growth can exceed 4 feet by mid-March (Roche 1989). Yellow starthistle rosettes resume growth early in the spring and the roots utilize stored soil moisture before other species resume growth. Plants bolt in late spring and usually develop a single stem. The stem may branch several times and flowers are borne on the ends. Each flower produces both plumed and plumeless seeds. Plumed seed are primarily wind disbursed and are shed soon after maturity. Plumeless seeds are held longer in the seedhead and are disbursed by mechanical destruction and/or disturbance of the seedhead. Seeds may remain viable in the soil for up to 10 years (Callihan et al. 1993).

Yellow starthistle is utilized by cattle and sheep prior to bolting but can cause chewing disease (*Nigropallidal encephalomalacia*) in horses (Cordy 1954). Utilization drops considerably after bolting due to low palatability and long, sharp spines on the seed bracts distract livestock grazing.

It is unclear if allelopathy is a major competitive factor (Kelsey and Bedunah 1989).

Geographic and Ecologic Distribution - Yellow starthistle occurred in all 20 eastern Washington counties in 1987 with the exception of Pend Oreille, Douglas, Lincoln, and Grant counties (Roche and Roche 1988). Much of the yellow starthistle acreage is located in the southeastern counties. North Central Idaho and North Eastern Oregon are also heavily infested with yellow starthistle. Environmental conditions for yellow starthistle appear to reach the optimum in northern California where 7.9 million acres are infested (Maddox 1985).

Yellow starthistle is well adapted to areas with Mediterranean climates - cool, wet winters and hot, dry summers. Mediterranean type climates enable yellow starthistle to grow during the winter months, bolt in the spring, and escape the summer drought.

Seedlings require close to full sunlight to grow. As a result, yellow starthistle is found predominantly on south facing slopes (Roche 1989). Roche and Roche (1991) reported that 55% shading reduced yellow starthistle foliage production 80%.

Yellow starthistle does not perform well on shallow soils because it depletes soil moisture too rapidly to allow flowering (Roche and Roche 1991). A typical Idaho and Washington site has deep soils or shallow soils which receive supplemental moisture.

Vegetative Suppression - Successful establishment of desirable vegetation requires control of yellow starthistle prior to seeding. Prather and Callihan (1991) showed that yellow starthistle seedlings were more competitive than pubescent wheatgrass seedlings and were affected little by pubescent wheatgrass density. Greenhouse trials have shown root growth of yellow starthistle far

exceeding growth of several other species including a perennial grass (Sheley et al. 1993). Cold soil temperatures encountered in the field would most likely amplify root growth differences since yellow starthistle is well adapted to cold soil. Suppression species must remove a significant amount of moisture in the rooting zone of starthistle seedlings and overlap the active growth period of starthistle in order to be effective (Larson and McInnis 1989).

Established stands of intermediate and pubescent wheatgrass generally provide good to excellent suppression in the northwest. Since neither species exhibits adequate seedling vigor to establish in stands of yellow starthistle as pointed out above, it is important that the starthistle competition be reduced. Unfortunately, both species are very large seeded and are poorly suited for broadcast seeding onto unprepared seedbeds. Removal of too much top growth of either species will enable yellow starthistle to colonize a site because the shade furnished by the wheatgrass has been removed (Roche, B.F. pers. comm.).

Selection of species for suppression must be based on performance beyond first year results (Larson and McInnis 1989). For example, 'Ephraim' crested wheatgrass provided very good suppression the year of establishment but performed poorly the second year. 'Covar' sheep fescue, a slow establishing species, performed poorly the first year but was relatively free of starthistle the second year. 'Paiute' orchardgrass and 'Critana' thickspike wheatgrass performed similarly both years.

Idaho fescue and orchardgrass provide excellent moisture depletion early in the spring and have been shown to suppress yellow starthistle in trials conducted in southwestern Oregon (Borman et al. 1991, Borman et al. 1992). Both grasses initiate growth early in the spring, remain semi-active during the winter, and mature early in the region.

SPOTTED KNAPWEED (*Centaurea maculosa*)

Biology - Spotted knapweed is a short-lived perennial that reproduces by seed. Seed disseminated in the fall readily germinates in the spring. A small percentage exhibit primary dormancy and can remain viable in the soil for at least 8 years (Davis et al. 1993). The fast growing taproot enables spotted knapweed to exploit soil moisture and nutrients. The seedlings are low growing rosettes which escape grazing and produce carbohydrate reserves for next year's growth. Flowering generally occurs after the first year and occurs each year until death of the plant. Flower heads are borne on the ends of the stems which arise from a single crown.

Early reports showed that spotted knapweed produced an allelopathic compound, cnicin, which inhibited plant growth and seed germination. As a result, allelopathy received considerable attention as an important competitive mechanism. Allelopathy is not a major factor in the competitiveness of spotted knapweed because concentrations of cnicin are too low to be herbicidal (Kelsey and Bedunah 1989). Prolific seed production, rapid seedling establishment, and depletion of soil nutrients are probably much more important competitive factors enjoyed by spotted knapweed. Spotted knapweed's ability to colonize a site from dormant seed long after herbicides have degraded is another asset enjoyed by this species.

Spotted knapweed tolerates shade poorly and this can reduce its spread. It is also sensitive to several broadleaf herbicides, is readily utilized by sheep, and several insects (bio-agents) have provided promising results in the reduction of spotted knapweed.

Geographic and Ecologic Distribution - Spotted knapweed was located in 19 counties in Washington in 1987 (Roche and Roche 1988). West of the Cascades and the arid-interior scablands appear to be the upper and lower climatic limits for spotted knapweed. Most of the spotted knapweed acreage in Washington is located in the Northeast corner of the state. Spotted knapweed is also very common in Northern Idaho and Western Montana.

Disturbed areas such as roadsides, gravel pits, and abandoned cropland are frequently the first areas to be invaded by spotted knapweed. It readily colonizes pasture and rangeland especially if overgrazing is evident. Overgrazing is not a prerequisite for invasion (Lacey et al. 1990). Spotted knapweed will invade pristine, excellent condition range in the complete absence of livestock grazing (Lacey et al. 1990, Tyser and Key 1988). It is less adapted to forested areas where sunlight is limited but readily invades open areas such as roadsides (Losensky 1989).

Vegetative Suppression - Reseeding knapweed infested sites without implementing a herbicide program to remove knapweed competition has been very ineffective in studies comparing the effects of several management practices (Roche 1991). Reseeding was unnecessary if a remnant stand of desirable grasses was present. Herbicide control of spotted knapweed and proper management of the remnant grasses would be more cost effective than reseeding the site.

Screening plant materials for suppression of spotted knapweed has received little attention. Losensky (1989) stated that a species mix which provides quick establishment and early growth was necessary for preventing spotted knapweed invasion onto disturbed forest roads. Annual rye, crested wheatgrass and yellow sweetclover were proposed as potential species. Persistence of these materials is questionable on highly disturbed, low fertility soils.

DIFFUSE KNAPWEED (*Centaurea diffusa*)

Biology - Diffuse knapweed reproduces by seed and is generally a biennial. It grows as a vegetative rosette the first year and bolts after the rosette has acquired 6 or more leaves (Thompson and Stout 1991). Since vernalizing temperatures are also required, bolting rarely occurs the first year. Seedlings of diffuse knapweed readily emerge when favorable conditions occur in the spring and fall. Seedlings develop into rosettes and maximal root development occurs in this stage (Watson and Renney 1974). After over-wintering, a single, many-branched stem develops from the crown. Flowers grow at the end of the branches in the summer. Once seed matures, the plant dies. Dead plants break off at ground level and tumble with the wind, spreading the seed as it rolls (Watson and Renney 1974).

Allelopathy does not appear to be an important factor in diffuse knapweed's competitive ability. The concentrations of cnicin are too low to affect other vegetation (Kelsey and Bedunah 1989). Prolific seed production coupled with "tumble" distribution and high seedling vigor greatly aid in the spread of diffuse knapweed. It is also very adept at depleting soil moisture.

Geographic and Ecologic Distribution - Diffuse knapweed is the most drought tolerant of the four knapweed species and is the most widely spread knapweed in Washington. The 1987 weed survey showed diffuse knapweed occurring in 20 counties and occupying over 425,000 acres. Areas of highest occurrence include Stevens, Okanogan, Kittitas, Chelan, Ferry, and Yakima counties (Roche and Roche 1988). Typical habitat subject to diffuse knapweed invasion include disturbed sites such as transportation rights-of-ways, gravel pits, and industrial areas. Semiarid rangeland and dry open forest are subject to invasion especially if vigor of the site is low. Diffuse knapweed is also very common in Central Idaho.

Overgrazing is not a prerequisite for diffuse knapweed invasion (Myers and Berube 1983, Lacey et al. 1990). Diffuse knapweed moved at a rate of 40 feet/year into good condition range in a study conducted in British Columbia (Myers and Berube 1983).

Vegetative Suppression - Diffuse knapweed will readily invade practically any disturbed site in the northwest. However, its competitiveness lies within a narrow moisture range (Berube and Myers 1982). They reported that crested wheatgrass provided very good long-term suppression in a region of British Columbia which receives 6" MAP (Berube and Myers 1982). However, suppression was poor on a site which receives 12" MAP. Fertilization of grass may greatly aid in suppression in areas where moisture conditions are suboptimal for diffuse knapweed (Berube and Myers 1982).

Seedling establishment is the critical period of diffuse knapweed and suppression efforts are most effective during this period. Species which extract moisture in the spring from the top few inches of soil will stress diffuse knapweed seedlings.

RUSSIAN KNAPWEED (*Acroptilon repens*)

Biology - Russian knapweed is a long-lived perennial which reproduces by seed and creeping horizontal roots. Russian knapweed was originally classified as *Centaurea repens*. It does not share some characteristics common to the *Centaurea* genus and has been placed in the *Acroptilon* genus.

Russian knapweed is a very poor seed producer and germination of Russian knapweed seed rarely occurs in the field (Selleck 1964). Reproduction is primarily accomplished by spread of the horizontal roots. Roots of Russian knapweed may reach 2.5 meters within one year and 7 meters by the second year (Watson 1980).

Russian knapweed is extremely competitive and dense patches will totally exclude other vegetation. Plants grow radially and a patch can cover an area of 12 m^2 within 2 years. The presence of Russian knapweed in wheat is very detrimental to yield and flour quality. Wheat seed contaminated with small amounts of Russian knapweed will impart a bitter taste to the flour (Watson 1980).

Russian knapweed is allelopathic and can cause chewing disease in horses (Kelsey and Bedunah 1989, Young et al. 1970). The allelopathic compound, cnicin, is contained in the leaves and is

released into the soil after leaves fall. Grazing animals generally avoid Russian knapweed due to the bitter taste.

Geographic and Ecologic Distribution - Russian knapweed is native to Eurasia and was introduced to North America as a contaminant of alfalfa seed. It is widely distributed throughout eastern Washington with only Pend Oreille county reporting no Russian knapweed in a survey conducted in 1987 (Roche and Roche 1988). Areas of highest occurrence in 1987 were the Columbia Basin and the Yakima and Okanogan valleys. It is less abundant than the other three major knapweeds in Washington. Russian knapweed is also found in most counties in Idaho.

Russian knapweed is commonly found on deep soils or soils which receive supplemental moisture. Basin wildrye (*Leymus cinereus*) appears to be an indicator species for sites susceptible to Russian knapweed invasion (Roche 1990). Russian knapweed is tolerant of poorly drained and saline to alkaline soils (Roche and Roche 1991). However, it is drought tolerant and will survive on sites that receive as little as 10" MAP (Watson 1980).

Russian knapweed is well adapted to cropland and is a severe problem in dryland crops of the former USSR (Watson 1980). Cultivation can spread root fragments which regenerate new plants and mowing simply stimulates underground buds to replace lost aboveground foliage (Watson 1980, Roche and Roche 1991). Russian knapweed performs poorly in heavily forested areas or dense stands of irrigated alfalfa due to its low tolerance to shading (Roche and Roche 1991).

Vegetative Suppression - Studies have shown that a season of intense cultivation followed by a crop of smooth brome or crested wheatgrass that is sprayed with 2,4-D will eliminate a high percentage of Russian knapweed (Derscheid et al. 1960). However, if either cultivation or 2,4-D were omitted, neither grass provided effective suppression. Cultivation prior to seeding of alfalfa or alfalfa/grass did not give the crop enough advantage to suppress Russian knapweed (Derscheid et al. 1960).

Early emergence, rapid dense growth, and maintenance of high vigor until frost are attributes required by species for suppression of Russian knapweed (Rogers 1928). Few range grasses exhibit these characteristics. Pasture species which provide season-long production are probably better candidates. Trees and shrubs might also be considered.

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TECHNICAL NOTE

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WILDFIRE REVEGETATION EFFECTIVENESS

FINAL REPORT OF EVALUATIONS OF FOUR SELECTED EWP PROJECTS IN IDAHO AND OREGON

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Wildfire Revegetation Effectiveness
Final Report of Evaluations of Four Selected EWP Projects in Idaho and Oregon

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Abstract

Key words: wildfire seedings; reclamation seedings; Emergency Watershed Protection (EWP) seedings

This review covers four wildfires, three in Idaho and one in Oregon. All of the Emergency Watershed Protection (EWP) projects involved aerial reseeding on all or part of the burned area. Drill seeding was completed on portions of the three fires in Idaho in selected areas, generally slopes of 30% or less. Seed mixes were used in all projects. In most cases, seeded species were non-native but adapted to the local soil and climate of the particular area. Species were selected based on the following criteria: adaptability, availability, ease of establishment, erosion control ability and forage quality for wildlife.

This review covers species selection, seeding rates and techniques, long-term species adaptability and effectiveness of the seedings on state and private lands within the EWP project areas.

All drill seeding was successful. Aerial seeding had mixed success. Native species seeded generally did not establish successfully. Intermediate wheatgrass (*Thinopyrum intermedium)* was the most successful seeded species. Seeding rates were appropriate where improved watershed values and livestock forage production were the objectives. Seeding rates of sod forming grasses were too high where native species regeneration is an objective. Successful seedings were generally higher in species richness, forage, cover, watershed and wildlife habitat values compared to controls.

Program overview

The Natural Resources Conservation Service (NRCS) administers the Federal Emergency Watershed Protection Program (EWP) to help people reduce threats to life and property following a natural disaster. NRCS works through local sponsors on a voluntary basis. Typical sponsors include city and county governments, soil and water conservation districts and state agencies such as fish and game departments and department of lands. EWP work can include: purchasing floodplain easements, removing debris from channels, culverts and bridges; stabilizing eroded streambanks; repairing levees and watershed structures; installing erosion control structures; and reseeding damaged areas.

Study Areas

EWP funds administered by NRCS can only be spent on private or state lands. For this reason, this review only covers EWP seeding on private and state lands. See Appendix 1.

The **Eight Street Fire** burned 15,300 ac. (6192 ha.) in the foothills north of Boise, Idaho. The fire started on August 26, 1996, and was declared controlled on September 2, 1996. At the time of ignition

temperatures were in excess of 100 degrees Fahrenheit (38 C) with winds gusting to 30 mph (48 kph). Within the EWP-treated area ownership is both private and the State of Idaho. Elevation ranges from 2600-7000 ft. (792-2134 m.). EWP-treated lands ranged from 2600-4500 ft. (792-1372 m.) (USDA NRCS, Meridian Field Office). Average annual precipitation ranges from 12-17 in. (300-430 mm.) falling mostly as snow in the winter. Average annual air temperature ranges from 46 to 52 degrees Fahrenheit (8-11 C). Potential natural vegetation within the EWP-treated area includes bluebunch wheatgrass (*Pseudoroegneria spicata),* Idaho fescue (*Festuca idahoensis),* Thurber needlegrass (*Stipa thurberiana),* NeedleandThread (*Stipa comata),* basin big sagebrush (*Artemisia tridentata var. tridentata),* foothills big sagebrush (*Artemisia tridentata var. xericensis)* and antelope bitterbrush (*Purshia tridentata).* Existing vegetation at the time of the burn included mostly annual grasses such as cheatgrass (*Bromus tectorum)* and medusahead rye (*Taeniatherum asperum)*

The topography is predominantly rolling to steep hills and benches. Gently and moderately sloping stream terraces, draw bottoms and alluvial fans occur adjacent to drainage ways at the lower elevations.

The soils on mountains generally formed in residuum and colluvium from cretaceous granite rocks of the Idaho batholith. The soils on the hills generally formed in alluvium, colluvium and residuum from Tertiary lacustrine deposits of sand and mudstone. The hills are sometimes capped with arkosic sandstone or fan remnants composed of late Pliocene volcaniclastic sediments. The soils on structural benches and buttes are formed in residuum and colluvium from either early to mid-Pliocene basalt and tuff or in alluvium and colluvium from mixed sediments. The soils on stream terraces, draw bottoms and alluvial fans formed in alluvium from mixed sediments.

Soil surface textures range from coarse sandy loams to loams at the lower elevations. Soil textures at the middle and upper elevations range from fine gravelly coarse sandy loams to stony or cobbly loams (Harkness 1997).

The **Snow Basin Fire** burned approximately 4000 ac. (1619 ha.) of timberland in Wheeler County in North Central Oregon. The fire started on July 5, 1968 and was declared controlled on July 10, 1968. One timber company and several individual private landowners own the EWP-treated areas. Elevation ranges from 2800 ft. (853 m.) to 4400 ft. (1341 m.). The burned area includes portions of three range sites. The area between 2800 ft. (853 m.) and 3400 ft. (1036 m.) elevation is in the Pine-Sedge site; between 3400 ft. ((1036 m.) and 3800 ft. (1158 m.) elevation is in the Pine-Mixed Fir site; and the upper portion of the burn, which lies between 3800 ft. (1158 m.) and 4400 ft. (1341 m.) elevation is in the Mixed Fir site. Average annual precipitation varies from about 15 (381 mm.) to 22 in. (559 mm.) within the burned area. Perennial grasses, elk sedge (*Carex geyeri*) and forbs are abundant, and shrubs are important in the potential native plant communities of the Pine-Sedge and Pine-Mixed Fir sites. The Mixed Fir site normally has a dense tree canopy under which herbaceous cover and shrubs are sparse. These species were present prior to the fire.

Most of the burned area has a southerly aspect. The Top soil series occurs over most of the burned area and is the principal soil of the two higher elevation sites that occur above 3400 ft. (1036 m.) elevation. The surface layer of this soil is silt loam about 14 in. thick, the subsoil is silty clay loam about 20 in. thick and the substratum is loam to a depth of about 50 in. Hankins silty clay loam, which is about 7 in. thick over clay and fine textured sediments, is the principal soil of the Pine-Sedge site. Tolo silt loam, a deep ashy soil, occurs on north exposures, which constitutes a minor portion of the area (Anderson 1975).

The Foothills Fire burned approximately 250,000 ac. (101,171 ha.) north and east of Mountain Home, Idaho from August 19, 1992 to September 10, 1992. Land ownerships included private, state, BLM and Forest Service. The EWP project covered reseeding of 31,918 ac. (12917 ha.) of private and state land.

About 6400 ac. (2590 ha.) of this was drill seeded with the remainder aerially applied with a helicopter. Elevation ranges from 3500 ft. (1067 m.) to 6300 ft. (1920 m.) (USDA NRCS, Mountain Home Field Office). Average annual precipitation ranges from 11 in. (279 mm) to 27 in. (686 mm) at the highest elevations. Average annual air temperatures range from 40 to 50 degrees Fahrenheit (4-10 C). Potential natural vegetation ranges from Wyoming big sagebrush (*Artemisia tridentata var. wyomingensis*) with bluebunch wheatgrass (*Pseudoroegneria spicata ssp. spicata*) at the lower elevations and drier slopes to mountain big sagebrush (*Artemisia tridentata var. vaseyana*) with Idaho fescue (*Festuca idahoensis*) and bluebunch wheatgrass (*Pseudoroegneria spicata ssp. spicata*) at the higher elevations. At the highest elevations, there are scattered areas of forestland consisting mostly of Douglas fir (*Pseudotsuga menziesii),* mallow ninebark (*Physocarpus malvaceus*), white spirea (*Spiraea betulifolia*), and elk sedge (*Carex geyeri*). Pre-fire vegetation consisted of these species with some invaded cheatgrass (*Bromus tectorum)* and other annual weeds.

The topography is predominantly rolling to steep and very steep hills and mountains. Ridge tops, toe slopes, foothills and shoulders are often 10- 30 percent slopes. Slopes range from 20-70 percent on all aspects.

Some of the soils on foothills were formed dominantly in material weathered from rhyodacitic rock. Soils on mountains and foothills in the northern part of the area were formed in materials weathered from intermediate intrusive rock (granitic). There are small areas within the project where the soils were formed in loess, mixed alluvium, and material weathered from basalt.

Soil surface textures vary over the area. Large areas within the project area have surface textures of sandy loams to gravelly sandy loams. There are other large areas of loams, stony fine sandy loams and stony loams. There are small areas formed from residuum basalt that are silty clays (Noe 1991).

City Creek Fire started on August 30, 1987 at 1:30 p.m. with air temperatures of 90 degrees Fahrenheit (32 C) and winds of 15-35 mph (24-56 kph). It burned 2680 ac. (1085 ha.) of rangeland and forest adjacent to the City of Pocatello, Idaho. The fire burned on city, state, private, BLM, and Forest Service land. Elevation ranges from 5000 ft. to 6476 ft. (1524-1974 m.) (USDA NRCS, Pocatello Area Office). Average annual precipitation ranges from 12-17 in. (305-432 mm.) falling mostly as snow in the winter. Average annual air temperature ranges from 40 to 47 degrees Fahrenheit (4.4-8.3 C) from the lower to higher elevations. Potential natural vegetation within the EWP-treated area includes bluebunch wheatgrass (*Pseudoroegneria spicata ssp spicata*), Thurber needlegrass (*Stipa thurberiensis*), Wyoming big sagebrush (*Artemisia tridentata var. wyomingensis*) at lower elevations and mountain big sagebrush (*Artemisia tridentata var. vaseyana*) at the higher elevations and Utah juniper (*Juniperus utahensis*). Some north exposures have bigtooth maple (*Acer grandidentatum*), quaking aspen (*Populus tremuloides*), common chokecherry (*Prunus virginiana*) and mountain brome (*Bromus marginatus*). At the time of the burn there was some cheatgrass (*Bromus tectorum*), broom snakeweed (*Gutierrezia sarothrae*), rabbitbrush (*Chrysothamnus sp.),* Dyers woad (*Isatis tinctoria*), tumble mustard (*Sisybrium altissimum*) and thistle (*Cirsium sp.)* particularly at the lower elevations. Utah juniper encroachment had occurred on some sites.

