2004-2009

PULLMAN PLANT MATERIALS CENTER TECHNICAL REPORT

Harvesting plots 1936

Blanketflower seed increase for the Beneficial insect habitat project 2009

INTRODUCTION

The Pullman PMC land boundaries underwent a few changes in 2004 to 2009. Approximately 1 acre of the north farm (Irwin tract) was sold to the Washington Department of Transportation as part of the highway widening project. This land was in permanent cover and no studies were affected. WSU took over management of a large portion of the north farm to create an arboretum. The portion includes those fields that lie between Airport Road and the PMC farm road that runs up the spine of the ridge. This amounts to approximately 100 acres. The fields that are on the south aspect remain under PMC management.

A Selected Class Release of blue wildrye was developed in 2008. This release was named "Union Flat germplasm" blue wildrye.

The PMC program has enjoyed the support of numerous cooperators in 2004-2009. We thank all that contributed to our program.

To obtain additional information on the Pullman Plant Materials Center, contact:

USDA – NRCS
Pullman Plant Materials Center
P.O. Box 646211
Pullman, WA 99164-6211
Phone: (509) 335-6892 or (509) 335-6894
Email: mark.stannard@wa,usda.gov or pamela.scheinost@wa.usda.gov

Website: http://Plant-Materials.nrcs.usda.gov

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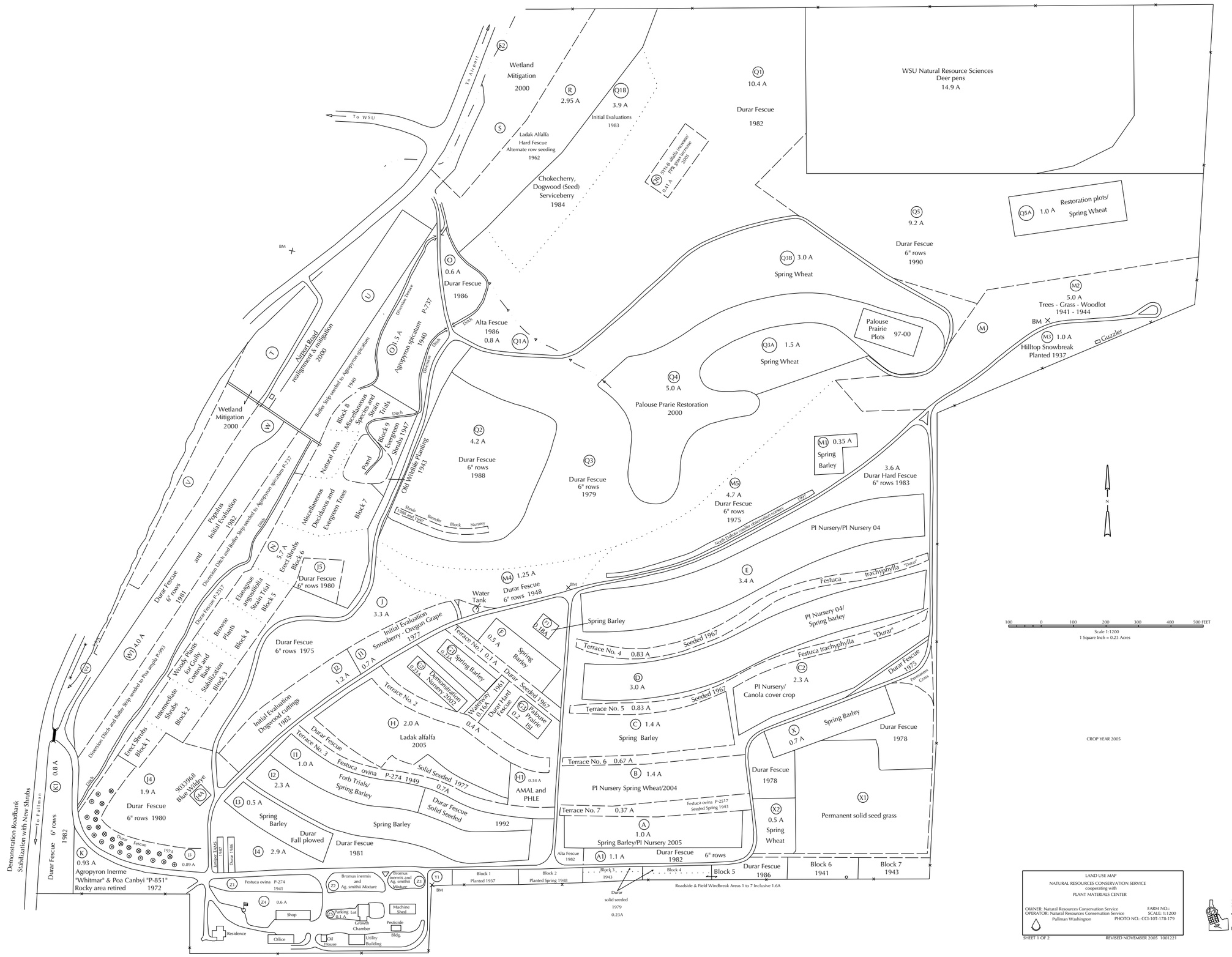
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1 Square Inch = 0.23 Acres
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NATURAL RESOURCES CONSERVATION SERVICE
cooperating with
PLANT MATERIALS CENTER
OWNER: Natural Resources Conservation Service
OPERATOR: Natural Resources Conservation Service
Pullman Washington
FARM NO.:
SCALE: 1:1200
PHOTO NO.: CCI-10T-178-179
SHEET 1 OF 2
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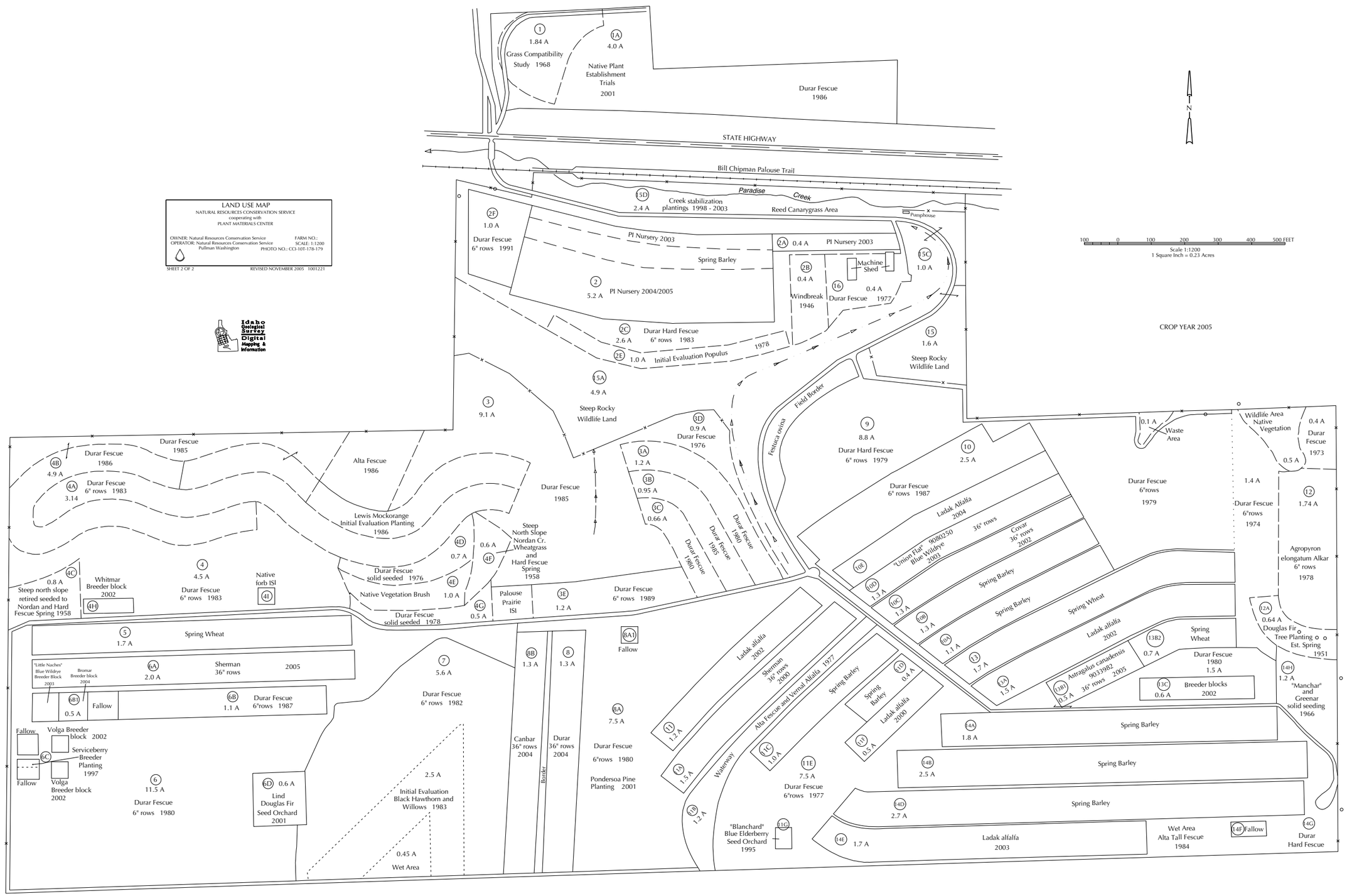
Idaho Geological Survey
Digital Mapping & Information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N
100 0 100 200 300 400 500 FEET
Scale 1:1200
1 Square Inch = 0.23 Acres
CROP YEAR 2005
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Durar Fescue 1980
Durar Fescue 1985
Durar Fescue 1980
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UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

STUDY TYPE: Plant Demonstration Nursery

LAND USES:

VEGETATIVE PRACTICES: PRIMARY:
SECONDARY:

DESCRIPTION: Demonstration plantings of the major conservation plants used in the area served by the Pullman PMC are needed. The plantings are used as training aids to familiarize NRCS employees with the materials available for use in their work areas. The plants are also available for viewing by the general public.

The objective is to establish and maintain demonstration nurseries that are functional and require minimal input to maintain. The nurseries will contain conservation plants commonly used in the area served by the PMC. They will be used as training aids by NRCS employees, district supervisors, university and high school students, and other interested groups. By familiarizing NRCS employees and the public, it is hoped that use of conservation plants will ultimately increase. The nurseries will also serve as a source of material for plant mounts and sheaths.

DURATION OF STUDY:

STUDY LEADER: Dave Skinner

LOCATION: Pullman, WA Lind, WA

COOPERATORS:

EXPERIMENTAL DESIGN:

PROCEDURE: In 2008 the nursery was re-established in Field G1. All plants were grown from seed in the growth chamber, then transplanted to the field.

Since the Lind demonstration nursery received little use, it was decided not to re-establish it in 2002 due to staffing shortages and subsequent time constraints. The 1996 nursery at Lind was removed in 2003.

PROGRESS:
The Pullman Nursery was planted in field G1 on May 8, 2008 from transplants grown in the PMC Growth Chamber. The planting was weeded as needed throughout the summer. Seed of Sand Hollow Bottlebrush squirreltail could not be obtained and that portion of the row was left open.
A demonstration planting of the Lind selection of Douglas fir, *Pseudotsuga menziesii*, was established at the Lind Dryland Research Unit in 2001. It is located in the old woody block west of the headquarters buildings. 100 plants of 3/1 stock were planted in 10 rows with a 10 foot spacing between rows and between plants within the row. Each row was covered with weed barrier fabric. There was no survival in the 2 western most rows of the planting. See “Lind Tree & Shrub Demo Planting” below for layout.