The topography is moderately sloping foothills to steep and very steep mountainsides.

The soils are generally formed in alluvium, colluvium and residuum derived from loess or sedimentary or metasedimentary rock or quartzite. The soils are generally moderately deep to very deep.

Soil surface textures range from gravelly silt loams, silty loams, loams and stony loams (McGrath 1987).

Methods and Materials

On all study areas, a post-fire reconnaissance survey was completed immediately following control of the fire to determine acres burned, severity, location, land ownership and major plant associations by staff associated with EWP. An EWP project plan was then developed that included species to be seeded, methods, amounts and timing for application of seed. Seed purchase contracts were developed and contracts awarded. In some cases, the desired species or cultivars were not available and suitable substitutions were made. On all four-study areas the majority of the seed was applied using a helicopter. On three of the study areas, flatter slopes were seeded using a rangeland drill. All seeding was done in the fall, late October through mid-December. High quality seed was used in all cases. The files indicate that certified seed or better was used but complete documentation was not available. Seed tags indicate that there were no noxious weeds, germination was high and little inert matter was present.

The following tables summarize acres treated, methods, seed quality, species used, rates and timing by EWP project.

Table 1. Acres treated by method, rate and date of each study area (USDA NRCS Meridian and Mountain Home Field Offices, Pocatello Area Office, Anderson 1975)

Project	Broadcast Seeded (ac.)	Drill Seeded (ac.)	Rate PLS Lbs./ac.	Date Seeded	Mixture Reference	Notes
8th Street Fire	3312		10.5	11/27-12/2/96	1	
		1820	10.5	10/15-11/15/96	1	
Snow Basin Fire	4000	0	11.87 14.4 12.18	10/30-11/2/68	1 2 3	Pine-Sedge Pine-Mixed Fir Mixed Fir
Foothills Fire	25,456		11.7	Mid-November-Early Dec., 1992	1,2,3	
		6462	10	October 1992	1,2,3,4	
City Creek Fire	848		13.6	Nov.1-15/1987	1	
		390	10.2	Oct.15-Nov.15/1987	1	

Table 2. Species seeded, cultivar, origin, rate, percent germination, and percent of mix and certification status for Eighth Street Fire, Boise, ID (USDA NRCS Meridian Field Office)

Species seeded Common name	Scientific name	Cultivar	Origin	Rate Lbs./ac.	% Germination	% of mix	Certified Y/N
8th Street Fire Mixture 1							
Intermediate wheatgrass	Thinopyrum intermedium	Rush	ID	5 lbs.	95%	47	Y
Thickspike wheatgrass	Elymus lanceolatus	Bannock	ID	0.5 lbs.	87%	5	Y
Thickspike wheatgrass	Elymus lanceolatus	Critana	ID	1.5 lbs.	91%	14	Y
Slender wheatgrass	Elymus trachycaulus ssp. trachycaulus	Pryor	Canada	1.5 lbs.	96%	14	Y
Yellow blossom sweetclover	Melilotus officinalis		Canada	0.5 lbs.	92%	4	N
Small burnet	Sanguisorba minor	Delar	ID	1.5 lbs	90%	14	Y
Foothills big sagebrush*	Artemisia tridentata ssp. xericensis	Unk.**	Unk.	0.125 lbs.	Unk.	Unk.	N
Basin big sagebrush*	Artemisia tridentata ssp. tridentata	Unk.	Unk.	0.25 lbs.	Unk.	Unk.	N
Mountain big sagebrush*	Artemisia tridentata ssp. vaseyana	Unk.	Unk.	0.125 lbs.	Unk.	Unk.	N

* Seeded on state land only
**Unk. Is Unknown

Table 3. Species seeded, cultivar, origin, rate, percent germination, percent of mix, certified status of Snow Basin Fire, Wheeler County, OR (Anderson 1975)

Species seeded Common name	Scientific name	Cultivar	Origin	Rate Lbs./ac.	% Germination	% of mix	Certified Y/N
Snow Basin Fire* Pine-Sedge Mixture 1							
Big bluegrass	Poa secunda	Unk.	Unk.	2	Unk.	17	Unk.
Desert wheatgrass	Agropyron desertorum	Unk.	Unk.	7	Unk.	59	Unk.
Hard fescue	Festuca trachyphylla	Unk.	WA	1	90	8	N
Bitterbrush	Purshia tridentata	Unk.	Unk.	0.6	Unk.	5	Unk.
Lana vetch	Vicia villosa	Unk.	Unk.	0.32	Unk.	3	Unk.
Sainfoin	Onobrychis viciifolia	Unk.	Unk.	0.63	Unk.	5	Unk.
White clover	Trifolium repens	Unk.	Unk.	0.32	Unk.	3	Unk.
Pine-Mixed Fir Mixture 2							
Hard fescue	Festuca trachyphylla	Unk.	WA	1	90	7	N
Intermediate wheatgrass	Thinopyrum intermedium	Greenar	OR	8	85-94	56	N
Timothy	Phleum pratense	Climax	ID	1	85	7	N
White clover	Trifolium repens	Unk.	Unk.	1.6	Unk.	11	Unk.
Rose clover	T. hirtum	Unk.	Unk.	2.8	Unk.	19	Unk.
Mixed Fir Mixture 3							
Intermediate wheatgrass	Thinopyrum intermedium	Greenar	OR	5	85-94	41	N
Timothy	Phleum pratense	Climax	ID	1	85	8	N
Orchardgrass	Dactylis glomerata	Unk.	OR WA	4	92	33	N
White clover	Trifolium repens	Unk.	Unk.	0.38	Unk.	3	Unk.
Rose clover	T. hirtum	Unk.	Unk.	1.8	Unk.	15	Unk.

* Poison rodent bait and tree seed (Ponderosa pine and Douglas fir) was applied aerially on 800 ac. of the Mixed fir site.

Table 4. Species seeded, cultivar, origin, rate, percent germination, percent of mix, certified status of Foothills Fire, Mountain Home, ID (USDA NRCS Mountain Home Field Office)

Species seeded Common name	Scientific name	Cultivar	Origin	Rate Lbs./ac.	% Germination	% of mix	Certified Y/N
Foothills Fire							
Mix #1				11.7			
Crested wheatgrass	Agropyron cristatum	Hycrest and/or Fairway	Unk.		Unk.	58	Both
Intermediate wheatgrass	Thinopyrum intermedium	Greenleaf and/or Luna and/or Mandan	Unk.		Unk.	29	Both
Yellow sweetclover	Melilotus officinalis		Unk.		Unk	4	Y
Mix #2				11.7			
Crested wheatgrass	Agropyron cristatum	Hycrest and/or Fairway	Unk.		Unk.	29	Both
Intermediate wheatgrass	Thinopyrum intermedium	Greenleaf and/or Luna and/or Mandan	Unk.		Unk.	60	Both
Yellow sweetclover	Melilotus officinalis		Unk.		Unk	4	Y
Mix #3				11.7			
Crested wheatgrass	Agropyron cristatum	Fairway	Unk.		Unk.	46	N
Intermediate wheatgrass	Thinopyrum intermedium	Luna	Unk.		Unk.	47	Both
Yellow sweetclover	Melilotus officinalis		Unk.		Unk.	4	Y
Mix #4				10			
Crested wheatgrass	Agropyron cristatum	Hycrest	Unk.		Unk.	21	Y
Intermediate wheatgrass	Thinopyrum intermedium	Greenar	Unk.		Unk.	9.5	Unk.
Intermediate wheatgrass	Thinopyrum intermedium	Oahe	Unk.		Unk.	21.7	N
Orchardgrass	Dactylis glomerata	Paiute	Unk.		Unk.	20.8	Unk.
Small burnet	Sanguisorba minor	Delar	Unk.		Unk.	6.4	Unk.
Alfalfa	Medicago sativa	Ladak	Unk.		Unk.	20.8	Unk

Table 5. Species seeded, cultivar, origin, rate, percent germination, and percent of mix and certification status of City Creek Fire, Pocatello, ID (USDA NRCS Pocatello Area Office)

Species seeded Common name	Scientific name	Cultivar	Origin	Rate lbs./ac.	% Germination	% of mix	Certified Y/N
City Creek Fire Mixture 1 *							
Siberian wheatgrass	Agropyron fragile	P-27	ID	1.3	96	12	Unk.
Intermediate wheatgrass	Thinopyrum intermedium	Greenar	ID	4.7	93	44	Unk.
Streambank wheatgrass	Elymus lanceolatus	Sodar	ID	1.2	91	11	Unk.
Lewis flax	Linum lewisii	Appar	ID	0.7	73	7	Unk.
Small burnet	Sanguisorba minor	Delar	ID	1.8	96	17	Unk.
Alfalfa	Medicago sativa	Ranger	ID	0.5	94	5	Unk.

* Antelope bitterbrush was seeded using a "Hansen Dribbler" mounted on tractor at a targeted rate of 3.0 lbs. per acre on acres that were drilled.

Post Seeding Monitoring

8th Street Fire

No post-seeding monitoring was found in the records for the 8th Street Fire.

Snow Basin Fire

Post-seeding monitoring on Snow Basin Fire was done from 1969 through 1972 (Anderson and Brooks, 1975). The methods are described below.

Herbage production for each site was determined at the end of the growing season by clipping plots 9.6 sq. ft. in size. No attempt was made to randomize. Two steel-staked belt transects 100 ft. long and 1 ft. wide were established on each site. Annual changes in native and seeded species and other items were documented by:

1) Counting the number of plants of each species in each transect and averaging the two transects.

2) Using the above data to compute the percent composition of each species in the plant community.

3) Estimating the percent ground cover of each plant species, mosses and lichens, litter and mulch, and the percent of bare ground in the vicinity of each transect. This procedure results in a total that exceeds 100% when all items are added together, as illustrated by Table 2, because bare ground occurs beneath the foliage of plants and the foliage of different species is often layered. It also reveals the dynamics of changes within a plant community with a minimum input of time and money and thereby adequately fulfilled the objective of this field study.

4) Rating each plant species according to its dominance in the physiognamy of the plant community in the immediate vicinity of each transect. A 5-digit system was used in which 5 represents the dominant species, 3 represents species that are common, and 1 represents species that are rare in the stand (Anderson and Poulton, 1958).

5) Counting the number of standing snags, by species, in each of the seven diameter classes having 2-inches through 12- inches + on plots 100 feet square in which each transect was the centerline.

6) Taking photos of each transect at the time data were recorded (Anderson 1975).

The authors concluded the following: A satisfactory vegetation cover was established by seeded grass the first year after seeding on all three sites, whereas natural re-vegetation did not provide satisfactory cover on an unseeded area within four years. Seeded legumes did not survive. Broadcasting tree seed was a failure. Seeded grasses suppressed development of some native shrubs. Herbage production on seeded areas was four times greater than unseeded areas.

Foothills Fire

There was a Master's Degree thesis written by Marlene Eno in 1996 for the Foothills Fire. She monitored plots in all vegetation zones and on north and south aspects for two growing seasons following seeding. Her analysis of success or failure was based on measurements of frequency, density, canopy cover and basal cover. Species diversity was also evaluated.

She concluded that Intermediate wheatgrass and alfalfa should continue to be seeded on both north and south aspects in the mountain big sagebrush vegetation type. She also concluded that Hycrest crested wheatgrass, Paiute orchardgrass, yellow sweetclover and small burnet should be re-considered based on low seeding success, within a burned mountain big sagebrush/bluebunch wheatgrass habitat type with a pre-fire community in mid to late seral successional stage. This conclusion is for the north and south aspect Loamy 300-400 mm. site. She also concluded that a better use of existing soils information would improve overall aerial seeding success.

City Creek Fire

The City Creek Fire, had a report prepared called "Final Report, Agreement Number ID910-CA8-07 entitled Post-fire Vegetation Development on Seeded and Unseeded Areas of the 1987 City Creek Burn, Pocatello, Idaho" July 1990 authored by Teresa D. Ratzlaff and Jay E. Anderson. The data collected for this report was used to complete a master's thesis by Teresa Ratzlaff.

They concluded "seeding of the benches burned by the City Creek Fire was unnecessary because of the abundance of fire-adapted perennial species present at the time of the fire." The benches include moderately sloping foothills. They also concluded "disturbance of the site by drilling increased the erosion potential and resulted in lower plant cover on the site during the first two post-fire seasons".

2002 Evaluation Methods

All four EWP seedings were visited in the summer of 2002. For each seeding, a reconnaissance survey was first completed to determine access and which soils/range sites were seeded. For three of the projects, 8th Street, Foothills and City Creek, it was determined that evaluation should be done on north, south and non-aspect sites. These three situations represented in excess of 90% of the treated areas. For Snow Basin, the previously read site locations, except one that could not be found, were evaluated.

Numerous procedures were used on all four fires to evaluate seeding effectiveness following each burn and seeding effort. The two Master's degrees that were written on City Creek and Foothills re-seeding efforts used very labor intensive vegetation measuring techniques on relatively small areas. Monitoring on Snow Basin used a belt transect to initially evaluate the seeding. It was decided that none of these procedures would adequately evaluate large areas that were seeded, measure success on different range sites and soils, or address the dynamics of the plant communities over time.

The selected procedure was to use the NRCS inventory write-up procedure with some minor modifications. Idaho NRCS ID-190-002, Range Condition (Ecological Rating) Forage Quality and Apparent Trend Worksheet was used. Intermountain Rangeland Consultants, LLC modified the form by adding Rangeland Health Indicators to the form.

An indeterminate plot was selected for each site and treatment to be evaluated. A uniform, representative area was selected for the plot. Data gathered includes: range site, soil mapping unit where available, plant species present, estimated total annual production in pounds by species, apparent trend, percent slope, aspect, percent cover for vascular plants, litter and bare ground and up to seventeen of the rangeland health indicators as appropriate for the situation. See exhibit A.

A total of 54 write-ups were completed. At least two write-ups were completed for each site and treatment, where possible, including controls (not seeded). In some cases controls could not be found due to the completeness of the seeding effort. See Appendix 2.

Results

Tables 6-9 arrays the data collected in the field for each EWP project.

Tables 10-13 summarizes the data from Tables 6-9 by averaging values by treatment and range site or aspect.

Table 6. Field Data for 8th Street Fire

									% Composition			
Write-up Number	Seeding method 1/	Range site	Aspect/ % slope	Total lbs/ac.	% bare ground	% litter	% cover vascular plants	Number of species/ # perennials	Grass	Forb	Shrub	Lbs./acre seeded species present
G-9	A	North slope loamy 12-16	North/ 45	765	10	40	60	18/13	44	56	Trace	Int. whgr. trace small burnet trace
F-9	A	North slope loamy 12-16	North/ 30	1330	10	60	40	21/14	39	57	4	Int.whgr.20 Cr. whgr. trace Bitterbrush 20
G-6	A	South slope loamy 12-16	South/ 25	485	20	45	40	17/9	71	27	2	0
G-7	A	South slope loamy 12-16	South/ 50	375	50	25	20	15/9	80	7	13	Int. whgr. 10
F-4	A	South slope loamy 12-16	So. 15	615	30	20	30	12/7	76	22	2	Int. whgr. 150 Bitterbrush 15
G-8	A	Loamy 12-16	Non-aspect< 2	653	10	40	60	22/12	81	17	2	Int. whgr. 20 Small burnet 3 Bitterbrush 5
F-12	A	Loamy 12-16	Non aspect < 5	455	30	30	50	16/13	77	21	2	Int. whgr.10 Bitterbrush 10
G-3	D	North slope loamy 12-16	North/ 20	1180	5	65	45	11/6	98	1	< 1	Int. whgr.1100 Small burnet 5 Bitterbrush 5
F-2	D	North slope loamy 12-16	North/ 15	485	10	20	60	17/10	55	33	12	Int. whgr. 25, Small burnet 10 Bitterbrush 20
G-1	D	South slope loamy 12-16	South/ 20	950	15	50	45	12/5	63	37	T	Int. whgr.125 Small burnet 15
F-6	D	South slope loamy 12-16	South/ 15	1120	10	30	40	12/7	95	4	1	Int. whgr. 400 Small burnet trace
F-11	D	South slope loamy 12-16	South/ 12	550	10	50	30	10/4	35	65	Trace	Int. whgr.125
G-2	D	Loamy 12-16	Non-aspect < 5	1122	10	50	45	12/6	93	7	T	Int. whgr. 900 Small burnet 12
F-3	D	Loamy 12-16	Non-aspect 5	465	20	50	25	11/4	32	68	0	Int. whgr20 Sweet clover 10
F-13	D	Loamy 12-16	Non- aspect < 2	745	10	10	70	11/6	74	10	1	Int. whgr. 200
G-4	C	North slope loamy 12-16	North/ 30	650	5	60	40	11/7	98	2	T	0

F-1	C	North slope loamy 12-16	North/ 65	1055	20	30	50	8/6	50	50	None	0
F-7	C	North slope loamy 12-16	North/ 50	575	5	30	30	11/10	89	5	6	0
G-5	C	Stony South 12-16	South/ 30	490	20	40	40	16/8	83	16	1	0
F-8	C	Loamy 12-16	Non-aspect 5	650	5	30	30	13/9	82	10	8	0
F-10	C	Loamy 12-16	Non-aspect< 5	950	10	20	20	12/9	74	8	18	0

Table 7. Field Data for Snow Basin Fire

										% Composition			
Write-up No.	Seeding method 1/	Range site	Soil depth/texture	Aspect/ % slope	Total lbs/ac.	% bare ground	% litter	% cover vascular plants	Number of species/# perennials	Grass	Forb	Shrub	Lbs./acre seeded species present
I-1	A	Pine-sedge		South 8%	812	20	50	47	24/19	63	0.6	37	Hard fescue 500 Bitterbrush 20
I-2	A	Pine-sedge		SE/5-8	768	15	45	50	21/16	84	0.7	16	Hard fescue 600 Int. whgr. 10 Crest. whgr. Trace Bitterbrush 10
II-4	A	Pine-Fir		South/10-15	1647	25	50	37	15/10	96	0.06	4	Int. whgr. 1500 Hard fescue 75
II-5	A	Pine-Fir		Non-aspect/7	405	10	75	44	17/16	72	1.2	27	Int. whgr. 250 Hard fescue 25
III-6	A	Mixed Fir		Non-aspect/10	458	8	65	10	22/15	72	4	24	Int. whgr. 200 Timothy 1 Orchardgrass Trace
III-7	A	Mixed Fir		Non-aspect/10	456	10	50	58	22/20	56	6	40	Int. whgr. 250

Table 8. Field Data for Foothills Fire

									% Composition			
Write-up No.	Seeding method 1/	Range site	Aspect/ % slope	Total lbs/ac.	% bare ground	% litter	% cover vascular plants	Number of species/# perennials	Grass	Forb	Shrub	Lbs./acre seeded species present
F-2	A	North slope	North/40	1150	T	70	40	11/10	80	13	7	Int. whgr. 600 Cr. whgr. 100
G-2	A	North slope	North/55	715	10	25	50	16/15	90	2	8	Int. whgr. 450 Cr. whgr. 100
G-6	A	North slope	North/45	1760	T	45	75	20/15	88	8	4	Int. whgr. 1400 Cr. whgr. 75
F-4	A	South slope	South/25	385	20	20	30	11/9	47	4	49	Int. whgr. 125 Cr. whgr. Trace
G-1	A	South slope	South/45	480	45	10	30	20/15	75	3	22	Int. whgr. 75 Cr. whgr. Trace
F-3	A	Loamy 12-16	Non-aspect/3	450	10	20	40	11/11	28	27	45	Int. whgr. 25
F-5	A	Loamy 12-16	Non-aspect/3	595	20	25	35	16/13	63	8	29	Int. whgr. 300 Cr. whgr. 50
F-10	D	North slope	North/20	1425	0	90	40	10/10	61	28	11	Int. whgr. 800 Cr. whgr. 75
G-5	D	North slope	North/20	1005	5	35	70	16/14	75	24	1	Int. whgr. 375 Cr. whgr. 150
F-8	D	South slope	South/10	1025	<5	50	50	13/11	47	51	2	Int. whgr. 35 Cr. whgs. 150
G-4	D	South slope	South/15	855	20	35	60	12/11	52	19	29	Int. whgs. 370 Cr. whgs. 25
F-9	D	Loamy 12-16	Non-aspect/1	1585	<5	40	60	15/10	87	12	1	Int. whgs. 1200 Cr. whgs. 20
G-3	D	Loamy 12-16	Non-aspect/10	1315	2	40	70	13/9	90	10	T	Int. whgs. 900 Cr. whgs. 75
F-1	C	North slope	North/55	555	20	30	35	15/15	78	7	15	0
F-7	C	South slope	South/25	420	20	10	30	10/8	49	11	40	0
F-6	C	Loamy 12-16	Non-aspect/3	725	10	20	40	12/10	31	39	30	0

Table 9. Field Data for City Creek Fire

									% Composition			
Write-up No.	Seeding method 1/	Range site	Aspect/ % slope	Total lbs/ac.	% bare ground	% litter	% cover vascular plants	Number of species/# perennials	Grass	Forb	Shrub	Lbs./acre seeded species present
G-2	A	Steep slopes 16-22	North/55	1345	8	40	65	25/23	46	43	11	P-27 200 Int. whgr. 5
F-2	A	Steep slopes 16-22	North/60	2040	5	70	40	31/27	90	6	4	Int. whgr. 1700 Cr. whgs. 5 P-27 5
F-4	A	Steep slopes 16-22	North/55	2080	10	30	75	11/11	55	44	1	Int. whgr. 900
G-3	A	Steep slopes 16-22	South/40	878	5	35	40	23/16	43	56	1	0
F-3	A	Steep slopes 16-22	South/45	1305	10	35	35	15/8	79	18	3	Int. whgr. 800
F-1	A*	Loamy 12-16	Non-aspect/10	2749	10	60	50	22/17	95	5	Trace	Int. whgr. Luna2000 Greenar 500
F-5	A	Loamy 12-16	Non-aspect/10	826	10	40	40	28/26	79	8	13	P-27 80 Cr. whgr. 20 Int. whgr. 120
G-1	D	Loamy 12-16	Non-aspect/10	1890	<5	75	50	29/26	81	13	6	Int. whgr. Luna 1350 Greenar 150 P-27 10 Alfalfa T
G-5	D	Loamy 12-16	Non - aspect/10	2435	<5	65	60	23/21	80	13	7	Int. whgr. Luna 1600 Greenar 200 P-27 60
G-4	C	Loamy 12-16	Non-aspect/10	1125	<5	45	65	28/22	28	42	30	Cr. whgr. 15 Int. whgr. 5
F-6	C	Loamy 12-16	Non-aspect/15	815	15	55	40	28/26	51	18	31	0

* Area chiseled prior to aerial seeding

1/ A = Aerial application
D = Drill seeded
C = Control (not seeded)

Table 10. Average Field Data Values for 8th Street Fire

									% Composition			
Aspect	Seeding method 1/	Range site	% slope	Total lbs./ac	% bare ground	% litter	% cover vascular plants	Number of species/# perennials	Grass	Forbs	Shrubs	Lbs./ac. seeded species present
North	A	North slope loamy 12-16	30-45	1047	10	50	50	20/13	42	56	2	Int. whgr. 10 Bitterbrush 10
South	A	South slope loamy 12-16	15-50	492	34	30	30	15/8	76	19	6	Int. whgr. 53 Bitterbrush 5
Non-aspect	A	Loamy 12-16	2-5	554	20	35	55	19/12	79	19	2	Int. whgr. 15 bitterbrush 8
North	D	North slope loamy 12-16	15-20	832	7	43	52	14/8	77	17	7	Int. whgr. 562 Small burnet 7 Bitterbrush 12
South	D	South slope loamy 12-16	12-15	873	12	43	38	11/6	63	35	T	Int. whgr. 175
Non-aspect	D	Loamy12-16	2-8	725	17	32	45	11/6	73	22	1	Int. whgr.324 Small burnet 3 Bitterbrush 2
North	C	North slope loamy 12-16	30-65	750	10	40	40	10/8	79	19	2	0
Non-aspect	C	Loamy 12-16	5	800	8	25	25	13/9	78	9	13	0
South	C	South slope loamy 12-16	30	490	20	40	40	16/8	83	16	1	0

Table 11. Average Field Data Values for Snow Basin Fire

								% Composition			
Seeding method 1/	Range site	Aspect/ % slope	Total lbs/ac.	% bare ground	% litter	% cover vascular plants	Number of species/# perennials	Grass	Forb	Shrub	Lbs./acre seeded species present
A	Pine-sedge	South /7	790	17	48	48	23/17	74	0.6	26	Hard fescue 550 Int. whgr. 5 Cr. whgr. trace Bitterbrush 15
A	Pine-Fir	South/10	1026	17	62	41	16/13	84	.63	15	Int. whgr. 875 Hard fescue 50
A	Mixed Fir	Non-aspect/10	457	17	57	34	22/18	64	5	32	Int. whgr. 225 Timothy 1 Orchardgrass trace

Table 12. Average Field Data Values for Foothills Fire

									% Composition			
Aspect	Seeding method 1/	Range site	% slope	Total lbs/ac.	% bare ground	% litter	% cover vascular plants	Number of species/# perennials	Grass	Forb	Shrub	Lbs./acre seeded species present
North	A	North slope loamy 12-16	North/47	1208	3	47	55	16/13	86	8	6	Int. whgr. 817 Cr. whgr. 92
South	A	South slope loamy 12-16	South/35	433	33	15	30	16/12	61	4	36	Int. whgr. 100 Cr. whgr. trace
Non-aspect	A	Loamy 12-16	Non-aspect <5	523	15	23	38	14/12	46	18	37	Int. whgr. 163 Cr. whgr. 25
North	D	North slope loamy 12-16	North/20	1215	3	63	55	13/12	68	26	6	Int. whgr. 588 Cr. whgr. 113
South	D	South slope loamy 12-16	South/13	940	10	43	55	13/11	50	35	16	Int. whgr. 203 Cr. whgr. 88
Non-aspect	D	Loamy 12-16	Non-aspect/5	1450	1	40	65	14/10	89	11	1	Int. whgr. 1050 Cr. whgr. 48
North control x	C	North slope loamy 12-16	North/55	555	20	30	35	15/15	78	7	15	0
South control x	C	South slope loamy 12-16	South/25	420	20	10	30	10/8	49	11	40	0
Non-aspect x	C	Loamy 12-16	Non-aspect<5	725	10	20	40	12/10	31	39	30	0

X not an average-one plot only

Table 13. Average Field Data Values for City Creek Fire

									% Composition			
Aspect	Seeding method 1/	Range site	% slope	Total lbs/ac.	% bare ground	% litter	% cover vascular plants	Number of species/# perennials	Grass	Forb	Shrub	Lbs./acre seeded species present
North	A	Steep slopes 16-22	North/57	1822	8	47	60	22/20	64	31	5	Int. whgr.868 P27 68 Cr. whgr. 2
South	A	Steep slopes 16-22	South/43	1092	8	35	38	19/12	61	37	2	Int. whgr. 400
Non-aspect	A	Loamy 12-16	Non-aspect 10	1788	10	50	45	25/22	87	7	7	Int. whgr. 1310 P27 40 Cr. whgr. 10
Non-aspect	D	Loamy 12-16	Non-aspect 10	2163	<5	70	55	26/24	81	13	7	Int. whgr. 1656 P27 35
Non-aspect	C	Loamy 12-16	Non-aspect/13	970	8	50	53	28/24	40	30	31	Int. whgr. 3 Cr. whgr. 8

1/ A = aerial seeding application
D = drill seeded
C = control (not seeded)

Interpretations and Analysis

The results of the field inventory are summarized in the following tables. The following criteria were developed in order to interpret and analyze the field data. The values are admittedly subjective but the author's felt that the following criteria adequately analyzes and interprets the wide array of data gathered from the field.

Criteria for value ratings:

Seeding Success:

A successful seeding on north slope and non-aspect sites of seeded species is greater than 300 lbs./ac.
A successful seeding on south slope sites is greater than 100 lbs./ac. of seeded species.

Species richness is the total number of species (seeded and unseeded), number of perennials and relative composition.

High species richness has more than 20 species in the plant community, more than 15 perennials and a composition of grasses greater than 70%, forbs greater than 15% and shrubs greater than 10%.
Medium species richness has 15-19 total species, 8-14 perennials and a composition of 40-70% grasses, forbs less than 30% and 4-9% shrubs.
Low species richness has less than 15 total species, less than 8 perennials and a composition of less than 40% grasses, greater than 30% forbs and less than 3% shrubs.

Forage Value was determined by using a 25% harvest efficiency multiplied by total pounds per acre annual production.

High forage value is greater than 200 lbs./ac.
Medium forage value is 100-199 lbs./ac.
Low forage value is less than 100 lbs./ac.

Cover Value is derived from estimated total vascular plant cover.

Good cover value is greater than 45%.
Fair cover value is 30-44%.
Poor cover value is less than 30%.

Watershed value is derived by adding total vascular plant cover, litter percentage and a factor for bare ground.

High watershed value is total vascular plant and litter cover greater than 80% and bare ground less than 15%.
Medium watershed value is total vascular plant and litter cover between 60-79% and bare ground less than 25%.
Low watershed value is total vascular plant and litter cover less than 60% and bare ground greater than 25%.

Big game wildlife habitat value uses values already determined for cover, species richness, forage and percent composition of shrubs.

High big game wildlife habitat value has a medium to high forage value, medium to high species richness, good cover, and the composition of shrubs greater than 10%.
Medium big game wildlife habitat value has a medium forage value, medium species richness, fair cover, and the composition of shrubs is 5-9%.
Low big game wildlife habitat value has a low forage value, low species richness, poor to fair cover, and the composition of shrubs is less than 5%.

Future fire resistance was a value that was reviewed and rated. It was determined that all the seedings have a high resistance to future fires due to the extended green period of the successfully seeded species. Therefore the ratings were not included in the tables.

Table 14. Summary of Seeding Success

Fire	Aspect	Seeding success-drilled	Seeding success-aerial
8th Street	North	--	No
	South	--	No
	Non-aspect	--	No
	North	Yes	--
	South	Yes	--
	Non-aspect	Yes	--
Snow Basin	Pine-sedge	--	Yes
	Pine-mixed fir	--	Yes
	Mixed fir	---	Yes
Foothills	North	--	Yes
	South	--	Yes
	Non-aspect	--	No
	North	Yes	--
	South	Yes	--
	Non-aspect	Yes	--
City Creek	North	--	Yes
	South	--	Yes
	Non-aspect	--	Yes
	Non-aspect	Yes	--

Table 15. Summary of values for unsuccessful seedings

Fire	Aspect or Site	Method	Species richness	Forage value	Cover value	Watershed value	Wildlife habitat value
8th Street	North	Aerial	Low	High	Good	High	Low
	South	Aerial	Medium	Medium	Poor	Low	Low
	Non-aspect	Aerial	Low	Medium	Good	Medium	Low
Foothills	Non-aspect	Aerial	Low	Medium	Fair	Medium	Low

Note: No unsuccessful seedings were found at City Creek or Snow Basin.

Table 16. Summary of values for successful seedings

Fire	Aspect or Site	Method	Species richness	Forage value	Cover value	Watershed value	Wildlife habitat value
8th Street	North	Drilled	Low	High	Good	High	Low
	South	Drilled	Low	High	Fair	High	Low
	Non-aspect	Drilled	Low	Medium	Good	Medium	Low
Snow Basin	Pine-sedge	Aerial	Medium	Medium	Good	Medium	Medium
	Pine-mix. Fir	Aerial	Medium	High	Fair	Medium	Medium
	Mix. fir	Aerial	Medium	Medium	Fair	Medium	Medium
Foothills	North	Aerial	Medium	High	Good	High	Medium
	South	Aerial	Medium	Medium	Fair	Low	Medium
	North	Drilled	Low	High	Good	High	Low
	South	Drilled	Low	High	Good	High	Low
	Non-aspect	Drilled	Low	High	Good	High	Low
City Creek	North	Aerial	Medium	High	Good	High	Medium
	South	Aerial	Low	High	Fair	Medium	Low
	Non-aspect	Aerial	Medium	High	Fair	High	Medium
	Non-aspect	Drilled	Medium	High	Good	High	Medium

Table 17. Summary of values for controls.

Fire	Aspect or Site	Method	Species richness	Forage value	Cover value	Watershed value	Wildlife habitat value
8th Street	North	NA	Low	Medium	Fair	High	Low
	South	NA	Low	Medium	Fair	Medium	Low
	Non-aspect	NA	Low	High	Poor	Medium	Low
Foothills	North	NA	Medium	Medium	Fair	Medium	Low
	South	NA	Low	Medium	Fair	Low	Low
	Non-aspect	NA	Low	Medium	Fair	Medium	Low
City Creek	Non-aspect	NA	Medium	High	Good	High	Medium

Note: No controls were found at Snow Basin.

Weather Data

The following tables give monthly precipitation for the water year (October to June) for the nearest weather station for each of the EWP seedings. Figures are in inches.

Tables compare long-term average precipitation by month to monthly precipitation the first year following seeding.

Green indicates above average precipitation for the period.

8th Street Fire
Boise Airport – Monthly Precipitation Means
Period of Record: 1/1/1940 to 12/31/2001.

Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	Total
.79	1.35	1.36	1.44	1.16	1.23	1.21	1.28	.89	10.71

Data for water year 1996-1997

Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	Total
1.03	1.3	3.38	2.1	.30	.39	.90	.43	.21	10.04

The official weather station is located on the Boise River valley floor approximately four miles from the seeding. The seeding is on the foothills of the Boise Front at a higher elevation. Monthly precipitation is likely higher than the official weather station but it is assumed that the weather patterns are similar.

Foothills Fire
Mountain Home—Monthly Precipitation Means
Period of Record: 8/1/48 to 12/31/2001

Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	Total
.63	1.20	1.28	1.38	.90	1.08	.84	.90	.76	8.97

Total monthly precipitation for water year 1992-1993

Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	Total
.90	1.37	.89	1.65	.96	2.45	2.09	2.10	.52	12.93

The official weather station at Mountain Home is located approximately 10-15 miles from the seeding. The seeding is in the foothills at a higher elevation than the weather station. Monthly precipitation is likely higher than the official station but it is assumed that the weather patterns are similar.

City Creek Fire
Pocatello Airport—Monthly Precipitation Means
Period of Record: 1/3/1939 to 12/31/2001

Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	Total
.87	1.07	1.04	1.11	.92	1.21	1.11	1.36	1.07	9.76

Data for water year 1987-1988

Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	Total
.25	.44	1.21	1.06	.21	.83	.97	.78	.37	6.12

The official weather station at Pocatello is located approximately 8-10 miles from the seeding. The seeding is in the foothills at a higher elevation than the weather station. Monthly precipitation is likely higher than the official station but it is assumed that the weather patterns are similar.

Snow Basin Fire
Fossil—Monthly Precipitation Means
Period of Record: 1961-1990 and 1971-2000. The reason for two sets of weather data is unknown.

Record period	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	Total
1961-1990	1.16	1.92	1.80	1.66	1.23	1.34	1.41	1.27	1.03	12.82
1971-2000	1.33	1.77	1.57	1.50	1.27	1.49	1.42	1.66	1.11	13.12

Data for water year 1967-1968

Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	Total
1.10	.86	1.20	1.10	1.25*	.64	.21	1.31	1.07*	8.74

* monthly data not available. Values shown are the average of the two figures in previous table.

The official weather stations at Fossil are located approximately 20-30 miles from the seeding. The seeding is in the mountains at a much higher elevation than the weather stations. Monthly precipitation is undoubtedly higher than the official stations.

Conclusions

The following species were seeded but not found during the inventory process:
8th Street: Thickspike wheatgrass, Slender wheatgrass and Yellow sweetclover.
Snow Basin: Big bluegrass, Lana vetch, Sainfoin, White clover and Rose clover.
Foothills: Yellow sweetclover and Alfalfa.
City Creek: Lewis flax and Small burnet.
In conclusion, these species are apparently not well adapted to the site, there was no initial establishment, they established but did not persist or they do not compete well with other established species.

Intermediate wheatgrass, where seeded, has become established and has persisted. Hard fescue was seeded on one site in Snow Basin. It has become the dominant grass species on that site. All other seeded species that were recorded during the inventory were found in relatively minor amounts.

All four EWP seedings that were evaluated had some degree of success. All drill seeding was successful on north, south and non-aspect sites. Mixed success was obtained by aerial seeding regardless of aspect. Observations during the inventory suggest that aerial seeding success is higher on concave slopes and where shrubs had a high density before burning. This is probably due to heavier ash accumulation, better coverage of the seed and more effective precipitation in the concave locations. These areas probably burned hotter and resulted in a greater reduction of understory competition the first growing season.

The water year immediately following the fire was compared to long-term averages of the nearest official weather station for each seeding. Below average monthly precipitation for the water year and during the growing season appeared to have no effect on the long-term success of City Creek and Snow Basin seedings. Below average precipitation during the first growing season on the 8th Street Fire resulted in very poor establishment of the aerial seeding. Drill seeding success on 8th Street fire is probably due to the above average fall and winter precipitation that occurred before and after seeding. Above average precipitation during the spring of the first growing season unquestionably influenced the success of Foothills seeding.

Aerial seeding of tree species on the Snow Basin fire was a failure. Direct tree planting of seedlings was partially successful and repeated attempts have been made. Intermediate wheatgrass is retarding Ponderosa pine regeneration and re-establishment by hand planting.

The 8th Street fire area had burned prior to 1996. The number of shrubs was probably already low at the time of this fire. This reduced the amount of ash on the ground, thus reducing soil/ash covering of aerially applied seed. This and the below average spring precipitation may be the causes of the aerial seeding failures.

Successful seedings are generally higher in values for all categories i.e. species richness, forage, cover, watershed and wildlife.

Unsuccessful seedings are generally no better than controls in all categories.

Results or values for cover and watershed on unsuccessful seedings are mixed and inconclusive.

Species richness and wildlife habitat values rated low to medium on successful seedings. Unsuccessful seedings and controls were generally low in species richness. Species richness and wildlife habitat values are inconclusive regardless of aspect and seeding method.

Successful seedings were generally high or good in forage, cover and wildlife values. North slopes were generally higher in forage, cover and wildlife values than south slopes and non-aspect sites. Controls were generally medium or fair in these values.

Where post-fire restoration or rehabilitation objectives are improved watershed and livestock forage, the seeding rates used for these EWP seedings would be appropriate.

Where species richness needs improvement due to pre-fire dominance of annuals and/or weedy species, seeding of native species would be beneficial.

Where natural regeneration of native species, particularly shrubs, is a major objective, EWP seeding rates of introduced sod-forming species need to be reduced. If an increase in native shrubs is an objective, a better effort is needed to seed or plant shrubs or use less competitive grass species.

Introduced species were the dominant seeded species on these fires. An observation during field data collection indicated that native Big bluegrass was successfully aerially seeded on BLM land and added to species diversity. Big bluegrass should be considered as a mixture component in future watershed protection seedings.

Foothills and City Creek seedings are suppressing native plant succession, especially shrubs. In those areas where intermediate wheatgrass was seeded and is rated successful, it is the dominant species in the plant community. Little shrub recruitment is occurring. In these areas, low species richness and low big game wildlife habitat values were recorded. In Snow Basin, Hard fescue and Intermediate wheatgrass are retarding Ponderosa pine regeneration.

Intermediate wheatgrass, Crested wheatgrass and Hard fescue have an extended green period compared to most native species and therefore are resistant to future fires.

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TECHNICAL NOTES

USDA-Natural Resources Conservation Service
Boise, Idaho

TN PLANT MATERIALS NO. 36 **May 2004**

OPTIMIZE FORAGE QUALITY BY AFTERNOON HARVESTING

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OPTIMIZE FORAGE QUALITY BY AFTERNOON HARVESTING

H.F. Mayland
http://kimberly.ars.usda.gov

This note summarizes new research supporting advantage of afternoon harvesting of forages. It was prepared as a handout for producer meetings. It is cryptic by design. More in-depth information may be obtained by viewing the WEBB PAGE or contacting the author. Many scientists have contributed to these findings and credits are so noted. Photocopying of this note is permissible.

- Plants accumulate sugars during the day and use them up at night. This causes a diurnal cycling of forage sugars and overall quality (Fig. 1). Cutting forage during late afternoon (PM) captures much of the extra sugar, causing the afternoon cut hay to have higher feed value than morning-cut hay (AM) (Mayland et al., 1998 and Fisher et al. 1999, in press).

- Total digestible nutrients are likely higher, and ADF and NDF are lower in afternoon than morning cut hay (Fisher et al. 1999, in press).

- Cattle, sheep and goats have a strong preference for afternoon-cut hay compared with morning-cut hay. Animals also eat more PM- than AM-cut hay and consume more nutrients (Fisher et al., 1998 & 1999).

- Dairy cows will eat about 8% more *(ad lib)* TMR containing 40% PM-cut alfalfa hay than one containing *(ad lib)* AM-cut alfalfa hay and will produce about 8 % more milk (Kim, 1995). Adjusting schedules to cut hay in afternoon and early evening can increase feed value of hay as much as 15%.

- Green-chopped alfalfa cut in the afternoon will have more feed value and is relished more by cows than if cut in the morning (Mayland, unpublished).

- When making silage from alfalfa or clover hay, one can enhance the fermentation process by cutting the hay in the afternoon compared to cutting in the morning (Owens, 1996).

- Increased sugars in afternoon- vs. morning-cut hay dilute the ADF and NDF values. Measuring these small changes in ADF or NDF may not be precise enough to measure increased benefits of afternoon harvested hay. Sugar methodology is needed that could be adapted to routine forage testing. Afternoon vs. morning-cut hay may have an additional 10 to 30 relative feed value (RFV) units (Mayland et al., 1998).

- Grazing animals eat more grass and clover in afternoon than morning. Animal behavior is related to increases in soluble carbohydrates (Orr et al., 1997).

- Dairy cows foraging pastures under 24-h strip grazing management produced 8% more milk when the fence was moved at 4 PM vs. 6 AM. (Orr et al., 1998).

- Increased sugars in afternoon forage may explain increased bite counts in afternoon vs. morning grazing.

- The daily increase in forage sugars may follow similar patterns among varieties. High referenced or digestible varieties may have higher sugar levels than low referenced or low digestible ones (Shewmaker et al. 1999). Breeders are encouraged to add some measure of soluble sugars to their selection criterion.

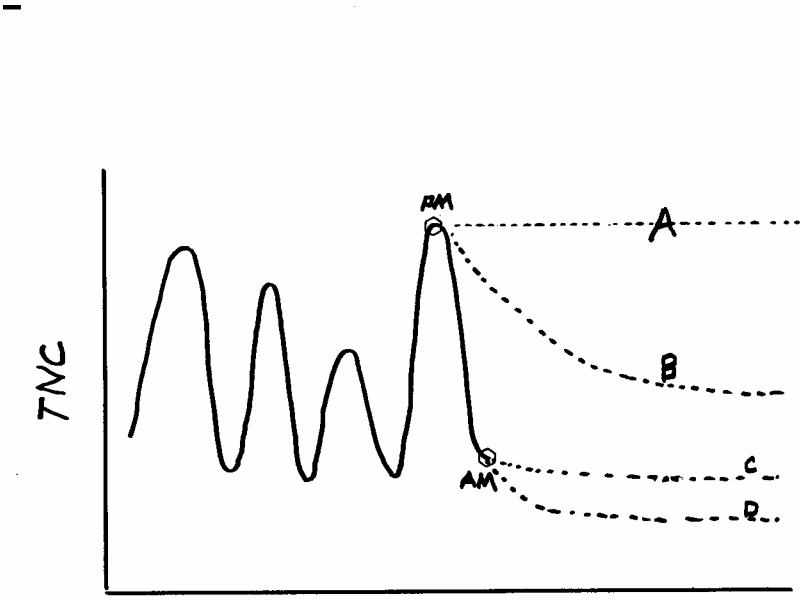

Figure 1. Example of diurnal cycling of sugar levels in green forages showing higher concentrations in mid- to late afternoon. Cutting in afternoon captures these higher levels. Rapid drying of hay preserves more sugars (A/C) than will slow drying (B/D).