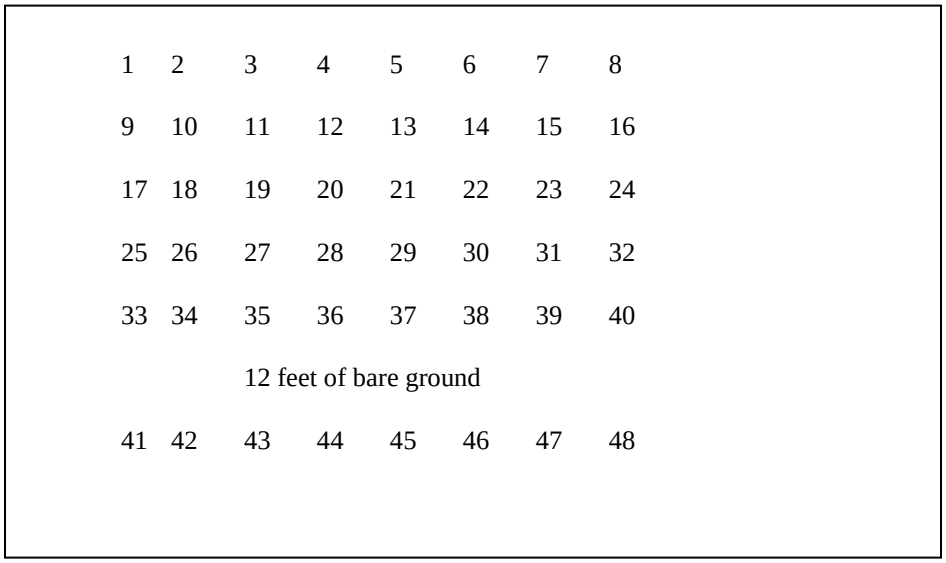
A shrub demonstration planting was established at the Lind Dryland Research Unit in 2004. On 4/19/04, 5 Bridger Select Rocky Mountain juniper, *Juniperus scopulorum*, 5 Basin big sage, *Artemisia tridentata*, and 5 gray rabbitbrush, *Ericameria nauseosa*, were planted in 2 strips of existing weed barrier on the south end of the 2001 Douglas fir planting. 5 golden currant, *Ribes aureum*, and 5 Snake River Plains fourwing saltbush, *Atriplex canescens*, were added on 5/12/05. See "Lind Tree & Shrub Demo Planting" below for layout.

Demonstration Nursery
Pullman WA Plant Materials Center

Plants in this nursery were selected for demonstration based on current usefulness and popularity. They were planted in spring 2008 with plugs grown in greenhouse.

Layout

North



1 ---- Sandberg Bluegrass *Poa secunda*

Local germplasm –not released

Native bunchgrass. Sandberg bluegrass is one of the earliest-growing perennial grasses in the Pacific Northwest. It escapes summer drought and is capable of growing on very shallow soils. This particular collection is a native Palouse Prairie ecotype.

2 Canbar Canby bluegrass *Poa secunda*

Pullman WA PMC 1979

Native bunch grass. Associated with bluebunch wheatgrass and ponderosa pine plant communities. Primary use: as understory species in mixture on sites that need an early spring grass to compete with annual weeds. Grows well in regions with 24+" rainfall.

3 Sherman Big bluegrass *Poa secunda*

Pullman WA PMC 1945

Native bunch grass. Collected in Sherman County, Oregon. Selected for productivity of forage, roots and seeds. Has distinctive blue color. Adapted to well-drained soils in PNW and Great Basin states, at elevations 300 – 8,000 feet with 10 – 20" annual rainfall. Used for seeding dryland pasture and range, stabilizing soil, reseeding after wildfires, and restoring natural areas.

4 Common Kentucky bluegrass *Poa pratensis*

Many cultivars available. Native and introduced sod-forming grass. Valued for quality forage and ability to withstand heavy impact. Considered to be most important turf grass in the U.S.