Table 1. Intake and composition of alfalfa hays used in preference experiment with cattle. Fisher et al. (*in press)*

Hay Harvest	ADF	NDF	TNC	Intake
	---------- % ----------			g/meal
Afternoon - 8 July	31.0	40.8	4.32	1022
Morning - 9 July	32.6	42.9	3.62	842
Afternoon - 14 Aug	32.1	41.5	5.00	619
Morning - 15 Aug	32.7	43.0	3.53	324
Afternoon - 22 Sept	27.9	36.4	6.65	1320
Morning - 23 Sept	28.7	37.4	5.43	1107
Afternoon average	**30.3**	**39.6**	**5.32**	**987**
Morning average	31.3	41.1	4.19	758

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TECHNICAL NOTE

USDA-Natural Resources Conservation Service
Boise, Idaho

TN PLANT MATERIALS NO. 42 **DECEMBER 2003**

Willow Clump Plantings

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Excavator moving a harvested willow clump to planting site on Mary Jane Creek, Manitou, Manitoba, Canada in 2000.

Willow Clump Plantings

J. Chris Hoag, Wetland Plant Ecologist, Plant Materials Center, Aberdeen, Idaho

Introduction:

Willow clump plantings are a streambank soil bioengineering technique that can be used when large stands of willows are available in the project site area. This Streambank Soil Bioengineering technique harvests an entire live willow clump including the above ground stems and roots. This method unlike pole cuttings, already has part of the root system present, so the willow doesn't need to grow as many new roots from scratch. This results in a significant advantage for the plant in terms of shortened establishment period, lower failure rate and faster protection of the problem site.

Another principle that makes this technique desirable is that willows are depositional plants. Willows generally grow in riparian areas and on flood plains that commonly receive sediment from upstream sources. Some of this sediment deposits around the stems when stream flows bring high sediment laidened water that flows through the willow stems, slowing flow velocity and thus dropping sediment.

Willow stem collars (where the stem meets the root material), unlike conifers for example, do not need to be at the soil surface or slightly below the soils surface in order for the plant to survive. When sediment is dropped out of the water column, it accumulates around the stem. As the stems are covered with sediment, the root buds in the stem swell and start to sprout roots. This is one way willows increase their root mass. This also results in more stems and leaves. This ability to adapt to sediment deposition makes willow clump plantings a great Streambank Soil Bioengineering technique especially on channel reconstruction projects, for stabilizing outside meanders, areas where cuttings are difficult to plant, and where soil conditions such as saturation or very fine soils make it difficult for willow cuttings to establish new roots.

Willow clump harvesting and planting methods

- This method should only be used where willows cover extensive areas of the floodplain or meadow areas. In addition, the willow stand should show good regeneration over the area.

- Locate willow clumps that are young and vigorous, about 8-20 feet tall, and about the diameter of the backhoe bucket. Dig straight down and under to the willow clump root mass. Start the hole about 10 inches away from the stems and dig down about the depth of the bucket (approximately 2 feet). Try to get about 70% of the root mass.

- If the planting site is close to the willow clump source, dig the clump and travel to the planting site with it in the bucket. Try to keep as much soil as possible around the root mass.

- If the planting site is a long distance from the harvest site, dig as many willow clumps as you can fit on a flatbed trailer and replant within one hour. Do not allow the clumps to dry out significantly. Transport the clumps to the planting site on the trailer. If it is sunny and hot, consider temporarily tarping the clumps to reduce sun exposure and potential drying during transport. Water the willow clumps when they have arrived at the planting if it will some time before clumps can be planted. Avoid leaving the clumps for long periods in the sun.

- Dig the clumps about 15- 20 feet apart in areas that have lots of willows. Do not harvest willows from critical locations that would be prone to future erosion. The hole that the willow was removed from should be refilled with local, good quality soil materials from off-site locations. Pack the soil firmly in the excavated hole.

- Soil conditions will vary from site to site. In some situations, you will be able to plant the clumps without pre-digging the planting hole by pushing the soil out of the hole with the bottom of the backhoe bucket and then dropping the clump into this hole. Under more difficult soil conditions or where the watertable is deep, you will need to pre-dig the holes to put the willow clumps in. Dig the

holes deep enough so you are just above the standing watertable. Do not dig into the watertable. Ideally you want the root mass of the clump to be in the saturated moisture zone and not in the standing water zone. Dig a hole that is close to the diameter of the clumps. You want to have at least 4-5 feet of the willow stems sticking out of the ground when you are finished planting the clump.

- Pull the clumps off the trailer with a thumb on the backhoe or with the front-end bucket and drop them in the holes. Fill in the hole with soil and water. Muddy-in the willow clumps so there are no air pockets around the root mass.

- The last step is to take a set of loppers and cut off about one third to one half of the willow tops straight across. This decreases the amount of stem that the reduced root mass will have to support. It also stimulates a dense regrowth of stems and leaves that will speed up the photosynthesis process to grow additional roots, stems, and leaves and store energy in the root mass.

- Spacing between the willow clumps should be about 6-15 feet. This depends on the critical streamflow energy you are trying to protect against. If your harvest site does not have enough willows, change to a wider spacing. However, the wider the spacing, the more the potential stream energy can impact the bank area you are trying to protect.

This method is more successful than planting cuttings and more tolerant of droughty conditions.

You should always obtain permission to harvest clumps from the landowner or public land management agency. In addition, state and federal regulators should be consulted to obtain permits if required and to ensure that they concur with the practice.

Case Study Examples

Medicine Lodge Creek, ID

A serious bank erosion problem on the lower end of Medicine Lodge Creek about 15 miles West of Dubois, Idaho on the Jack Webster ranch was designed and treated with rock rip-rap, clumps, stream barbs, fascines, and a brush mattress by Bob Lehman, NRCS AE in 2000. This area is extremely dry and the riparian vegetation is limited to the wetted areas of the stream. The willow clump plantings established extremely well and helped to add aesthetics to the rock rip-rap as well as other functions like wildlife habitat, water quality improvement, and fish habitat.

Figure 1: Eroding bank on the Jack Webster Ranch, lower end of Medicine Lodge Creek about 15 miles West of Dubois, ID in March, 2000.

Figure 1: Willow clumps installed in rip-rap along the lower end of Medicine Lodge Creek about 15 miles West of Dubois, ID in August, 2000.

Figure 2: Willow clump planting on Medicine Lodge Creek after one growing season (August, 2001).

Irving Creek, ID

Irving Creek, a tributary of Medicine Lodge Creek about 25 miles West of Dubois, Idaho near the Montana border, had some major erosion problems because of an improperly installed culvert. The entire stream below the culvert was downcut and the willow community was dying because the watertable was well below the root mass. The steep banks were reshaped and willow clumps were placed at the toe of the bank. Large rocks were placed as toe rock in front of the clumps. The willow clumps were trimmed back so that about 1/3 of the stems remained. New growth was extensive and lush.

Figure 3: Steep cut bank on Irving Creek was being eroded away especially during high water periods. The landowner signed up for a NRCS program called Continuous CRP to restore the stream in exchange for fencing out the cows.

Figure 4: Willow clumps installed on Irving Creek, a tributary of Medicine Lodge Creek, about 25 miles West of Dubois, ID

Corral Creek, ID

Corral Creek, near Fairfield, Idaho in Camas County is a small stream that had major bank erosion. The landowner wanted to restore the willow community and protect adjacent grazing lands. A large willow community was located close to the project site and willow clumps were harvested and brought to the site where the backhoe placed the clump into the bank by pushing the soil out of the hole with the bottom of the backhoe bucket and then dropping the clump straight into the hole. Sod mats from adjacent locations were then placed above the willow clumps to the top of the bank. This was the first willow clump planting project by NRCS in the state of Idaho – installed in 1985.

Figure 5: Willow clump planting with sod mats on a streambank of Corral Creek near Fairfield, Camas County, ID

Figure 6: Corral Creek willow clump planting after a few years of growth. Note sediment deposition and grass growth between willows and stream – most of this deposition occurred the first year following planting as a result of the willow clumps, when above ground willow stems reduced the stream energy-flow rate on the outside meander resulting in sediment deposition in front of the willow clumps. This was quickly followed by natural revegetation of the sediment and permanent relocation of the low flow stream channel.

TECHNICAL NOTE

USDA-Natural Resources Conservation Service
Boise, Idaho – Bozeman, Montana

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PROPER INSTALLATION, MAINTENANCE, AND REMOVAL OF RIGID SEEDLING PROTECTOR TUBES

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Introduction: There are numerous types of seedling shelters or protectors used to prevent or minimize animal damage to recently planted tree and shrub seedlings. One type of seedling shelter is the rigid seedling protector tube, sometimes referred to by the specific brand name Vexar®. Improper installation of rigid seedling protector tubes may result in damage to the form and function of seedlings on which they are installed. Similarly, improper maintenance and untimely removal of the tube may result in branch deformation, structural weakness, or mortality. This Technical Note provides information on the proper installation, maintenance, and removal of rigid seedling protector tubes.

I. BACKGROUND: One method of reducing seedling damage from animal browsing and rubbing is the installation of seedling shelters. These products come in various designs, shapes, sizes, and construction materials. One type of seedling shelter that has proven effective in reducing animal damage to seedlings in the northern Great Plains and Rocky Mountains is the rigid seedling protector tube. These are cylindrical, open-mesh products that fit over a seedling and are supported by 1 or 2 tall stakes (FIGURE 1). They consist of flexible polyethylene and polypropylene (plastic) mesh with diamond-shaped openings, and often have an ultra-violet light inhibiting formulation (FIGURE 2). They are available in various sizes including 3.25- and 4.0-inch diameters, and 18-, 24-, 30-, and 36-inch lengths. They are effective in reducing browse damage to small seedlings from animals such as deer, elk, moose, rabbits, and large gophers. They do not exclude mice, voles, small gophers, or other rodents that are small enough to slip through mesh openings. Browsing of plant parts is possible once they protrude from the tube. Large animals have been observed biting and pulling tubes completely off seedlings, although they seldom continue this behavior if other sources of food are available nearby. Rigid seedling protector tubes offer varying degrees of seedling protection for approximately 2 to 6 years, depending on the tube, plant species, and growing conditions.

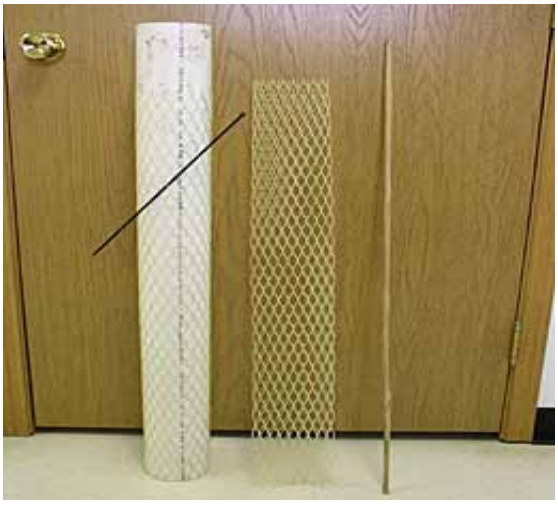

FIGURE 1

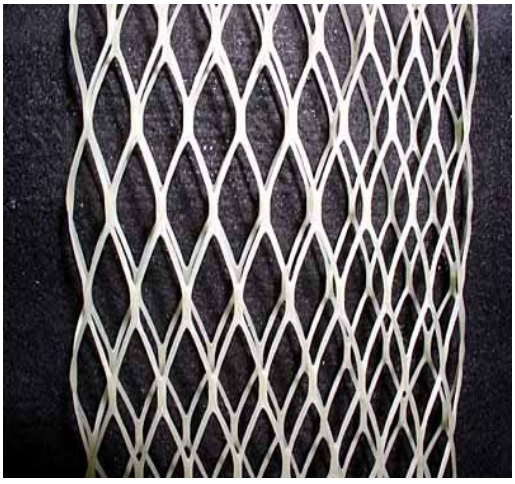

FIGURE 2

II. PROPER INSTALLATION: Rigid seedling protector tubes can be installed on most small deciduous species by manually slipping the tube over the seedling. They are not normally used on conifers because of potential needle and branch deformation. For larger stock, especially deciduous species with long, upright stems, the branches may become entangled in the openings as the tube is slipped over the plant. In some cases, branches are deformed or broken. To prevent this from occurring and to speed the installation process, carefully slip a rigid piece of PVC (polyvinyl chloride) pipe the same or greater length as the rigid seedling protector tube over the seedling.

FIGURE 3

FIGURE 4

As an example, a 4-inch inside diameter, 4.5-inch outside diameter, Schedule 40 (0.25-inch thick side walls) PVC pipe that is about 38 inches long works well for 4-inch diameter, 36-inch long tubes. The extra length of the PVC pipe provides a surface to grab when removing it from the tube. A piece of rope attached to each side of the top lip of the PVC pipe acts as a handle for pulling the pipe. When slipping the PVC over the seedling, it may be necessary to compress branches together in one hand while placing the PVC pipe over the seedling. See FIGURES 3 and 4.

After the pipe is in place, slip a protector tube over the pipe and slide the tube downward until it contacts the ground. The tube may also be slipped over the PVC prior to placing the PVC over the plant. See FIGURE 5.

FIGURE 5

Pull the PVC pipe upward while holding the protector tube in place. See FIGURE 6. Secure the tubes to 1 or 2 stakes (bamboo or other material) with wire ties or other fasteners. Verify that terminal branch ends are not tangled in the tube mesh.

FIGURE 6

A graphic example of a properly installed tube appears in *Hand-Planting Guidelines for Bareroot Trees and Shrubs* posted at *http://www.mt.nrcs.usda.gov/technical/ecs/forestry/bareroot.html*.

III. PROPER MAINTENANCE: Initially, rigid seedling protector tubes require minimal maintenance other than periodic inspection to assure that they have not been damaged or removed by animals or shaken loose from their bamboo supports. Each seedling and tube should be inspected each spring and fall for litter and debris buildup inside the tube, a condition that harbors rodents. This is especially important for deciduous species. As seedlings grow over time, it may be necessary to enlarge some mesh openings to prevent girdling of expanding lateral branches (FIGURE 7). In some cases, elongating branches may become entangled within the tube, causing a shepherd's crook growth pattern to the individual branch (FIGURE 8). Carefully feeding these branches through a mesh opening as they elongate in the spring prevents this problem.

FIGURE 7

FIGURE 8

IV. TIMELY REMOVAL: Initial manufacturer information indicated that rigid seedling protector tubes would photo- and thermal-degrade within approximately 5 years, eliminating the need for manual removal. On 400 bur oak seedlings at the Plant Materials Center at Bridger, Montana, more than 75 percent of the tubes did not show significant signs of physical deterioration after 6 years in use. In approximately 10 to 15 percent of cases, girdling damage was caused by the tube to lateral branches. Bridger is an area characterized by a high number of solar days, low relative humidity, and extreme temperature fluctuations--conditions that favor tube deterioration. Since several companies manufacture rigid seedling protector tubes, presumably with different formulations of materials, it is possible that product performance may vary. As a result, the performance of the tubes at Bridger may not necessarily be the same as other brands. Although the life span of rigid seedling protector tubes varies by tube, plant species, and site conditions, an average useful life appears to be approximately 2 to 6 years. **Tubes should be inspected annually for condition and possible negative impacts to protected seedlings.** Protector tubes and other types of shelters should be removed when they begin to interfere with normal plant growth or deteriorate and function improperly. Protector tubes are removed by pulling aged shelters apart with pliers or cutting the tube lengthwise with a pair of heavy-duty scissors. In some cases, embedded plastic must be removed with pliers or Vise Grips™, or a razor or knife may be needed to cut away bark tissue to facilitate plastic removal. Branches severely weakened or killed by girdling should be properly pruned to prevent portals of entry for insects and disease.

Creeping Foxtail

Alopecurus arundinaceus Poir.

Plant symbol = ALAR

Contributed by: USDA, NRCS, Idaho State Office

Photo: Lars Hedenäs

Photo: Swedish Museum of Natural History

Alternate Names

Creeping foxtail, *Alopecurus ventricosus*

Key Web Sites

Extensive information about this species is linked to the PLANTS web site at www.plants.usda.gov. To access this information, go to the PLANTS web site, select this plant, and utilize the links at the bottom of the Plants Profile for this species.

Uses

Grazing/livestock/pasture: Creeping foxtail is very well suited for pastureland or hayland. Because it does not undergo dormancy during the summer, creeping foxtail produces high yields of palatable forage season long. Plants break winter dormancy early in spring, and leaves remain green and palatable even during the hottest months. Studies indicate that creeping foxtail yields equal or exceed those of other comparable grasses.

Creeping foxtail is palatable to all classes of livestock. Cattle show preference to creeping foxtail over other widely employed pasture grasses. In separate studies, cattle preferred creeping foxtail to smooth brome (*Bromus inermis*), reed canarygrass (*Phalaris arundinaceus*) and tall wheatgrass (*Thinopyrum ponticum*). In another study, cattle preferred straw from seed production fields of creeping foxtail over thickspike wheatgrass (*Elymus lanceolatus*), western wheatgrass *(Pascopyrum smithii*), basin wildrye (*Leymus cinereus*) and others. It can be seeded in pure stands or combined with a legume.

This species produces numerous aggressive underground rhizomes. These contribute to long-lived-stands and an ability to recover quickly from grazing.

Filter fields: Because of creeping foxtail's tolerance to high levels of fertilizer, particularly nitrogen and water, it can be used in filter fields for liquid waste disposal. It can also be used in a variety of other water settings including sewage treatment, food processing and livestock waste removal programs.

With suitable moisture, creeping foxtail can also be used as an excellent silt trap. This species is known to tolerate up to six inches of silt per single deposition.

Erosion control: Creeping foxtail's vigorous rhizome production (up to 120 cm crown diameter/year) and water tolerance make it well suited to erosion control and stream bank stabilization. Creeping foxtail can tolerate both high water levels and periods of drought, it can be used on earthen dams where water levels fluctuate. It survives in a broad range of pH, making it suitable for mine spoils, saline seeps (tolerant to ECs of 12) bogs and acidic roadways.

Wildlife: All manner of wildlife benefit from the forage and cover provided by creeping foxtail. Elk and deer eat the succulent forage in the spring and fall. The tender spring growth also provides forage for geese and other waterfowl. Numerous species of birds use the dense growth for cover and nesting habitat. Creeping foxtail has been used for plantings around ponds, lakes, grassed waterways and other waterways.

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

Weediness
In addition to aggressive rhizomes, creeping foxtail proliferates by windborne and waterborne seeds. Rapid reproduction can be useful in repairing damaged sites; however, creeping foxtail's ability to spread quickly may create management problems in canals, irrigation ditches and other waterways.

Please consult with your local NRCS Field Office, Cooperative Extension Service office, or state natural resource or agriculture department regarding this species' status and use. Weed information is also available from the PLANTS Web site

Description
General: Grass Family (Poaceae). Creeping foxtail is a large, long-lived, rhizomatous, sod-forming, perennial grass introduced from Eurasia.

Culms are tall (5 to 12 dm) and stout (~8 mm). Cauline leaves are numerous, flat and green, mostly 6 to 8 mm (12), glabrous above and scabrous beneath. The membranous ligule is 1 to 5 mm long and is rounded to acute.

The inflorescence is a spike-like, cylindrical panicle, typically 4 to 10 cm long and around 8 mm thick, turning purplish or black with maturity. It has a very similar appearance to the seedheads of timothy, but creeping foxtail heads turn the dark colors described above with maturity and Timothy seedheads turn a brownish – buff color.

Individual spikelets are single flowered and urn-shaped (4 to 5 mm long, 1 to 1.5 mm wide). The glumes are fused basally and are strongly keeled with a ciliate margin, the hairs 1 to 2 mm. Lemmas are typically shorter than the glumes and may bear a straight to geniculate awn (1 to 2 mm) arising from below to slightly above mid-length. Anthers are usually purple but are occasionally yellow or orange.

Anthesis occurs early in the season. Seed maturation begins at the top of the inflorescence and proceeds downward. Spikelets disarticulate below the glumes with the spikelet falling as a single unit.

Creeping foxtail should not be confused with other grass species that share the common name foxtail. Creeping foxtail is a close relative of meadow foxtail (*Alopecurus pratensis*) and can be distinguished by having broader leaves (8-12 mm vs. 4-8 mm) and a dark purplish inflorescence. There are also many weedy species that bear the name foxtail, i.e. foxtail barley (*Hordeum jubatum*) and green foxtail (*Setaria viridis*). These may occupy the same habitats as creeping foxtail but bear little or no resemblance.

Distribution: This species is native to the colder regions of Europe and Asia. It ranges naturally from the British Isles in the west to Siberia in the east going as far south as Turkey and Italy and possibly China.

Records indicate that creeping foxtail was introduced into the United States around the end of the 19th century. At the time it was little used by farmers who lacked the specialized equipment to plant and harvest its small fluffy seeds. With the advent of more advanced machinery in the 1930's and 40's it became more widely used in forage practices.

Presently it is most commonly utilized throughout the Pacific Northwest, Intermountain West, Northern Great Plain States and western Canada. It is projected that creeping foxtail could be used as far east as the New England states.

For more information on distribution, please consult the plant profile page for this species on the PLANTS Website.

Adaptation
Creeping foxtail is adapted to cold temperatures and wet conditions. It is extremely winter hardy. It can establish and survive in areas where frost-free periods average less than 30 days annually. Studies indicate creeping foxtail outperforms smooth brome on flooded permafrost soils in Alaska. It also grows well at a broad range of elevations (500-9000 ft), but grows best on mid to high elevation wet to semiwet sites.

This species is well adapted to areas of high moisture typically too wet for good production of most forage

grasses, i.e. brome (*Bromus* species) and orchardgrass (*Dactylis glomerata*) and is a superior forage to other semi wetland grasses such as tall fescue and other wetland grasses such as reed canarygrass, meadow foxtail and timothy. Naturally it occurs in areas receiving more than 18 inches of precipitation. It also grows readily along margins of ponds, lakes, bogs, ditches and in mountain meadows. It can withstand periodic flooding of 60 to 90 cm for up to 45 days. Some varieties are also somewhat drought tolerant, being able to survive in areas with widely fluctuating water levels and drought during later summer periods.

Creeping foxtail does well in a broad spectrum of soils provided there is sufficient available water. It can grow in sand, clay, peat and muck. It is moderately salt tolerant (up to 12 millimhos/cm) and tolerates both moderately acidic soils (pH 5.6 to 6.0) and slightly alkaline soils (pH 7.9 to 8.4).

Establishment
Creeping foxtail establishment techniques are similar to those for other forage grasses. For best results the seedbed should be weed free, moist and firmly packed. Follow seeding with a light harrowing or packing operation. Optimum seeding depth is 1/8 to 1/4 inch and no deeper than ½ inch.

Timing depends almost entirely on available moisture. Irrigated fields can be seeded in early to mid spring or late summer avoiding the hot mid summer period. Irrigated fall seedings can be successful as late as early to mid-September allowing for enough time (6 to 8 weeks) for seedling establishment before freezeup. Where precipitation is required, seed when soil is moist but firm enough or frozen to support seeding equipment. Late fall dormant seedings (after October 20th in most areas), winter and very early spring seedings are most effective under non-irrigated conditions where seeds are not allowed to germinate until spring.

This species produces very light seed units (750,000 seeds/lb) which allow for low relative seeding rates for adequate stand establishment. It is recommended that a minimum seeding rate of 3 to 4 lb/acre is used for ease of handling and uniform distribution through seeding equipment. This rate provides 51 to 68 seed/ft^2.

It is popular to dilute the seed with inert materials, i.e. rice hulls, cracked corn or other cracked grains. For rice hulls, cracked wheat or cracked barley, dilute 3-4 lb/acre seed with 2 bushel/acre diluent, and set the drill to seed the equivalent of 2 bushels of barley per acre. For cracked corn reduce diluent to 1 bushel/ acre.

When seeding with a legume it is recommended that one plant in alternate rows. Studies conducted with 'Lutana' cicer milkvetch (Astragalus cicer) and 'Eski' sainfoin (Onobrychis viciaefolia) showed increases in yield over a four year period when planted in alternate rows.

Management
Young seedlings are small and weak. Growth is slow for the first 4 to 6 weeks even under irrigated conditions. Rhizomes can emerge as early as 8 weeks. With the emergence of rhizomes, growth is rapid. With adequate soil moisture inflorescences may develop in mid to late summer, but first year plants typically do not produce seedheads, or when they do there is not enough seed for a profitable harvest.

Under non-irrigated conditions, it is not uncommon to have difficulty determining stand establishment the first growing season. Stand success should not be determined until the second or third growing season under non-irrigated conditions.

Applications of commercial fertilizer are not required during the establishment period; however, creeping foxtail responds very favorably to applications of 50 to 60 lb/acre actual nitrogen once established. Creeping foxtail plants show little response to applications of potassium, phosphates and secondary elements.

When planted with a legume adjust fertilizer rates according to desires: for more grass production increase nitrogen, for legumes increase phosphorus and potassium.

Weeds can be controlled using standard herbicide practices, although weeds should cause few problems with adequate fertilizer.

Pests and Potential Problems
Creeping foxtail has historically shown little damage from insects and other diseases; however, in some years leaf spot diseases have been recorded as a problem in Canada.

Seed and Plant Production
Seed production practices for creeping foxtail are more involved and difficult than those of most other forage grasses. Harvest timing is critical for a good yield, and seed cleaning requires more time and equipment than for most other grass species.

Stands should be planted in wide-spaced 36 to 48 inch rows, but rhizomes cause sod binding and row closing. This can be overcome by applying high levels of nitrogen and aggressive cultivation to maintain desired row culture.

During establishment apply enough phosphorus for three years according to forage production rate. No nitrogen should be added until seedlings are established, or drill 50 lb/acre of 11-48-0 with the seed. Once seedlings are established apply 30 lb/acre N for dryland or 60 to 80 lb/acre N for irrigated fields.

Nitrogen application in the fall on established fields positively influences inflorescence size and number. Apply 100 to 150 lb/acre N each year. Studies have shown inflorescence production rose as nitrogen levels were increased up to 100 lb/acre actual N. After 150 lb/acre production tapered off as plants used more nitrogen for foliage than seed production. Seed yields with 100 lb/acre were as high as 570 lb/acre while yields of 350 lb/acre were achieved when no nitrogen was applied.

During establishment enough water should be applied to get stands started. The soil surface should be kept moist to avoid crusting. In early September bring soil moisture up to field capacity. Established fields should be irrigated in spring through the boot stage. Soil moisture should be kept above 50% field capacity. Good soil moisture is necessary during the early phase of seed development to prevent moisture stress, but do not irrigate during flowering or seed ripening. After harvest irrigate to field capacity to promote vegetative production.

Since seed maturation is temperature dependent, different regions will be harvested at different times of year. For proper timing of harvest, attention must be paid to three indicators. (1) 75 percent or more of the seeds should be black. (2) 50 percent of the inflorescences have begun to shatter at the tip. (3) 75 percent of the stems are yellow up to 3 to 4 inches directly below the inflorescence. These three events often occur quickly over a three day period.

Plants are typically windrowed, dried (3 to 5 days) and picked up by a combine. Seed heads shatter readily. Hand harvested seeds yielded over 500 lb/acre while machine harvested fields yielded as little as 180 lb/acre. It is recommended to slow the reel speed of both the windrower and combine to equal to or slightly higher than ground speed. It is also recommended to make these adjustments to the combine: (1) slow ground speed to allow more separating time; (2) shut off air flow by sealing the fan housing or inactivating the fan; (3) remove screens following the sieves; (4) adjust concave spacing to ¼ inch; (5) adjust cylinder speed to approximately 3500 ft/min. (750 to 850 rpm).

An alternative harvesting method employed by the Bismarck Plant Materials Center and others is using a seed stripper. For best results ground speed should be 1.5 to 2 mph. Tachometer speed can be from 1100 to 1800 rpm, and the brush speed should be around 425 rpm.

Typical production is 300 pounds per acre irrigated and 150 pounds per acre non-irrigated. Non-irrigated seed production is not recommended below 16 inches of annual precipitation.

Seeds should be dried prior to storage at temperatures not over 104º F (40º C). Store seed in bins at 12% moisture content or sacks (15%).

A barley debearder can be used to remove the fine hairs from the glume keels and to remove stems and chaff. The debearder should be run at 500 rpm long enough to break down stems. Seeds can then be cleaned using a #9 round hole in the top screen, 1/18" x ¼" slotted middle screen and a 6 x 36 wire mesh bottom screen. The fan should be set to a slow, light wind speed (100 to 150 rpm).

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

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

'Garrison' creeping foxtail (*Alopecurus arundinaceus*) was named and released by the Natural Resources Conservation Service Plant Materials Center in Bismarck, North Dakota in 1963. The original collection was made in 1950 near Max, North Dakota where plants were growing on the margins of potholes. 'Garrison' is adapted to cold temperature regions where there is abundant water. It is especially well suited to higher elevation areas that receive 18 inches or more precipitation annually or along the margins of ponds, lakes, ditches and other waterways. It provides excellent forage for cattle and other classes of livestock by producing highly palatable leaves throughout the growing season. 'Garrison' has a high moisture tolerance and produces vigorous rhizomes making it an excellent choice for controlling streambank and shoreline erosion. Certified seed is available.

Breeder and Foundation seed is maintained by the Bridger, Montana PMC.

'Retain' creeping foxtail (*Alopecurus arundinaceus*) was selected by the South Dakota Agricultural Experiment Station and released in 1979. This is a five-clone synthetic single plant selection from Garrison. Retain is very similar to Garrison, but this cultivar retains seed on the panicle making it possible to harvest with a direct cut combine. Like Garrison, it is well adapted to wet areas and is flood tolerant. It is highly palatable to livestock. It matures early, heading in mid-May.

Breeder and foundation seed are maintained by South Dakota State University. Contact for availability.

Control

Contact your local agricultural extension specialist or county weed specialist to determine the best control methods in your area and how to use it safely.

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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 <http://plants.usda.gov> and Plant Materials Program Web sites <http://Plant-Materials.nrcs.usda.gov>.

Images courtesy of “Den Virtuella Floran” used by permission of the Swedish Museum of Natural History.

Russian Wildrye

Psathyrostachys junceus (Fisch.) Nevski

PLANT SYMBOL = PSJU3

Contributed By: USDA, NRCS, Idaho State Office

'Bozoisky-Select' Russian Wildrye
Larry Holzworth

Alternate Names

Elymus junceus (Fisch.) ELJU
Leymostachys korovinii Tzvelev LEKO

Uses

Russian wildrye is one of the most versatile forage grasses available for dryland pastures. Its forage can be utilized during all seasons, and when cured, retains a higher protein percentage than wheatgrasses.

Use for Hay: Russian wildrye is not well suited to hay production. Most of the growth and production is from basal leaves, which are difficult to pick up with harvesting equipment.

Use for Pasture: This grass is best adapted for use as pasture in dry areas. It is as long-lived as crested wheatgrass. Russian wildrye begins spring growth a little later than crested wheatgrass. It continues growth and stays greener longer into the summer than crested wheatgrass. The forage is very palatable. It has a longer growing period than most dryland grasses. Russian wildrye has the ability to cure later in the growing season with good protein levels. This allows for a long grazing season. It is generally recommended for late summer through winter grazing. It is tolerant of grazing and regrows quickly after clipping lending itself to use as irrigated as well as dryland pasture.

Erosion control/reclamation: Russian wildrye gradually develops into stands with fairly wide spaced plants. It therefore is not considered the best choice for erosion control for either wind or water erosion objectives. In low rainfall areas, Russian wildrye requires wide spaced rows (18 inches or greater) to be productive. It is very competitive with weeds once established.

Salinity: Russian wildrye has good tolerance to salinity. It is a species of choice in low rainfall saline areas with moderate to well drained soils.

Wildlife: Russian wildrye is highly palatable to wildlife, especially deer, elk and antelope. It is generally utilized by wildlife in late summer through winter.

Status

Consult the PLANTS Web site and your State Department of Natural Resources for status, such as state noxious status and wetland indicator values.

Description

Russian wildrye is a large, cool-season, introduced, long-lived, perennial bunch grass. It has an abundance of long, dense, basal leaves that are from 6 to 18 inches long and up to ¼ inch in width. Plants vary from light to dark green, with many shades of blue-green.

The erect, leafless reproductive stems are about 30 to 40 inches tall. The seedhead is a short dense, erect spike with two or more short-awned spikelets clustered at axis joints. The seed shatters readily at maturity. The seed is about the same size as crested wheatgrass seed.

Russian Wildrye

Spikelet Seed

The roots are fibrous and may establish to a depth of 6 to 8 feet. However, about 75 percent of the roots are in the surface 6 to 24 inches. Russian wildrye roots have an extended horizontal spread and may draw heavily on soil moisture for a distance of up to 4 to 5 feet. Its long season of growth and its vigorous soil-feeding habit make this species an excellent competitor with weeds once the grass is well established.

Distribution

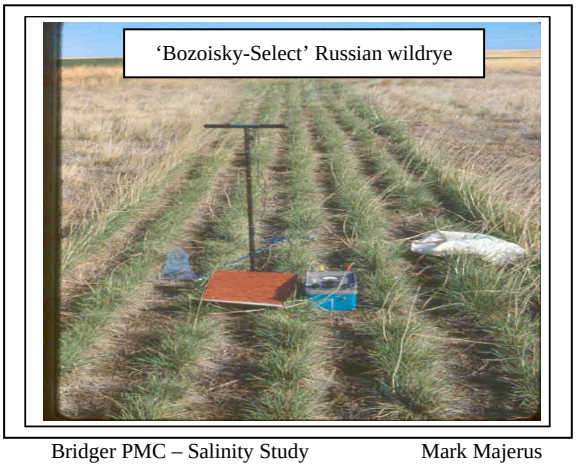
This species was introduced from Siberia. For current distribution, consult the Plant Profile page on the PLANTS Web site.

Adaptation

Russian wildrye can be grown successfully wherever crested wheatgrass is grown, but it is primarily a dryland pasture grass adapted to 8 to 16 inch annual precipitation areas.

Russian wildrye is well adapted to silt loam to heavy clay soils. It can be grown on a fairly wide range of soil types, but is most productive on fertile loam soils. It does poorly on soils with low fertility. It is more difficult to establish on sandy soils in dry areas than crested wheatgrass, but once established does very well.

It grows at elevations up to 7,500 feet in northern latitudes and to 9,000 feet in southern latitudes. Wide row spacing plantings (18 to 36 inch) produce more forage than narrow row spacing (6 to 14 inch) plantings.



Bridger PMC – Salinity Study Mark Majerus

It is exceptionally cold and drought tolerant and has moderate tolerance of salinity and sodic to saline-sodic soil conditions. Its

production is affected beginning at electrical conductivity (EC) levels of 12.

This grass is not tolerant of spring flooding or high water tables.

Establishment

Russian wildrye requires special attention during the year it is seeded because it is difficult to establish. It must be planted in a firm, weed-free seedbed at ¼ inch depth or less. Wide row spacing plantings, 18 inches or greater, are recommended. The recommended seeding rate at this spacing is 4 pounds Pure Live Seed (PLS) per acre.

Seedlings are slow growing and weak requiring more time to establish a stand. The plants should be allowed to mature and set seed before they are grazed. Stands generally develop into widely spaced plants over time.

Stands are often open because Russian wildrye is usually seeded with wide row spacing, leaving the soil between plants susceptible to erosion. It should be planted on the contour where slopes are greater than 2 percent or may not be desirable at all where erosion control is the most important objective. Forage yields are similar to those of crested wheatgrass. Wide row spacing increases forage production.

Alternate Row Planting Russian Wildrye – Alfalfa
Larry Holzworth

Forage yields are also increased by seeding mixtures with legumes. Seeding the legume in alternate rows or cross-seeded rows decreases competition from Russian wildrye and optimizes forage quality and yield.

Environmental Concerns

Russian wildrye is long-lived and spreads via seed. It is not considered "weedy" or an invasive species. Most established stands do not spread beyond original plantings. It is not known to hybridize with native species.

It is subject to attack by grasshoppers, cutworms and other insects, but no troublesome diseases have been noted.

Properly established and managed stands of Russian wildrye generally exclude weeds and native grasses and forbs. Some native shrubs such as big sagebrush and rabbitbrush can invade Russian wildrye stands if seed sources are nearby.

Management

Russian wildrye begins growth in the spring a little later than crested wheatgrass and should not be grazed as early. However, fall regrowth of Russian wildrye is better than crested wheatgrass.

Russian wildrye is very tolerant of grazing and regrows quickly after grazing. Although grazing can occur from spring to winter, it is best to graze this grass lightly in the spring, if at all, and save most growth for late summer to fall to winter when other grasses are less productive or low in forage quality. Stands can be injured from extensive use by livestock and wildlife in early spring. Grazing should be carefully managed to avoid over utilization.

It remains palatable and of adequate nutritive quality for mature stock on winter maintenance rations. It is palatable to all classes of livestock and wildlife. It is high in protein and retains higher protein content than most grasses after maturity. Protein

levels of 5 to 7 percent can be expected in late fall through winter. Because of its high palatability, competitiveness with other vegetation as well as itself, it is recommended for planting in pure stands and fenced for better utilization.

As a pasture grass, it recovers rapidly after grazing if soil moisture is available. Because of this characteristic, it has been used for irrigated pasture in rotational grazing systems.

It responds very well to applications of fertilizer and also to supplemental irrigation.

Because of its high digestibility and long season of use, Russian wildrye is unique among the semi-arid cool season grasses. In comparison trials with domestic sheep, Russian wildrye had a digestibility coefficient of 60.2 percent while crested wheatgrass had a coefficient of 45.1 percent. Its yield of forage per acre may not be as great as other adapted grasses, but high digestibility and its extended season of growth are compensating factors for livestock use.

In studies using protein supplements in the fall with yearling cattle at the Lee A. Sharp Experimental Area, Idaho by the University of Idaho, yearlings benefited from supplements when grazing crested wheatgrass, but not while grazing Russian wildrye. This study indicates that protein was not a limiting factor in fall while grazing Russian wildrye.

Seed Production

Seed production of Russian wildrye has been very successful under cultivated conditions. Row spacing of 36 inches-irrigated (seeding rate 3.0 pounds PLS per acre) to 48 inches-dryland (seeding rate 2.0 pounds PLS per acre) are recommended. Cultivation will be needed for weed control and to maintain row culture.

For seed production, Russian wildrye benefits from low levels of fertilization based on soil tests. Apply enough phosphorus fertilizer to last 3 years and incorporate into the soil. During establishment, apply approximately 30 pounds actual N (nitrogen) per acre on dryland plantings and 60 to 80 pounds actual N per acre on irrigated plantings for optimum stand establishment. On established stands apply at least 50 pounds actual N per acre on dryland plantings and 60 to 80 pounds actual N per acre on irrigated plantings each fall.

The seed heads have moderate rates of shatter and require close scrutiny of maturing stands to determine optimum harvest date. Seed is generally harvested in late July. The preferred method of harvest is to swath field when seed is in the hard dough stage prior to shatter. Allow 2-3 days curing time in the windrow and then combine using a pickup attachment. Seed must be dried immediately after combining (Moisture content: 12 percent bins and 15 percent sacks).

Crop residues from seed fields must be removed after harvest to maintain plant health, plant vigor and good future seed yields.

Seed production declines as stands get older. Seed fields are productive for at least four years. Average production of 100 to 200 pounds per acre can be expected under dryland conditions in 14- inch plus rainfall areas. Average production of 300 to 700 pounds per acre can be expected under irrigated conditions.

Seed remains viable for at least ten years under good seed storage conditions.

Releases

Russian wildrye was introduced from Siberia as a forage crop. It was first grown in nurseries near Mandan, North Dakota in 1927. Because of its erratic seed yields, it did not come into common use until the 1950s.

The Russian wildrye cultivars that have performed the best in replicated plantings in the Northern Great Plains and Intermountain West (Idaho, Montana, Nevada, North Dakota, Wyoming and Utah), are 'Bozoisky-Select' and 'Mankota'.

'Bozoisky-Select' Russian wildrye was selected by USDA ARS at Logan, Utah for improved seedling vigor and increased forage yield. It was released in 1984 and has shown good seedling performance. Forage yields are about 123 percent of Vinall. Breeder seed is maintained by ARS in Logan, UT and Foundation seed is produced at the NRCS Bridger, MT PMC.

'Bozoisky II' Russian wildrye was developed by USDA ARS at Logan, Utah and selected for seedling vigor (emergence from a deep planting depth), seed mass, seed yield, vegetative vigor, total dry matter production and response to drought. It is a broad-based 15 clone synthetic that is much broader than other Russian wildrye releases. It was released in 2004. Breeder and Foundation seed is maintained by USDA ARS Forage and Range Research Laboratory in Logan, Utah.

'Cabree" Russian wildrye was selected by Agr. Canada Research Station, Lethbridge, Alberta, Canada for its improved seed retention, resistance to powdery mildew, leaf rust and spot blotch. It was released in 1976.

'Mankota' Russian wildrye was selected by USDA ARS at Mandan, North Dakota for resistance to leaf spot and improved forage yields. Breeder seed is maintained by ARS in Mandan, ND and Foundation seed is produced at the NRCS Bismarck, ND PMC.

'Mayak' Russian wildrye was selected by Agr. Canada Research Station, Lethbridge, Alberta, Canada for its high forage and seed yields and resistance to leaf spot. It was released in 1971.

'Swift' Russian wildrye was selected by Agr. Canada Research Station, Lethbridge, Alberta, Canada for better seedling emergence and good resistance to leaf spot. It was released in 1978.

'Tetracan' Russian wildrye was selected at Agr. Canada Research Station, Lethbridge, Alberta, Canada for its excellent seedling vigor, large seed size, and better seedling emergence from deeper seeding depths. It was released in 1988.

'Vinall' Russian wildrye was selected by USDA ARS at Mandan, North Dakota. It was the first released cultivar in 1960. It is no longer recommended and has been replaced by 'Mankota'.

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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 <http://plants.usda.gov> and Plant Materials Program Web sites <http://Plant-Materials.nrcs.usda.gov>.

Fact Sheet

'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 up 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 developed 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 uses include: as a component of a seed mix for rangeland, erosion control, forage and cover seedings in 12 to 20 inch rainfall zones; mine spoil reclamation; 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 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 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 up 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 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, 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, 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 high 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 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).

March 2004

Fact Sheet

'ANATONE' GERMPLASM BLUEBUNCH WHEATGRASS

Species: ***Pseudoroegneria spicata***

Common Name: **Bluebunch Wheatgrass**
Plant Symbol: **PSSP6**
Accession Number: **9076424**

Source: Anatone Germplasm is a selection from a native plant collection made in Asotin County, Washington in 1988 by the USDA Forest Service, Rocky Mountain Research Station, Provo, Utah. The original collection was made in a sagebrush/perennial grass community at an elevation of 3,200 ft. Other associated plants at the original collection site include Idaho fescue, Sandberg bluegrass, and mountain big sagebrush. More detailed collection site information is 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 to 12 inches or more.

Method of Selection: Anatone Germplasm was selected by the Rocky Mountain Research Station from a comparison of approximately 80 collections of bluebunch and Snake River wheatgrass, including 'Goldar' and 'Whitmar', in arid conditions. Plants were compared for stand, vigor, seedling establishment success and adaptability to arid sites. Additionally, Anatone was compared against nearly 50 other populations for cold temperature germination rates. Plants have also been tested for seed production and seed quality.

'Anatone' Bluebunch Wheatgrass

Description: Anatone 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 18 to 40 inches tall. Spikes are generally loose, open with spikelets about the same length as the rachis internodes at maturity. Plants are diploid, 2N = 14.