5 P-6435 Idaho fescue *Festuca idahoensis*

Identical to 'Winchester' germplasm released by Benson Farms, Inc.

Native bunch grass. Useful for late season grazing. Is found on all aspects and on wide variety of soil types. Most common at elevations of 5,000 – 8,000 feet.

6 Covar Sheep fescue *Festuca ovina*

Pullman WA PMC 1977

Introduced bunch grass developed from material collected in Konya, Turkey. Slow to establish, but once established, is very persistent, winter hardy and drought tolerant. Recommended for controlling erosion in 10 – 17 inch rainfall zones of the Pacific Northwest. Not intended for forage.

7 Durar Hard fescue *Festuca brevipila*

Pullman WA PMC 1949

Bunch grass introduced from Europe. Originally evaluated in Union, Oregon. Competitive with other grasses and weeds. Low palatability. Useful anywhere a long-lived, low-maintenance ground cover is needed.

8 Hi-Mag Tall fescue *Schedonorus phoenix*

Missouri Agricultural Experiment Station and USDA-ARS 1997

Endophyte-free. Has higher levels of magnesiumthan other tall fescue cultivars. Developed for purpose of minimizing effects of grass tetany in cattle and sheep. (Grass tetany is nutritional disorder caused by magnesium deficiency.)

9 Bannock Thickspike wheatgrass *Elymus lanceolatus* ssp. *lanceolatus*

Aberdeen ID PMC 1995

Native sod-forming grass. Composite of germplasm collected near The Dalles, OR; Pocatello, ID; and Quincy, WA. Establishes quickly, produces large amounts of forage and is drought tolerant. Recommended for rangeland erosion control, forage and cover in 8 – 16" precipication zones, critical area stabilization, filter strips, and areas infested with annual weeds.

10 Critana Thickspike wheatgrass *Elymus lanceolatus* ssp. *lanceolatus*
Bridger MT PMC 1971
Native sod-forming grass. Developed from germplasm collected near Havre, MT. Selected because establishes more rapidly than other native species and is drought tolerant. Grows within the 10 – 20" precipitation zones in the northern Rocky Mountains and adjacent Great Plains regions.

11 Whitmar Beardless Bluebunch wheatgrass *Pseudoroegnaria spicata* ssp. *inermis*
Pullman WA PMC 1946
Bunch grass native to Palouse prairie. Germplasm collected near Colton, WA. Beardless form bluebunch wheatgrass. Adapted to 12+" precipitation zones. Selected for forage quality and seedling vigor. Intended for rangeland within Palouse region and re-establishment of native plant communities.

12 Secar Snake River wheatgrass *Elymus wawawaiensis*
Pullman WA PMC, ID-OR-WY-MT Agricultural Experiment Station, and WA Agriculture Research Center 1980
Native bunch grass. Originally released as cultivar of Bluebunch wheatgrass, but has been found to be different species. Germplasm collected from Snake River gorge near Lewiston, ID. Intended for rangeland and re-establishment of native plant communities in areas receiving 8 or more inches of rainfall. One of the most drought tolerant native grass cultivars available.

13 Goldar Bluebunch wheatgrass *Pseudoroegnaria spicata*
Aberdeen ID PMC, ID-UT Agriculture Experiment Station, USDA-ARS 1989
Native bunch grass. Developed from seed collected near Asotin, WA. Selected for rapid establishment, high forage production and ability to survive at 12+" rainfall. Intended for rangeland, re-establishment of native plant communities, firebreaks, and critical area stabilization.

14 p7 polycross Bluebunch wheatgrass *Pseudoroegnaria spicata*
Utah Agriculture Experiment Station, USDA-ARS 2001
Native bunch grass. Composite of 23 open-pollinated, native site collections from WA, OR, NV, UT, ID, MT and BC; and 2 cultivars: Whitmar and Goldar. Intended to provide genetic diversity with a single germplasm for reclamation of semi-arid to mesic sites where Bluebunch wheatgrass was component of original vegetation.

15 NewHy Hybrid wheatgrass *Pseudoroegnaria spicata* X *Elymus repens*
Utah Agriculture Experiment Station, USDA-ARS, USDA-NRCS 1989
Bluebunch wheatgrass X Quackgrass hybrid. Intended to combine the vigor, productivity, salinity tolerance, and persistence of quackgrass with the drought resistance, caespitose growth habit, seed quality, and forage quality of bluebunch wheatgrass. Recommended for range sites with moderate salinity problems and receive 14" rainfall.

16 Latar Orchardgrass *Dactylis glomerata*
Pullman WA PMC 1957
Introduced bunch grass. Selected for low lignin (fiber) content and late maturing characteristic. Matures 10 to 14 days later than common orchardgrass and is usually in the pre-bloom stage when alfalfa is at the optimum growth stage for cutting hay.

17 Rosana Western wheatgrass *Pascopyrum smithii*
Bridger MT PMC 1972
Native rhizomatous grass. Developed from germplasm collected in north central MT. Selected for seedling vigor and ease of establishment. Recommended for seeding degraded rangeland and disturbed sites in the northern Great Plains and Intermountain regions.

18 Alkar Tall wheatgrass *Thinopyrum ponticum*
Pullman WA PMC 1958
Introduced bunch grass. Original germplasm presented to the USDA by Vavilov in 1932. Intended for pasture in wet, alkaline soils and semi-arid regions of the west within 270 – 5500 feet elevation.

19 Pryor Slender wheatgrass *Elymus trachycaulus*
Briudger MTPMC 1988
Native bunch grass. Developed from germplasm collected in the Pryor Mountains of Southcentral Montana. Selected for salinity tolerance and rapid growth. Adapted to short-lived dryland seedings receiving 12+" precipitation.

20 Manska Intermediate (Pubescent) wheatgrass *Thinopyrum intermedium*
Bismark ND PMC, North Dakota Agriculture Experiment Station, USDA-ARS, University of Nebraska 1992
Introduced rhizomatous grass. Developed from material originating in Russia. Very nutritious and highly palatable. Recommended for pasture and grass alfalfa hay mixtures in the northern and central Great Plains regions that receive 14+" rainfall.

21 Reliant Intermediate wheatgrass *Thinopyrum intermedium*
Bismark ND PMC, North Dakota Agriculture Experiment Station, USDA-ARS 1991
Introduced rhizomatous grass. Developed from material adapted to the Great Plains region. Selected for persistence and sustained productivity under hayland management in mixes with alfalfa.

22 Rush Intermediate wheatgrass *Thinopyrum intermedium*
Aberdeen ID PMC, Idaho Agriculture Experiment Station 1994
Introduced rhizomatous grass. 'Rush' was initially considered a separate species, *Agropyron varnens,* but cytology studies determined that it was a member of the intermediate wheatgrasses. Developed from seed originating in Germany. Selected for superior seedling emergence and vigor compared to other wheatgrasses.

23 Manifest Intermediate wheatgrass *Thinopyrum intermedium*
Bismarck NDPMC, USDA ARS, ND Experiment Station 2007
Introduced rhizomatous grass. Manifest exhibits excellent persistence under Grazing and consistently high forage yield. It is adapted to areas that receive 14+ inches of annual precipitation.

24 ---- Prairie Junegrass *Koeleria macrantha*
Local Germplasm – not released
Native bunchgrass. This collection originates from a Palouse Prairie remnant. It differs from prairie junegrass that occurs east of the continental divide in chromsome number and maturity date. It is an important understory grass .

25 Garrison Creeping foxtail *Aleopecarus arundinaceus*
Bismarck, ND PMC 1963
Long-lived introduced rhizomatous grass. Adapted to wet soils at high elevations with 18+" precipitation. Has been recommended for streambank stabilization and wet pastures. Palatable only during early stages of growth and sometimes considered to be too aggressive.