Use: Anatone bluebunch wheatgrass uses include: as a component of a seed mix for rangeland, erosion control, forage and cover seedings in 10 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 Anatone. It may be susceptible to stripe rust and mildew if conditions are favorable for these pathogens.

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

Area of Adaptation: Anatone is adapted to the Northwest and Intermountain regions of the United States where annual precipitation averages at least 10 inches.

Soil Adaptation: Anatone prefers light to medium-textured well drained soils. It can be planted in big sagebrush communities as well as on mountain slopes with antelope bitterbrush, mountain big sagebrush and Idaho fescue. It can also survive in shallow rocky soils with Wyoming big sagebrush.

Planting and Harvesting: Anatone should be seeded with a drill to a depth of 1/4 to 1/2 inch in 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, Anatone should be seeded in 24 to 36 inch rows at a rate of 3 to 4 pounds PLS per acre to allow mechanical weed control and to maintain rows. Anatone 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 – 16 inch+ rainfall) to 170 pounds per acre (irrigated).

Seed Maintenance: G1 and G2 Certified seed is maintained at:

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

G2 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 G2, G3, and G4 generations of seed.

July 2004

Fact Sheet

'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 Forest Service Intermountain Forest and Range Experiment Station in Ephraim, Utah.

Native Site Information: Once thought to be the native, Lewis flax, Appar has since been identified as blue flax, an introduced species native to 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 taprooted 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. 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 in 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).

August 2004

Fact Sheet

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 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 as opposed to 'Appar' perennial flax which has been found to originate from Europe. 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 increased demand for a native flax for 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 taprooted 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 for 25 PLS per foot.

Maple Grove fields must be swathed before harvest. Seed is typically harvested in early-August. Irrigated seed yield averages 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 Associations 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.

July 2004

Fact Sheet

'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 Forest Service Intermountain Forest and Range Experiment Station, Utah Division of Wildlife Resources and the 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: Ephraim's rhizomatous nature 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 in 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:

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).

August 2004

Fact Sheet

'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 (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 1 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).

August 2004

Fact Sheet

'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 arid 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 1800'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. It is best suited to the sagebrush-grass and piñon-juniper communities.

Soil Adaptation: Paiute does well in 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 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).

August 2004

Fact Sheet

'REGAR' MEADOW BROME

Species: ***Bromus erectus***
Common Name: **Meadow Brome**
Plant Symbol: **BRER3**
Accession Number:

Source: The original collection was made in 1949 near Zek, in the Kars Province of Turkey. The 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 sixties. 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 under dryland or irrigated conditions. 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 more than 14 inches annual precipitation. It is best suited to locations above 4,000 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. In 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.

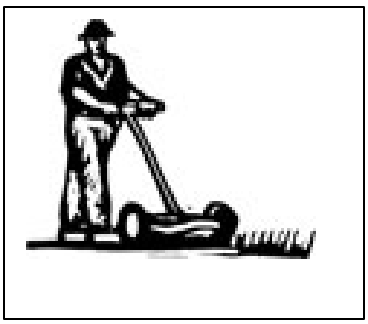
For seed production, plant fungicide treated seed in 24 to 36 inch rows at 4.5 to 5 pounds PLS per acre to allow mechanical weed control and to maintain rows. Seed is ready for harvest in mid-July to early August. Windrow in the firm dough stage and then combine in about 7 days (once seed has matured 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).

July 2004



LAWN IRRIGATION GUIDE

Lawn irrigation accounts for nearly half of homeowner water usage. Many homeowners irrigate too often and for too short a period to meet lawn and especially landscaping (tree and shrub) needs. Others tend to leave the water running too long, resulting in wasted water.

Turf studies show that most lawns only require irrigation once every 4 to 8 days to stay healthy and green. Shallow rooted plants result from irrigating every day.

Irrigating less often and applying more water per irrigation results in deeper rooted plants and a healthier turf. Grass roots grow deeper into the soil and the plants become stronger if enough water is applied when you do irrigate.

If grass doesn't spring back after being stepped on, it's probably time to irrigate.

It takes less water to maintain a green lawn if soil fertility is high. Weed levels also tend to be lower in a well fertilized lawn.

For optimal results, apply your fertilizer in split applications rather than one spring application. For example, in the Snake River Plains and Eastern Oregon and Washington, apply 2 pounds of ammonium sulfate each "holiday" during the growing season - Memorial Day, July Fourth, Labor Day, and Halloween.

Two fertilizer applications, while not as good as four, is better then one spring application. Split applications also reduce the danger of burning your lawn or risk of surface runoff and deep leaching from a high nitrogen application.

Irrigate through mid-September. Allow plants to slow their growth and harden for winter. Water again about mid-October to store moisture in the soil.

Evergreen shrubs and trees transpire during the winter, so it's important they have adequate soil moisture to ensure they don't stress during the winter period. A deep watering just prior to soil freeze up will help ensure shrubs and trees are healthy the next spring.

The irrigation schedule on the next page offers a guide. Your lawn may need more water when it is especially hot or less during cooler periods or when it rains. Avoid irrigating if possible on windy days and midday when the evaporation level is the highest. Try to irrigate during early morning hours to avoid fungal diseases. Proper lawn irrigation can save a lot of water – and it saves you money.

Determine Your Lawn Watering Needs

1. **Set 3 or more flat bottom cans or mugs at various locations on your lawn and at least 4 feet from sprinkler heads.**
2. **Turn on your sprinkler(s) for 15 minutes.**
3. **Measure the depth of water in each can with a ruler and determine the average water depth.**
4. **Match your sprinkler output to the table below and water the number of minutes indicated. Days between irrigation may vary based on season of year, soil textures, soil depth, aspect, elevation and other local conditions.**

Water Depth in Cans	1/8”	3/16”	1/4"	5/16”	3/8”	1/2"	5/8”	3/4"	1”
Watering Time in Minutes									
Spring - 0.5 inch water every 5-8 days	60	40	30	25	20	15	12	10	8
Summer - 1.0 inch water every 4-7 days	120	80	60	50	40	30	25	20	15
Fall - 0.75 inch water every 5-8 days	90	60	45	38	30	23	18	15	12

Note: Adjustments to the chart above for local conditions and soils may be necessary to meet your specific lawn and landscaping water needs. If irrigation water is running off site, stop watering for a short period to allow water to soak in and then continue watering for the recommended period.

Prepared by:

Dan Ogle, Plant Materials Specialist, USDA-NRCS, Boise, ID
Loren St. John, Manager, USDA-NRCS, PMC, Aberdeen, ID
Mark Stannard, Manager, USDA-NRCS, PMC, Pullman, WA
Larry Holzworth, Plant Materials Specialist, USDA-NRCS, Bozeman, MT

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

Grass for Gas?

Loren St. John, PMC Team Leader

You probably have seen or heard the commercials for ethanol-blended fuels made from corn and how increased use of bio-fuels may someday reduce our reliance on imported oil products and reduce air pollution. However, not much research has taken place to evaluate perennial plants for biofuel feed stocks.

The Aberdeen PMC began cooperating this summer with the USDA-ARS Forage Seed and Cereal Research Unit in Corvallis, Oregon to evaluate perennial native grasses for potential use as biofuel feed stocks.

Forage samples were collected from 13 accessions in the Grass Display Nursery at the PMC. Samples were collected at the vegetative, boot, flowering and seed fill stages. The samples were air-dried and shipped to the ARS Research Unit for biochemical analysis. The objective of this study is to identify the change in lignin, hemicellulose, cellulose, and sugars as a plant grows. Data analysis is not yet completed for samples collected this year.

The PMC also provided to the ARS Research Unit standard seed packets of 'Magnar' basin wildrye, 'Sodar' streambank wheatgrass, and 'Nezpar' Indian ricegrass for greenhouse studies to verify the field sampling.

The PMC plans to continue to cooperate with the ARS Research Unit in Corvallis to evaluate perennial grasses for potential use as biofuel feed stocks.

Submitted to Idaho, Oregon, Nevada, and Utah NRCS State Offices for inclusion in "Current Developments" November 7, 2003.

The Best Yielding Forage Grasses for Irrigated Conditions

Loren St. John, PMC Team Leader
Dan Ogle, PM Specialist

Forage grass cultivars developed for humid regions usually perform well in our semiarid region when adequate irrigation is available. However, as it seems we are experiencing more dry years than normal and more pressure is put on available water resources, it makes sense to choose irrigated forage grasses that are stable under full as well as limited irrigation.

The Agricultural Research Service Forage and Range Laboratory in Logan, Utah conducted a study to evaluate eight cool season grass species for forage yield and stability under five irrigation levels plus natural precipitation (33.5, 28.9, 23.2, 20.1 and 14.2 inches) during a 2 year evaluation. The species included in the study were a meadow brome x smooth brome hybrid, 'Matua' rescuegrass (brome), 'Fleet' and 'Regar' meadow brome, 'Ambassador' orchardgrass, 'Zero Nui' and 'Bastion' perennial ryegrass, 'RS-H' and 'Newhy' RS hybrid wheatgrass, 'BR3' and 'Manchar' smooth brome, and 'Forager' and 'Fawn' tall fescue.

The plots were harvested to simulate intensive rotational grazing to a 3 inch stubble height at the first harvest and when regrowth height was 10 to 12 inches for the later harvests. The plots were fertilized before the first harvest and after the second, fourth, and final harvest with 50 pounds Nitrogen per acre.

Tall fescue, meadow brome and orchardgrass had the highest yields and were stable across the irrigation levels in the study. Perennial ryegrass, RS hybrid wheatgrass and smooth brome had the lowest forage yields in this study.

Although this study showed orchardgrass to be stable and it produced fairly high yields even at 14.2 inches of natural precipitation and irrigation, experience shows that orchardgrass should not be recommended for areas with less than 18 inches of annual precipitation. Another species to consider which was not included in this study is intermediate wheatgrass which is adapted to areas receiving a minimum of 12 inches annual precipitation. It is ideally suited for areas with limited irrigation water availability and forage yield increases are impressive when additional irrigation is provided.

For further information, refer to ARS Fact Sheet BLW001, June 7, 2002. Selection of the Best Cool-Season Pasture Grass Species: Based on Forage Yield and Yield-Stability. Blair Waldron, Kay Asay, Kevin Jensen, and Michael Peel. USDA-ARS, Forage and Range Research Lab, Logan, UT.

Submitted to Idaho, Oregon, Nevada, and Utah NRCS State Offices for inclusion in "Current Developments" April 29, 2004.

United States Department of Agriculture

NRCS

Natural Resources Conservation Service
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NEWS RELEASE

May 6, 2004

Contact:
Jody Fagan, (208) 378-5725

Small Acreage Owners Can Win the Weed War

They seem to pop up over night. Marching through the garden, along irrigation ditches and across pastures. Ask an Idaho small acreage owner about weeds and you might get a frustrated sigh.

"Buying a small acreage doesn't usually come with an instruction manual," says Loren St. John, manager for the Natural Resources Conservation Service (NRCS) Plant Materials Center in Aberdeen. "Many owners aren't aware of practices that can help prevent weed infestation or the options for getting rid of them."

Weeds cost the Idaho economy hundreds of millions of dollars annually. From cheatgrass and meadow salsify (goat's beard) to one of the state's 35 designated noxious weeds, such as purple loosestrife, Canada thistle, field bindweed and whitetop, property owners can help reduce the cost of weed infestations through proper identification and vegetation management.

One of the first steps small acreage owners can take to control weeds is to change the practices that allowed weeds to become established in the first place. For example, continuous grazing of livestock can result in bare soil, allowing weeds to establish more readily.

"Many new small acreage owners aren't aware of proper vegetation management," St. John says. "I often see horses camping on a five-acre pasture all year long."

To better manage their pastures, small acreage owners can:

- Plant long-lived perennial irrigated grasses such as orchardgrass, meadow brome, tall fescue or intermediate wheatgrass, or dryland grasses such as crested wheatgrass, Siberian wheatgrass or Russian wildrye. Once established, and with proper grazing management, the grass will help prevent the weeds from establishing and spreading.

--MORE--

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- Graze livestock for shorter periods of time. Don't allow pasture grasses to be grazed shorter than 4 to 6 inches and allow plants to grow to about 8 to 10 inches in height before grazing. Plan on supplementing your animal's diet with hay and grain.

"It's also a good idea for small acreage owners to team up with neighbors," St. John says. "Managing weeds throughout a neighborhood will help make overall weed eradication more successful."

Additional weed control methods include:

- Mow weeds before they go to seed.
- Pull small weed patches by hand.
- If flowers or seeds are present when pulling weeds, prevent the seeds from falling back on the ground and place them in a plastic bag or container. Dispose of by burning or taking them to a sanitary landfill.
- Use EPA-registered herbicides. Carefully read and follow the directions for proper application.
- Do not use, mix or store herbicides near wells or other water sources.
- Apply herbicides only when the air is relatively calm. Herbicide drift can kill desirable grasses, trees and shrubs.

For more information on weeds, visit the NRCS website at www.id.nrcs.usda.gov or contact your county weed superintendent or county extension office. A publication titled, "Living on a Few Acres," is available from local USDA Service Centers.

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Aberdeen PMC Works with Region 1 of the Forest Service for Plant Solutions

Derek J. Tilley
Range Conservationist
Aberdeen PMC

The Aberdeen PMC is cooperating with Region 1 of the Forest Service to evaluate native plant materials for use in the Rocky Mountain and sagebrush steppe ecosystems. 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 fires. Increased fires create the potential for 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. Together the Forest Service and Aberdeen PMC are working to evaluate high priority plant materials and associated plant technology to address these and other problems throughout Montana and northern Idaho.

During the 2003 growing season technicians from national forests within Region 1 made 52 collections of eight species of native perennial grasses and forbs. Multiple collections were obtained for each species at many locations to ensure the full range of genetic material was obtained. Typically an individual species collection takes two to three years to complete. Thanks to the hard work and cooperation of the Forest Service employees, the needed collections were completed in a single season.

The collections were then sent to Aberdeen PMC where the materials were stored until the collections could be cleaned, processed and accessioned for further evaluations. Accessions will be planted this spring at the PMC and evaluated over the next two years for germination traits, seedling vigor, stand establishment, biomass production and other criteria to determine which would be most beneficial for future evaluation and production. The PMC will also develop technical materials to facilitate planting, management and to increase the likelihood of success in restoration plantings.

Accessions that perform well will be increased for immediate release and use on high priority conservation needs. The PMC will produce Generation 1 (G1) seed from the original source collected (G0) seed. G1 seed will then be made available to the private industry (commercial seed producers) for larger scale production of G2 and G3 seed. Once under production in the private sector the seed will be available to public and private land managers for revegetation needs.

Submitted to Idaho, Nevada, Oregon, and Utah NRCS State Offices for inclusion in "Current Developments" March, 2004.

highlight \hi-lit\ n. 1: the lightest spot or area. v. 2: to throw a strong light on, to emphasize.

Quotable Quotes

"If there is no dull and determined effort, there will be no brilliant achievement."

-Hsun-tzu

(submitted by **Pete Sinclair**)

"Life is not a journey to the grave with the intention of arriving safely in a pretty and well preserved body, but rather to skid in broadside, thoroughly used up, totally worn out, and loudly proclaiming 'Wow, what a ride!'"

-Unknown

(submitted by **Kathy Dingman**)

Highlights

The newsletter for Idaho NRCS employees and conservation partners.

In This Issue

Salmon Office Holds First CSP Sign-Up

About 13 percent of Lemhi Watershed producers signed up for the first ever Conservation Security Program (CSP).

"The sign-up was overall a success," says **Lindsay Obray**, CSP team leader and soil conservationist in Salmon.

State Conservationist **Rich Sims** *offers opening comments at one of the two public meetings held in the Lemhi Watershed.*

The Lemhi was one of 18 watersheds nationwide to participate in the sign-up July 6-30. CSP, authorized in the 2002 Farm Bill, rewards those farmers and ranchers who are meeting the highest standards of conservation on their land.

"This was definitely a hard time to hold a sign-up in the Lemhi Valley," Obray says. "Haying was in full-swing. Fifteen of the producers showed up the last afternoon and almost all of them had to go back home and get their farm records."

Still, Obray says the sign-ups demonstrate the valley's good conservation ethic. Several of the producers may qualify for Tier 2 or 3, the program's highest funding levels.

In 2005, the CSP sign-up is expected to include more than one watershed in Idaho, or about one-eighth of the state's producers. It may be another eight years before CSP returns to the Lemhi.

"With a new program, there is always skepticism," Obray says. "With a few success stories from producers in the Lemhi Valley, there will be more interest in the 2005 sign-up."

Just a few of the people making the sign-up a success: **Barry Albert**, *Cascade;* **Lindsay Obray**, *Salmon;* **Ralph Fisher,** *Boise;* **Frank Fink**, *Boise; and* **Glenn Shea**, *Boise.*

What to Expect in 2005

CSP will play a larger role in Idaho next year. We plan to target 3,000 producers in as many as six watersheds. A large information campaign will be needed to inform NRCS conservation partners and local producers about the program.

NRCS Natural Resources Conservation Service

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Special Feature

Emmett Creates 100+ Acres of Wildlife Habitat

What do you get when you mix a range conservationist, some irrigation water and a few homeless ducks? Believe it or not—the final concoction is the Emmett Field Office's first Wetland Reserve Program (WRP) project.

In 2000, Landowner Richard Zamzow enrolled a 118-acre irrigated pasture along the Payette River into a perpetual WRP easement. After four public meetings and four years of engineering head-scratching, the Emmett office has transformed the pasture into three wetland cells making up 32 acres of surface water.

"We've been learning as we go," says Scott Henderson, Emmett range conservationist turned wetland engineer. "This was our first wetland restoration handled out of this office and there will probably be more."

The results of the sharp learning curve are readily evident—native grasses swinging in the wind, yellow-headed blackbirds perching on cattails, bull frogs croaking across rippling water.

"It didn't take long for wetland species to colonize this new habitat," Henderson says. "When you go out, you see wood ducks, blue-winged teals, stilts, herons, frogs … ducks were even nesting and raising ducklings this year."

Although the project's results are now readily evident, Henderson says it's important to allocate more time than you think you need.

"These projects take three to four years from planning to completion," he says. "But it's worth it—this is a perpetual easement and the values will be long term."

It's also important to communicate with the neighbors, Henderson says. The office held four public meetings—two for information prior to construction, another during construction and the final one after project completion.

Most of the neighbors believed the wetland would use more water than the prior pasture. However, once the wetland is full, it will use the same amount or less.

"We wanted to start meeting early so the neighbors felt they could still provide input," Henderson says. "All of them began as naysayers and now they're in the wait and see mode."

Emmett Range Conservationist **Scott Henderson** *and DC* **Levi Montoya** *open a headgate to increase flows to one of the wetland's cells.*

Ranchers Balance Smart Grazing, Wildlife Habitat

by Kristen Clayton
Public Affairs Specialist, Idaho Falls

Verl and Shirley Arnold love their ranch as they should—they've spent their lives restoring it.

When they bought the place north of St. Anthony in 1954, it was in terrible shape. But 50 years of proper grazing and it's as productive as can be.

"Don't get greedy and overgraze," Verl Arnold says. "Sometimes when you get a dry year, you've got to cut back and you've got to do it yourself. You shouldn't wait until someone tells you to."

The Arnolds worked with St. Anthony DC **Ken Beckmann** to become one of the first Idaho landowners to enroll in the NRCS Grasslands Reserve Program

Ken Beckmann *(right), walks with the Arnold's on their property.*

(GRP). They signed their land into a permanent easement, keeping it for smart grazing and wildlife forever.

"There must be 50 different kinds of plants here," Beckmann says. "The Arnolds are good examples of western ranchers who not only have improved their deeded land, but also care about the public land they graze. The entire Sand Creek Allotment is in great condition."

Arnold says he's not sure what's going to happen with the ranch when it's passed on, but his hard work will remain for others to enjoy.

Snapshots from the Field

NRCS Chief **Bruce Knight** *presents a USDA Honor Award to Southwest RC&D Coordinator* **Bill Moore**. *The award went to all of Idaho's nine RC&D coordinators for their work on community wildfire projects.*

Carrie Janssen-Smith, *Pocatello, shows Soil Quality Workshop participants how to use the Soil Quality Test Kit during a session in Moscow. Landowner* **Gary Esser** *(with his dog) also attended.*

Salmon DC **Mark Olson** *and Challis SCT* **Joleen McCandless** *visit with Producer* **Jerry Hawkins** *about the fish screen installed on his property. Olson left June 28 for 18-month military duty in Iraq.*

Direct Seeding Focus of Tour

by Phil Oestreich, Soil Conservationist, Lewiston

Soil quality, earth worms, bacteria, assimilation, mycorrhizal action.

These are terms associated with soil when direct seeding and no–till are used. They are also terms 63 participants became familiar with after a recent tour near Genesee.

The Pacific Northwest Direct Seed Association hosted the tour. Jill Clapperton, a rhizosphere ecologist from the Agriculture and Agri-Food Canada Research Center in Alberta, Canada, was the guest speaker. Participants visited field trials at the Russ Zenner farm south of town where warm season crops (corn) are used in rotation. The farm also includes herbicide spray plots for broadleaf weed control in lentils, and winter pulse and brassica seeding trials.

Direct seeding improves soil's biological and physical characteristics. Also, sheet and rill, ephemeral gully and classic gully erosion decrease significantly.

Jill Clapperton *talks about soil quality with local producers.*

Cooperator benefits include an average fuel savings of 3.5 gal./ac., return from annual cropping, improved crop quality and yields, and better winter moisture reserves.

Challenges with direct seeding include getting through winter wheat straw and not plugging the drill when planting spring crops, or creating crop rotation diversity.

Funding for the tours was provided by the Environmental Protection Agency (EPA) 319 program. For more information, visit www.directseed.org.

Kurt Cates, *Fort Hall DC, describes how potatoes grow to several Shoshone Bannock students as part of a recent Green Manure Expo held in Fort Hall.*

Staff from Idaho Falls NRCS, IASCD, DEQ, and East Side/West Side SWCD supervisors discuss a spring-fed water trough a landowner developed through the Emergency Conservation Program.

New Resources-Check Out These Conservation Products!

A 10-minute video on how the Plant Materials Program can help conservationists. It features Idaho STC **Rich Sims** and scenery from MT and OR. Contact: **Dan Ogle**, Boise.