26 Bromar Mountain bromegrass *Bromus marginatus*
Pullman WA PMC, WA and ID Agriculture Experiment Stations 1946
Native, short-lived bunch grass. Developed from seed collected on the WSU campus in 1933. Taller, more productive, more disease resistant and later maturing than other bromegrass cultivars. Recommended for alternate row plantings with sweet clover (green manure), and pasture seedings.

27 Regar Meadow bromegrass *Bromus bierersteinii*
Aberdeen ID PMC and Idaho Agriculture Experiment Station 1966
Introduced bunch grass that may produce short rhizomes. Developed from germplasm collected in Turkey in 1949. Ideal pasture grass. Highly palatable and maintains green growth for extended period of time.

28 Vavilov Siberian wheatgrass *Agropyron fragile*
Utah Agriculture Experiment Station, USDA-ARS 1996
Introduced bunch grass. Developed from germplasm originating in the former USSR, Turkey and Kazakhstan. Used for forage. Similar to cultivars of Crested wheatgrass, though more drought tolerant and better adapted to sandy soils. Can be grown in regions with 8+" of precipitation and up to 7,000 feet elevation.

29 Douglas Crested wheatgrass *Agropyron cristatum*
Utah Agriculture Experiment Station, USDA-ARS, USDA-NRCS 1994
Introduced bunch grass. Derived from germplasm originating in the former USSR, Turkey and Iran. Named in honor of Douglas Dewey, who established the germplasm for the grass breeding program for the USDA-ARS at Logan. Produces less forage than other cultivars, but is leafier and remains green longer into the growing season. Requires 13-14" or more annual precipitation. Valued for forage.

30 Nordan Crested wheatgrass *Agropyron desetorum*
North Dakota Agriculture Experiment Station, USDA-ARS 1953
Introduced bunch grass. Selected for forage quality, seedling vigor and long-term productivity. More drought tolerant than *A. crisatutum*

31 Roadcrest Crested wheatgrass *Agropyron cristatum*
Logan, UT USDA-ARS 1998
Introduced. One of the only two cultivars of Crested wheatgrass that is rhizomatous. Recommended for use along roadsides or low-maintenance turf in 10 inch and higher rainfall areas.

32 HyCrest II Crested wheatgrass (cross) *Agropyron cristatum* x *Agropyron desertorum*
Logan, UT USDA-ARS 1996
Introduced bunch grass valued for forage. Released to preserve genetic purity of the cultivar HyCrest. Selected for productivity and drought and disease resistence.

33 Climax Timothy *Phleum pretense*
Canada
Short-lived introduced spreading grass. Spreads via culms rather than rhizomes. One of the most palatable and productive grasses grown for hay. Thrives well in rich, fine-textured soils. Does not tolerate drought or prolonged high temperatures.

34 Union Flat germplasm Blue wildrye *Elymus glaucus*
Pullman WA PMC 2008
Native bunch grass recommended for Palouse prairie restoration, wildlife habitat and roadside revegetation. Germplasm collected from Palouse prairie site at 1800 feet elevation. Selected for rapid emergence and growth rate.

35 Little Nachez germplasm (Source identified) Blue wildrye *Elymus glaucus*
Pullman WA PMC proposed release date 2010
Native bunch grass similar to Union Flat Blue wildrye, but has distinctive red color. Originates from a stand in the Nachez River drainage west of Yakima. This selection exhibits excellent vigor, high seed

production, and greater longevity than 225 other genotypes in a common garden study. Will be recommended for roadside revegetation and landscaping.

36 Bozoisky-select Russian wildrye *Psathyrostachys juncea*
Logan, UT USDA-ARS 1984
Long-lived introduced bunch grass valued for pasture in dry areas. Selected for seedling vigor and high forage yields. Provides excellent protein source even when fully mature.