Arco DC Steve Cote has authored a book on low-stress livestock handling, funded by NRCS and the Butte SWCD. Contact: **Rhoda Suderman**, Boise.

New Employees Tour Plant Materials Center

by Kristen Clayton, Public Affairs Specialist, Idaho Falls

A stop at the Plant Materials Center (PMC) is not only educational, but a whole lot of fun says NRCS employees who recently attended a field day there. Among those gathered at the Aberdeen training were NRCS personnel from around Idaho, Nevada and Utah, and Idaho's new student employees.

Dan Ogle, *Plant Materials Specialist, Boise, talks grasses with a new employee.*

How many of us really know what goes on at the PMC? A plot of land that, when viewed from the sky, looks like the striped brown and green shirt my sister wore back in the 1970s? That's why this one-day biennial training course is so important.

The tour participants learned the PMC can help them with their jobs—maybe finding a plant species for a rangeland need or offering willow cuttings for a riparian project. And ask PMC Technician **Brent Cornforth** to show you his natural way to catch mice! He'll likely demonstrate!

A visit to the PMC's demonstration plots teaches new techniques for plant establishment, windbreaks and grasses. New seeds are always springing and the PMC regularly releases new conservation plants to the public. The group toured the seed cleaning facilities, plots, nearby Idaho Department of Fish and Game farm, and ended with riparian training and a visit to a constructed wetland system just south of Aberdeen.

"Today's new employee training is probably the largest we've seen." says **Loren St. John**, PMC team leader. "Usually we'll have 20-30, but today we have close to 45 visiting."

An increase in new employees may be the reason. Since January 2004, Idaho has hired 20 new people. The student employment numbers have also grown—the Student Temporary Employment Program (STEP) and Student Career Experience Program's (SCEP) have made 10 new hires.

Above: New employees look over grasses being tested at the PMC in Aberdeen. Below: Idaho's STEP and SCEP hires from around the state.

Personnel Actions April-June 2004

CAREER CONDITIONAL APPT.

*__Clayton, Ryan__ to GS-05 SCT/Idaho Falls FO, 05/16/04.
*__Elliot, Kathy__ to GS-05 SCT/Lewiston FO, 05/16/04.
*__Graham, Roberta__ (Ronnie) to GS-05 SCT/Moscow FO, 05/16/04.
*__McCauley, Connie__ to GS-06 Admin. Asst. (P/T)/Mid-Snake RC&D, 06/13/04.
*__Oliphant, Katie__ to GS-05 SCT/Driggs FO, 05/16/04.
*__Reaney, Dinah__ to GS-05 SCT/Burley FO, 06/13/04.

EXCEPTED APPOINTMENT

*__Helsley, Jessica__ GS-03 returning Soil Con. Trainee/Moscow FO, 05/16/04.
*__Firebaugh, Krystal__ GS-04 Civil Eng. Trainee/Pocatello FO, 05/16/04.
*__Josephson, Ben__ GS-02 Bio. Sciences Aide/Aberdeen PMC, 05/16/04.
*__Jungert, Amie__ GS-04 returning Bio. Science Trainee/Gooding FO, 06/13/04.
*__Matlack, Nathan__ (Nate) GS-04 Range Mgmt. Trainee/Arco FO, 05/16/04.
*__Poor, Emily__ GS-04 Soil Con. Trainee/ Moscow FO, 05/23/04.
*__Rodriguez, Krystle__ GS-01 Soil Con. Aide/Payette FO, 06/06/04.
*__Schwenkfelder, Kayla__ GS-04 Civil Eng. Trainee/Salmon FO, 05/23/04.
*__Tibbets, Donald__ GS-04 Civil Eng. Trainee/Twin Falls FO, 05/16/04.

PROMOTION

*__Albiston, Barbara__ to GS-06, Human Res. Asst./Idaho SO, 05/02/04.
*__Miller, Jack__ to GS-07 SCT/Rigby FO, 05/30/04.
*__Williams, Cameron__ to GS-09, Soil Con./Soda Springs FO, 04/04/04.

TRANSFER

*__Meagher, Maureen__ to Rock Springs (Wyoming) RC&D, 06/12/04.

REASSIGNMENT

*__Adkins, Denise__ to GS-11DC/Rexburg FO (from Nevada BLM), 04/18/04.
*__Simonson, Lorraine__ to GS-06 Admin. Asst. (P/T)/Wood River RC&D, 06/13/04.
*__Smith, Dean__ to GS-11 DC/Blackfoot FO (from California NRCS), 05/30/04.

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INTERAGENCY

RIPARIAN/WETLAND PROJECT

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 10 (2004)

Project Contributors
J. Chris Hoag, Wetland Plant Ecologist – Project Leader
Derek Tilley, Range Conservationist – Research Scientist

"Treat the Earth well. It was not given to you by your parents, it was loaned to you by your children. We do not inherit the Earth from our Ancestors, we borrow it from our children."
---Ancient Indian Proverb

Introduction

This newsletter is part of the Aberdeen Plant Materials Center's continuing effort to provide useable information to the public on wetland and riparian plants, plant establishment, and management. This newsletter is the tenth issue published since the Interagency Riparian/Wetland Plant Development Project was established.

A Big Welcome to Derek Tilley

The Plant Materials Center's newest employee is Derek Tilley. Derek's title is range conservationist, but his primary job is as a research scientist on upland, riparian, and wetland projects. He has a good background in plant taxonomy and plant research. Derek has taken over all of the wetland greenhouse research and the wetland direct seeding trials in the PMC ponds.

Riparian Ecology and Restoration Workshops

AZ workshop participants laying out a new organic soil filled sock that could either replace a willow fascine or added to it for more protection.

As part of the Project's technology transfer program a three-day Practical Streambank Bioengineering Workshop has been developed. The first day of the workshop is devoted to the classroom where basic riparian dynamics, riparian zone vegetation, plant acquisition, and bioengineering techniques are discussed. The second day is spent at a field location where participants classify the riparian site and install a series of bioengineering structures on an eroding section of streambank.

Each year the Project conducts several workshops in different parts of our service area. If you are interested in attending this course, contact Pat Blaker at the PMC for the next scheduled workshop. If you are interested in having a workshop in your area and you have about 30 people that would like to attend the training, contact Chris Hoag and we will try to schedule a course in your area.

Balled and Burlap Trees
Joe Scianna, Plant Materials Center, Bridger, MT

Follow the same rules for handling and transporting a dormant balled & burlapped plant as actively growing stock. Avoid wind desiccation on the trip home. Do not move the trunk and branches independently from the rootball or drop the rootball from any height. A properly acclimated conifer should be fully dormant when purchased. To avoid bud break and the initiation of active growth, limit the amount of time the tree spends in a warm environment (above ~37^{0}F) or is held under long photoperiods (extended day length caused by artificial lighting). This means storing the plant in a shaded outside location or an unheated garage prior to planting. Store the tree in a galvanized tub, keeping the rootball lightly moistened, but do not allow any water to pool in the tub.

Riparian Erosion and Vegetation
Riparian Notes, Steve Nelle, NRCS, San Angelo, TX

A certain amount of erosion and sediment deposition is normal and natural in river and creek bottom areas. However, when bank erosion becomes excessive, it is a sure sign that something is out of balance and the riparian vegetation has low vigor, is severely stressed, or inadequate.

Three broad types of riparian vegetation help provide needed stability:

- **Colonizer plants** establish very quickly and spread. They put down a quick mat of new roots by stolons or rhizomes (knotgrass, spikerush, some sedges, water hyssop, water primrose, slender wheatgrass, etc.).
- **Stabilizer plants** are usually taller upright plants with strong dense root masses (basin wildrye, Nebraska sedge, rushes, Mannagrass, etc.).
- **Riparian Woody plants** with larger diameter roots function as "riparian rebar" (willows, cottonwood, dogwood, alder, birch, etc.).

Keep this in mind the next time you are planning a riparian project. Determine which species to plant in and make sure to incorporate all three classes of plants for a better overall erosion control results.

Soaking Willow and Cottonwood Cuttings
Derek Tilley, PMC Range Conservationist

In 2004 the PMC began a series of experiments in the greenhouse investigating the pre-soaking of willow and cottonwood poles for transplanting. The rationale was, if we could get the poles primed with water, there would be less chance of drying out, the poles would be more likely to quickly produce roots, and therefore establish faster and with a higher success rate.

In the first experiment, two sets of 18" cuttings were soaked in 5 gallon buckets, one group outside (daily highs in the 30s) and one group in the greenhouse (constant 75º F). We then monitored the development of rooting nodules (small white lesions where roots emerge from the bark).

We found that the greenhouse materials, began forming nodules between two and seven days (depending on the species) and quickly produce roots. However, the poles outdoors remained dormant until the temperatures warmed up to around 50º F during the day, and only then did they begin producing nodules.

We also monitored and compared how quickly roots grew by species. Some species (peachleaf willow, whiplash willow and Geyer willow) grew roots very quickly, up to 5 cm after 12 days of soaking. Other species (Black cottonwood, Booth willow, Drummond willow and coyote willow) were very slow to produce roots. Even after 30 days of soaking we didn't see any roots on Booth, coyote and Drummond willow.

The final experiment involved soaking 6' poles either completely submerged, half-submerged, or 1/3 submerged. We measured the weight gain from water every seven days for four weeks. We found that all poles initially take up water at the same rate. In about seven to 14 days, the poles in 1/2 or 1/3 soak start to produce leaves and roots and lose weight due to water loss through the leaves. Then they start to gain weight again from leaf and root production. Poles that are completely submerged never produce leaves or roots, so they took up water at a steady rate and then leveled off.

Nodule and root formation on a willow cutting after soaking.

The question now is, "does any of this affect establishment success in a real-life planting?" Is it better to plant poles soaked with water? Should they already have nodules or roots? In 2005, we plan to conduct additional experiments by planting the poles outdoors after being subjected to different treatments to see which treatments have a higher rate of establishment.

Direct Seeding Wetland Plant Species
Derek Tilley, PMC Range Conservationist

In 2004, we began evaluating different possibilities for direct seeding wetland species. Most of our commonly used wetland plants need three things in order for the seed to germinate: light, heat and water. Direct seeding has proven to be very difficult, because seed drilled into the soil doesn't get enough light, and seed placed on the surface tends to float away when the water comes up.

An example of Submerseed™ which is a small rock with Juncus seed embedded in a coating around the rock.

We are currently evaluating two new possibilities for direct seeding. The first involves using a tackifier (a glue used in hydroseeding applications), which could potentially glue the seed to the soil without blocking the necessary light. The second involves binding seeds to small gravel-sized aggregates with clay and organic polymers. These pellets can be spread by hand or through use of a fertilizer spreader mounted behind an ATV. Both techniques have worked well in the greenhouse. In the spring of 2005 we will plant six different species into our constructed wetland ponds at the PMC to test the techniques described above under a real-life setting.

Practical Tips for Wetland Seed Collection from an Experienced Collector
Derek Tilley, PMC Range Conservationist

1. Wear rubber hip boots - these not only keep you dry, but also keep weed seeds like cocklebur and beggar's ticks from sticking to your clothes and shoes.
2. Avoid driving onto wetlands and meadows - they may appear to be dry, but there can still be wet pockets under the surface, and even though your vehicle comes equipped with a winch, good luck finding something to attach it to!
3. Collect a pressed voucher specimen for each seed collection – just a good practice.
4. Use bug spray, use bug spray, use bug spray!
5. Identify all the plants in the community where you'll be collecting first – this way you avoid collecting noxious weeds such as perennial sowthistle, and you keep from trampling over any TES species.

Revision of the *Streambank Soil Bioengineering Field Guide for Low Precipitation Areas*

Jon Fripp and Chris Hoag are planning on revising the *Streambank Soil Bioengineering Field Guide for Low Precipitation Areas* this winter. If you have any suggested revisions, additions, or deletions, please email them to Chris Hoag by March 1.

Bigger is not Always Better for Streambank Stabilization

Jon Fripp and Chris Hoag have looked at a number of streambank stabilization projects where the designer thought that if a certain sized rock was calculated to be right for stream velocities, that a little bigger rock was even better. As rocks get bigger there is less and less velocity reduction and more and more energy redirection. A good mixed run of rock with large and small rocks will do a better job than just a few large rocks.

Large rocks used to protect a streambank and to hold rootwads. The river flowed between the rocks, washed the soil out from around the rootwads, and wiped out the entire bank.

The same thing can be said for tree revetments. Do not select tree trunks based on their large diameters. The only purpose of the tree trunk is to hold the branches. The larger the diameter of the tree trunk, the less velocity reduction and the greater the energy redirection. This usually translates into more streambank erosion.

If the Hole is There, Plant it.

During construction of various structures such as rock riprap, spurs, refusals, etc, have willow cuttings available on site to place in the holes that are dug to install the structure. A good example is when a spur is being installed. The root or anchor of the spur needs to be dug back into the bank. Once the hole for the root has been dug and before the rock is placed in the hole, line the outside of the hole with cuttings then dump the rock into the hole. The sides of the hole provide good soil to stem contact, the hole is usually deep enough to ensure the cuttings are into the low watertable, and the rock will hold the cutting upright. This is a good way to establish tree species (cottonwoods, peachleaf willow, etc.) on the upper bank. Do not plant tree species on low banks.

Additional Information

All publications are now available on the Internet in Adobe Acrobat format. You can download each of the papers below by going to http://www.Plant-Materials.nrcs.usda.gov/idpmc/riparian.html. If you do not have access to the Internet or would like to receive a hard copy, please contact the PMC.

Bioengineering Information

1) *The Practical Streambank Bioengineering Guide*: A user's guide for natural streambank stabilization techniques in the arid and semi-arid Great Basin and Intermountain West
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

No. 2 - Selection and Acquisition of Woody Plant Species and Materials for Riparian Corridors and Shorelines

No. 3 - Use of Willow and Cottonwood Cuttings for Vegetating Shorelines and Riparian Areas

No. 6 - Seed and Live Transplant Collection Procedures for 7 Wetland Plant Species

No. 7 - Use of Greenhouse Propagated Wetland Plants Versus Live Transplants to Vegetate Constructed or Created Wetlands

No. 8 - Constructed Wetland System for Water Quality Improvement of Irrigation Wastewater

No. 9 - Design Criteria for Revegetation in Riparian Zones of the Intermountain Area

No. 10 - Perigynium removal and cold-moist stratification improve germination of *Carex nebrascensis* (Nebraska sedge)

No. 11 - Getting "Bang for your Buck" on your next Wetland Project

No. 12 - Guidelines for Planting, Establishment, Maintenance of Constructed Wetland Systems

No. 13 – A Reference Guide for the Collection and Use of Ten Common Wetland Plants of the Great Basin and Intermountain West

No. 14 - Harvesting, Propagating and Planting Wetland Plants

No. 15 - Costs and considerations of streambank bioengineering treatments

No. 16 – Riparian Planting Zones

No. 17 – Waterjet Stinger: A tool to plant dormant unrooted cuttings of willows, cottonwoods, dogwoods, and other species

Idaho NRCS PM Technical Notes

No. 6 - The Stinger, a tool to plant unrooted hardwood cuttings of willow and cottonwood species for riparian or shoreline erosion control or rehabilitation

No. 13 - Harvesting, Propagating and Planting Wetland Plants

No. 23 - How to Plant Willows and Cottonwoods for Riparian Rehabilitation

No. 32 – User's Guide to Description, Propagation and Establishment of Native Shrubs and Trees for Riparian Areas of the Intermountain West

No. 38 - User's Guide to Description, Propagation and Establishment of Wetland Plant Species and Grasses for Riparian Areas in the Intermountain West

No. 39 - Waterjet Stinger: A tool to plant dormant unrooted cuttings of willows, cottonwoods, dogwoods, and other species

No. 42 – Willow Clump Plantings

For a copy, write or call:

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derek.tilley@id.usda.gov

Establishment of Wetland Plants by Direct Seeding: A Comparison of Methods

2004-2005
Preliminary Report (January 21, 2005)
Derek J. Tilley, Range Conservationist
Chris Hoag, Wetland Plant Ecologist
USDA-NRCS Plant Materials Center, Aberdeen, Idaho

Wetland ecosystem at Kirch Wildlife Management Area, Nye County, Nevada.

Introduction

Establishment of wetland plants by direct seeding methods is desirable for many reasons. Revegetating with greenhouse plugs is both time consuming and expensive. Considerable time is required in preparing seeds for greenhouse plantings, maintaining greenhouse seedlings and planting the plugs at field locations. In contrast, it would be very convenient to simply disc or press in or broadcast seed into a wetland restoration site. However; sources agree that direct seeding is unpredictable and ineffective for many wetland restoration projects.

Many of the commonly utilized perennial wetland plant species spread primarily through vegetative reproduction and thus allocate less energy and effort into seed production. While proliferation of rhizomes is desirable in wetland revegetation for soil stabilization, these plants typically have low seed production and poor viability making seeding a less

effective means of establishment (Steed & DeWald, 2003; Van der Valk, 1999). For these reasons seeding is considered less successful than transplanting live materials (Allen and Klimas, 1986; Kadlec & Wentz 1979; Van der Valk, 1999). See Table 1 for a comparison of wetland revegetation costs and potential success.

Most wetland plant species must meet three requirements in order for seed to germinate: adequate heat, water and light (Hoag, 2000). Meeting the light requirement means that planted seeds should not be drilled or broadcast and chained, because the seeds will be covered blocking the necessary light. A study conducted at the Aberdeen PMC greenhouse involving four common wetland species showed a mean decrease in germination of over 40% when seeds were covered by soil (data not shown).

Broadcast seeding onto the soil surface has, as yet, proven mostly unsuccessful, because most of the commonly utilized wetland species have seeds which float or are light enough to be easily displaced by water or wind. Runoff or flooding events, which are common in wetland areas, carry seeds and deposit them at the water's edge in a narrow zone instead of being uniformly spread across the surface. Dunne et al (1998) report that in high-energy environments or erodible sites, fall sowings are particularly susceptible to displacement by wind or water energies. According to Allen and Klimas (1986), "If the revegetation site will be subjected to fluctuating water levels or wave action soon after planting, seeding is probably not the best plant establishment alternative because the seeds are likely to wash out. Seeding in these cases should be done only to augment transplanting.'

Table 1. Comparison of revegetation method costs and effectiveness.

Revegetation method	Plant Material Cost	Plant Installation Cost	Shipping and Handling Cost	Notes	Relative Success
Passive	None	None	None		Ineffective
Broadcast seeding	Low	Low	Low-Medium	Seed cost dependent on species mix; seed quantities and varieties sometimes limited; handling time can be costly due to seed pretreatment.	Ineffective
Salvaged marsh surface	None	Low-High	Low-High	Installation and shipping cost largely dependent on distance between donor and restoration sites.	Ineffective
GP* bare root plants	Medium	Medium-High	High	Installation cost varies according to site conditions; shipping costs vary by distance and region.	Effective
GP container plants	Medium	Medium-High	Medium	Installation cost varies according to site conditions; shipping costs vary by distance and region.	Effective
Wild-collected transplants	None-Low	Medium-High	Low-High	Installation cost varies widely according to site conditions; shipping and handling cost dependent on distance between donor and restoration sites.	Effective
Vegetated mats	High	Low	High	Shipping costs vary by distance and region but inherently high due to bulkiness.	Effective

*GP=Greenhouse propagated (Adapted from Klausmann and Hook, 2001).

Private sector nurseries agree that direct seeding is ineffective for areas where water levels cannot be sufficiently controlled. Ernst Conservation Seed (2004) states in their catalog, "it is not practical to seed any wetland where the water is more than 2 inches deep or where flooding is likely to occur." Milner (2003) reports similarly, "seeding

opportunities are very limited in wetlands that rely chiefly on surface runoff because periodic flooding prevents seed incorporation…The dependence on a seed mix to provide vegetative cover should decrease as water levels and duration of flooding increase."

Direct seeding is more feasible where water levels can be controlled. The soil must be kept sufficiently wet to provide enough moisture for seed germination without the danger of the seed washing away. The soil must also not be allowed to dry out, or terrestrial species could become established and out compete desired wetland species (Hammer, 1992). Even with adequate water control, seeds can still be washed away or buried in silt with uncontrolled flooding.

Figure 1. Submerseed™ particles incorporated with alkali bulrush.

New technologies are being developed attempting to answer many of the problems faced in seeding wetlands. Tackifiers are available to glue seed to the soil. Greenhouse studies conducted by the authors indicate that a tackifier/seed slurry holds seeds well to the soil, even after multiple flooding events and does not inhibit germination (data not shown). Another product, Submerseed™ (SS) from Aquablok Industries, involves binding seed with clay or clay-sized material and organic polymers to a dense aggregate core (see Figure 1). These aggregates are reported to absorb water and be heavy enough to sink and hold to the soil (Krauss, 2004). Our preliminary test results showed excellent germination rates and no known seed loss due to washout (see Figure 2). This coupled with ease of planting and handling is very encouraging. The purpose of this study is to evaluate and compare direct seeding methods of wetland plant species in order to determine which (if any) method provides greater establishment success and is more cost effective.

Figure 2. SS particle with Baltic rush seedlings (six days after planting).

Materials and Methods

Six species were chosen to represent the most commonly utilized wetland species involved in wetland creation and restoration projects in the Intermountain West: Nebraska sedge (*Carex nebrascensis*), Creeping spikerush (*Eleocharis palustris*), Baltic rush (*Juncus balticus*), Hardstem bulrush (*Scirpus acutus*), Alkali bulrush (*S. maritimus*) and Common threesquare (*S. pungens*). In the late summer of 2004, 34 seed collections were made using a seed stripper (Prairie Habitats Ltd., Canada) from wetlands throughout the Intermountain West. One collection from each species was chosen for use in this experiment based on the quantity and quality of seed collected (See Appendix 1 for an overall summary of collections. See Table 2 for detailed seed collection data of utilized collections). Due to poor stands and low seed production in 2004, the authors were unable to obtain sufficient amounts of Nebraska sedge for testing. We therefore employed seed collected from the Aberdeen PMC wetland ponds in 2000. All harvested materials were allowed to dry and were then thrashed and cleaned at the Aberdeen PMC small seed lot cleaning facility. Appendix 2 shows machine techniques and calibrations used to clean each species.

Table 2. Seed information of utilized collections

Species	Common name	Collection #	Location	Collection date	Dirt wt (lb)	Clean wt. (lb)	% Purity	% Viability
Carex nebrascensis	Nebraska sedge	*	ID PMC wetland ponds	2000	*	*	98.62	88
Eleocharis palustris	Creeping spikerush	djt 3290	American Falls Res., ID	9/1/04	4.54	1.04	99.38	93
Juncus balticus	Baltic rush	djt 3242	Sterling WMA, ID	8/20/04	6.50	0.74	98.9	90
Scirpus acutus	Hardstem bulrush	djt 3236	Hagerman WMA, ID	8/23/04	1.72	1.02	99.68	85
Scripus maritimus	Alkali bulrush	djt 3275	Railroad Valley WMA, NV	8/28/04	12.00	7.60	99.56	94
Scirpus pungens	Common three-square	djt 3223	American Falls Res., ID	8/16/04	7.00	4.24	99.07	89

*Information not available.

Trial one:

Trial one will be a greenhouse study with tightly controlled conditions designed to evaluate seed displacement caused by a single flooding event. Trial one contains four treatments: (1) Submerseed™, (2) tackifier, (3) surface pressed, (4) drilled and pressed. Twelve 22” X 16” potting trays with holes in the bottoms will be filled with standard greenhouse soil medium consisting of soil, vermiculite and sand in a 1:1:1 ratio. Trays will be placed in a 4’ X 8’ simulated wetland tank. Each species will occupy two trays. Trays will be marked with ten rows making a total of 20 rows per species. Rows are ten inches long; each row will be considered as one plot. Experimental design will be completely randomized with five replications. All seeds in Trial one will be pre-stratified in a 30 day cold soak with sphagnum moss following Hoag and Sellers (1995). Rows will be ¼” deep on 2 ¼” centers. Trial one will begin after seed stratification and SS incorporation is completed.

Treatments one, three and four will be hand seeded with 20 seeds/row. Tackifier will be applied as a tackifier/seed slurry. Tackifier slurry for treatment two will be made from Turbo Tack High Performance Tackifier, Turbo Technologies, INC, at a rate of 0.05g

tackifier/125 ml H_20. The well agitated suspension will either be poured into the rows from a beaker or using a medicine eye dropper.

The 4' X 8' simulated greenhouse pond will be slowly filled and allowed to flow over the rims of the trays. Seed not held in place will be displaced by the water from the rows and deposited in a new location. It is foreseen that displaced seeds may relocate to other rows; however, seeds should disperse randomly and not affect the final analysis. Water will then be drained from the 4 X 8 pond until the water level is below the soil surface. Soil in the trays will remain saturated for best possible germination results.

Trial two:

The second trial will be established at the PMC farm in six lined wetland ponds, one pond per species. Each pond measures approximately 55' X 47' of plantable space. Soil is a Delco silt loam with pH of 7.4 to 8.4. Plots will be eight feet of row with rows planted on three foot centers. Experimental design of Trial two will be a randomized complete block design with eight replications (see Figure 5 for pond diagram). Five treatments will be evaluated in Trial two: (1) drilled and pressed (2) seed placed on surface and pressed (3) tackifier (4) SS (5) greenhouse plugs (Table 4).

Treatments one and two will be seeded using a belt seeder equipped with a packing wheel. Treatment one will be drilled to a depth of no more than ¼". Treatment three will be seeded as a tackifier/seed slurry as in Trial one. Slurry will be applied pouring the well agitated suspension from a pitcher. Treatment four (SS treatment) will be hand seeded. In all treatments, hardstem bulrush, alkali bulrush, common threesquare, Nebraska sedge and creeping spikerush will be seeded at a target rate of 20 PLS (pure live seeds)/foot. Baltic rush will be planted at a rate of 0.10 grams of bulk seed/ row (approximately 200 seeds/foot). Greenhouse grown plugs will be planted at a rate of one plant/foot.

Ponds will be flooded using a perforated four inch irrigation pipe laid across the edge of the pond. Water will be pumped in at a rate to approximate conditions encountered in natural settings. Water will be allowed to rise gradually until it reaches a target depth of one to two inches. Water will then be allowed to drain down naturally. Ponds will be re-flooded as necessary (when the surface soil is dry, approximately once every one to two weeks).

The original plan was to seed some treatments of this trial with non-stratified seeds in the fall and some with pre-stratified seeds in the spring, however, a large rain storm shortly before the fall planting date eliminated the possibility of a fall seeding. This trial will thus be seeded only in the spring using pre-stratified material. To compensate for the lost data, an additional small-scale trial was designed for a fall planting of non-stratified seeds (refer to support Trial two).

Support trials:

A series of smaller trials are also underway or planned at the PMC greenhouse. The first trial is being developed to determine the best water depth to plant SS pellets. Personal observations indicate that SS pellets will dissolve over time when left completely submerged in water. The trial is designed with SS pellets planted in blocks on an inclined plane with seeds above the water line, partially submerged and completely submerged.

This trial has two objectives: (1) determine the expected longevity of SS pellets at different water and saturation levels, (2) determine optimum depth for planting the six wetland species being evaluated in this study.

A second support trial was created in response to the poor weather conditions that prevented the planting of the fall treatments in the PMC wetland ponds. A 4' X 8' simulated wetland tank was erected outside the PMC office building in Aberdeen. The tank contained 12 greenhouse trays (two trays for each of the six species). Each species was seeded into three different treatments using non-stratified seed: (1) seed was drilled to a depth of ¼" and covered with soil; (2) seed was placed on the soil surface and pressed in and (3) SS. The trial was planted on 15 December, 2004 and will remain in place through the summer of 2005 (See Figure 3). Snow and rain will be allowed to drain out of the tank. In the late spring or early summer (when conditions and temperatures are suitable) the tank will be filled in the same manner as greenhouse Trial one and then evaluated for seed displacement and germination.

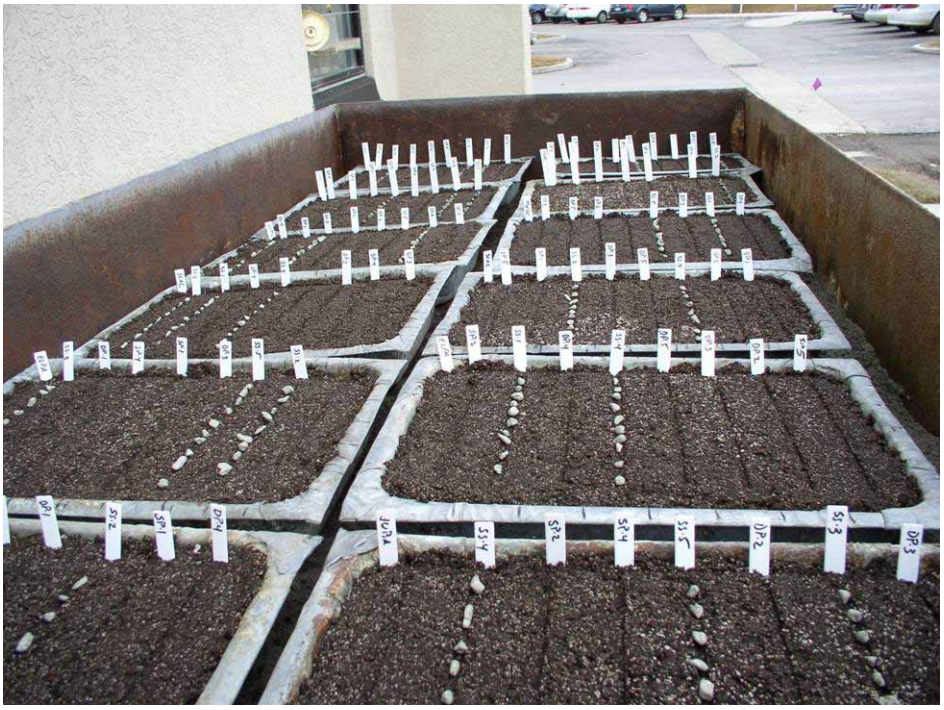


Figure 3. Outdoor trial with non-stratified seeds (white rocks are SS pellets).

Evaluations

Both trials are to be evaluated for the successful germination percentage and plant establishment percentage. Evaluations will take place after enough time has passed for most of the seeds to germinate but before vegetative recruitment occurs. In Trial one, germinated plants in each row will be totaled and divided by the known (or targeted) number of seeds in the row. In Trial two plots will be sampled to determine the mean plants per foot. Plants germinated in the soil medium but not in the row will be considered displaced and not counted.

Data will be subjected to an Analysis of Variance (ANOVA) and means will be separated with either a Tukey Test or Duncan's Multiple Range Test using the MSTAT-C Microcomputer Statistical Program (Freed et al, 1991).

Results

Early results indicate that new technologies (tackifier and SS) have great potential with regards to wetland seeding. There are however foreseen limitations in their application. Tackifier is known to degrade in sunlight. This eliminates the option of fall seeding, because the tackifier would dissolve by spring. Also, one would be forced to seed one wetland species at a time starting with species in the deeper hydrologic regimes. These would need to be allowed to establish before seeding the next zone of species and increasing water levels to allow for their establishment. Because SS pellets are not known to degrade in sunlight this would not be a problem, however, SS pellets are susceptible to frost damage. SS materials planted outdoors at the Aberdeen PMC in mid-December absorbed water during the day with above freezing temperatures. Ice wedges were subsequently created by the freezing nighttime temperatures (see Figure 4). An extended freeze-thaw cycle could potentially destroy the pellets over the winter months.

Figure 4. SS particle exhibiting ice fractures.

Cost analysis of methods

(This section will be completed after data collection and analysis)

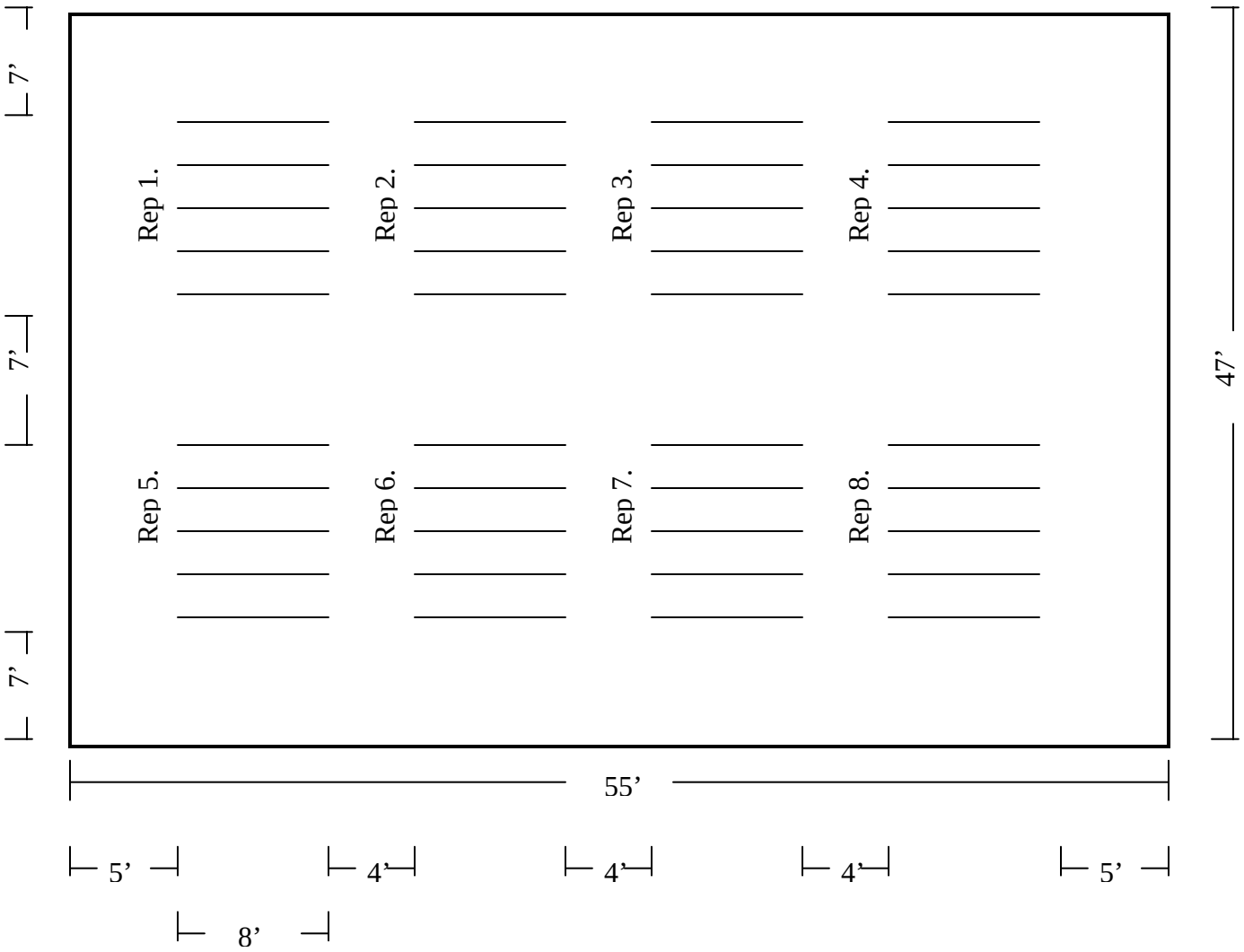
Summary/conclusions

Following data collection and analysis, a complete project summary will be written. This will include all findings and seeding protocols. Assumptions are that drilling and surface pressing of seed will be wholly ineffective. The use of greenhouse plugs is known to be an effective means of planting wetlands but is labor intensive and very costly. A tackifier has good potential, but is also limited in that it needs to be used in the spring and each species must be seeded one species at a time. SS also shows good potential. Germination rates are good with pre-stratified seed and seeding is very easy. Pellets can be broadcast easily by hand or using a fertilizer or salt-spreader (provided the holes are large enough) being hand-pushed or pulled behind an ATV. SS does require close attention to water levels, however, to allow deeper zoned species to establish before raising water levels. Seeds must be given enough time for roots to penetrate through the pellet and establish into the soil before raising the water levels, otherwise the pellet could dissolve and seedlings will be lost.

Table 3. Seeding information				
Species	Common name	Estimated seeds/lb[1]	PLS Rate[2]	Hydrologic regime[3]
Carex nebrascensis	Nebraska sedge	840K	2.3	Seasonally saturated
Eleocharis palustris	Creeping spikerush	1.4M	1.4	To 6" depth
Juncus balticus	Baltic rush	7M	0.3	Seasonally saturated
Scirpus acutus	Hardstem bulrush	500K	2.0	To 36" depth
Scripus maritimus	Alkali bulrush	150K	7.0	To 6" depth
Scirpus pungens	Common three-square	200K	5.5	To 6" depth

[1]Based on weight of 400 seeds except *Juncus balticus* which is based on 1000 seeds.
[2]PLS rates calculated using a target rate of 20-30 seeds/ft² for larger seeded species (≤ 500k seeds/lb) and 40-50 seeds/ft² for species with smaller seeds (>500,000 seeds/lb).
[3]Adapted from Ogle et al 2003.

Figure 5. Diagram of pond and experimental design for Trial two.



Appendix 1. Seed collection summary

Collection #	Species	Date Collected	Dirt wt. (lbs)	Clean wt. (lbs)	Location	% Viability*	% Purity*
3219	JUBA	8/13/04	0.34	0.10	Little Hole, ID		
3222	SCAC	8/16/04	5.90	3.20	American Falls Res, ID		
3223	SCPU3	8/16/04	7.00	4.24	American Falls Res, ID	89	99.07
3232	CANE2	8/23/04	trace	trace	Centennial Marsh WMA, ID		
3236	SCAC	8/23/04	1.72	1.02	Hagerman WMA, ID	85	99.68
3237	ELPA3	8/25/04	1.01	0.26	McTucker Pond, ID		
3238	SCAC	8/19/04	5.70	1.62	Camas NWR, ID	47	97.52
3239	JUBA	8/19/04	1.18	0.10	Camas NWR, ID		
3240	SCPU3	8/19/04	4.50	1.02	Market Lake NWR, ID	56	99.49
3242	JUBA	8/20/04	6.50	0.74	Sterling WMA, ID	90	98.9
3243	SCMA	8/17/04	7.01	5.25	American Falls Res, ID		
3244	ELPA3	8/27/04	1.33	0.16	Ruby Valley WMA, NV	79	98.87
3252	SCAC	8/27/04	1.86	1.00	Ruby Lake NWR, NV		
3253	JUBA	8/27/04	1.40	0.04	Ruby Lake NWR, NV		
3254	CANE2	8/27/04	trace	trace	Ruby Lake NWR, NV		
3264	JUBA	8/27/04	5.96	0.40	Kirch WMA, NV		
3269	SCMA	8/27/04	0.84	0.20	Kirch WMA, NV		
3270	ELPA3	8/27/04	1.54	0.30	Kirch WMA, NV		
3271	SCPU3	8/27/04	4.22	1.14	Kirch WMA, NV	65	91.27
3272	JUBA	8/27/04	2.86	0.26	Kirch WMA-Darcy, NV	53	56.21
3274	JUBA	8/28/04	3.14	0.04	Rail Road Valley WMA, NV	74	83.8
3275	SCMA	8/28/04	12.00	7.60	Rail Road Valley WMA, NV	94	99.56
3285	SCAC	8/29/04	1.46	0.54	Stillwater NWR, NV	82	99.72
3286	SCPU3	8/30/04	0.80	0.10	Ft. Boise WMA, ID		
3287	SCAC	8/30/04	3.44	1.46	Ft. Boise WMA, ID	41	98.88
3288	SCMA	8/30/04	2.72	1.02	Ft. Boise WMA, ID	96	99.48
3289	ELPA3	8/30/04	trace	trace	CJ Strike, ID		
3290	ELPA3	9/1/04	4.54	1.04	Little Hole, ID	93	99.38
3291	ELPA3	9/3/04	5.10	0.38	Malheur NWR, OR	93	98.59
3292	SCAC	9/3/04	1.40	0.32	Malheur NWR, OR		
3299	CANE2	9/3/04	0.30	0.12	Malheur NWR, OR		
3302	SCMA	9/9/04	13.10	7.50	Bear Lake NWR, ID	94	99.29
3307	SCMA	9/10/04	1.92	1.70	Bear River MBR, UT	97	99.05
3308	SCAC	9/10/04	trace	trace	Ogden Bay WMA, UT		

* As determined by the Idaho State Seed Lab

Appendix 2. Summary of seed cleaning techniques and equipment calibrations.

Baltic Rush (*Juncus balticus*)

1. Thrashing
    A. 3/8" screen (left several unbroken capsules; see #3)
2. Air screen cleaner
    A. Screens
        1. top-5.150
        2. middle-3.150
        3. bottom-1.250
    B. Valves
        1. 2.0
        2. 5.5
        3. 2.0
        4. closed
    C. Settings
        1. blower-1.5
        2. sieve-2
3. Debearder
    A. unbroken capsules from above ran through debearder and again through air-screen cleaner.
4. Gravity table
    A. Valve-3 ½
    B. Blower-2.1
    C. Sieve-2.2
    D. Pitch-1.5
    E. Slope-1.75

Creeping spikerush (*Eleocharis palustris*), Common three-square (*Scirpus pungens*), Alkali bulrush (*S. maritimus*) and Hardstem bulrush (*S. acutus*)

1. Hammer mill
    A. Screen-1/4"
2. Indent cleaner
    1. Drum-2.75
    2. Speed-10
3. Air screen cleaner
    A. Screens
        1. top-2.10 to 2.75
        2. bottom-blank
    B. Valves
        1. 3.8
        2. 5.0
        3. 4.75
        4. closed

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NATIONAL PARK SERVICE
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prepared by
NATURAL RESOURCES CONSERVATION SERVICE
ABERDEEN, IDAHO PLANT MATERIALS CENTER

INTRODUCTION

In 2003 the Aberdeen Plant Materials Center (PMC) entered into an agreement with the National Park Service to evaluate the efficacy of different methods of direct seeding of wetland plant species. At the present time, wetland restoration is best accomplished using greenhouse or wild collected plugs of the desired wetland plants. Direct seeding of wetland plants is rarely successful. However, direct seeding of wetland plants would be much cheaper.

ACCOMPLISHMENTS

Six species were chosen to represent the most commonly utilized wetland species involved in wetland creation and restoration in the Intermountain West: Nebraska sedge (*Carex nebrascensis*), Creeping spikerush (*Eleocharis palustris*), Baltic rush (*Juncus balticus*), Hardstem bulrush (*Scirpus acutus*), Alkali bulrush (*S. maritimus*) and Common threesquare (*S. pungens*). In the late summer of 2004, 34 seed collections were made with a seed stripper (Prairie Habitats Ltd.) from wetlands throughout the Intermountain West. One collection from each species was chosen for use in this experiment based on the quantity and quality of seed collected. Due low seed production in 2004, we were unable to obtain sufficient amounts of Nebraska sedge from wildland locations for testing. We will use Nebraska sedge seed collected from the Aberdeen PMC wetland ponds in 2000. Materials harvested in 2004 were allowed to dry and were then thrashed and cleaned at the Aberdeen PMC small seed lot cleaning facility.
Initial studies were conducted in the greenhouse and growth chambers at the PMC to evaluate the potential of two commercially developed seeding methods (tackifier and Submerseed™). Greenhouse results were encouraging, and it was decided to include these methods in the larger trials scheduled for 2005.

Derek Tilley seeding wetland plants in the greenhouse. An example of Submerseed™ which is a small rock with Juncus seed embedded in a coating around the rock.

Seed is currently undergoing a cold stratification treatment. When the stratification of seed is completed, the seeds will be used for greenhouse germination and establishment tests. A larger set of trials is planned for the spring of 2005 in the PMC wetland ponds located at the PMC home farm. These will be replicated plots evaluating six different seeding methods under “real life” field conditions.

TECHNOLOGY DEVELOPMENT

Both tackifier and Submerseed showed good germination and seed holding capabilities in greenhouse tests. These will continue to be evaluated against more traditional seeding methods. If either proves to be a viable wetland seeding method, the PMC will work to develop appropriate planting protocols for their use.