37 Shoshone Beardless wildrye *Leymus triticoides*
Bridger MTPMC 1990.
Long-lived rhizomatous grass. Extremely tolerant of saline and saline-sodic soil conditions. Provides excellent soil stabilization and weed suppression.

38 Magnar Basin wildrye *Leymus cinerus*
Aberdeen ID PMC 1979
Native bunch grass with large coarse leaves. Germplasm was provided by the Saskatchewan Experiment Station but may originate from Nelson BC. Selected for high forage production and good winter cover. Adapted to Northwest and Intermountain regions receiving 8 or more inches of rainfall. Recommended for rangeland, soil stabilization and wildlife cover.

39 Trailhead Basin wildrye *Leymus cinerus*
Bridger MT PMC 1981
Native bunch grass with large coarse leaves. Germplasm collected near Roundup, MT. Selected for stand longevity and drought tolerance. Adapted to Northwest and Intermountain regions receiving 8 or more inches of rainfall. Recommended for rangeland, soil stabilization and wildlife cover.

40 Volga Mammoth wildrye *Leymus racemosus*
Pullman WA PMC 1949
Introduced rhizomatous grass developed to control wind erosion on sand dunes in the Pacific Northwest. Other uses include mine reclamation, wildlife habitat, and soil stabilization on pivot corners.

41 Richfield Firecracker penstemon *Penstemon eatonii*
Aberdeen ID PMC 1994
Native forb with bright red flowers and fibrous root system. Germplasm collected near Richfield, UT. Adapted to full sunlight, moderately well drained soils and 10 – 16" rainfall in areas at 3,300 – 8,000 feet elevation. Intended uses include erosion control, diversification, beautification and pollinator habitat.

42 Clearwater Apline penstemon *Penstemon venustus*
Aberdeen ID PMC 1994
Native forb with violet to violet-purple flowers. Germplasm collected in the Clearwater River drainage in Idaho. Adapted to full sunlight, moderately well to well drained soils and 20 to 35 inch rainfall in areas at 1,000 to 6,000 feet elevation. Intended uses include erosion control, diversification, beautification and pollinator habitat.

43 Syn-B Alfalfa *Medicago sativa*
Germplasm in development- not released.
Introduced legume typically seeded for hay. Alfalfa performs well in deep well-drained soils. Syn-B originates from 11 plants growing in a 7" precipitation area. Heritability of drought tolerance of Syn-B is under evaluation.

44 Appar Blue flax *Linum perenne*

USDA-NRCS, Idaho Agricultural Experiment Station, Utah Division of Wildlife Resources, Forest Service Forest and Range Experiment Station 1980.

Native forb with deep blue flowers. Germplasm collected in Black Hills, SD. Originally released as native flax, *Linum lewisii*, however since has been determined to be naturalized Blue flax introduced from Europe. Selected for vigor, beauty and ability to compete with grasses. Adapted to sunny open slopes, well-drained soils, and 10 to 18 inch rainfall areas at 1,000 to 6,000 feet elevation. Intended for erosion control, reclamation, highway right-of-ways, homes, gardens, parks, diversity, and beautification.

45 Delar Small burnet *Sanguisorba minor*

Aberdeen ID PMC, Idaho Agriculture Experiment Station 1981

Introduced, long-lived, evergreen, non-leguminous, perennial forb. Germplasm from European sources. Selected for forage production, cold tolerance, and palatability for both livestock and wildlife.

46 ---- Blanketflower *Gaillardia aristata*

Cultivar not released

Native forb with bright yellow and orange flowers. Adapted to wide range of soil types, precipitation zones and elevations within Pacific Northwest and Intermountain regions. Recommended for diversification, beautification, and pollinator habitat.

47 Timp Utah sweetvetch *Hedysarum boreale*

Upper Colorado Environmental Plant Center, Utah Division of Wildlife Resources, Colorado State University Agricultural Experiment Station, Utah State University Agricultural Experiment Station, and USDA-NRCS 1994

Native perennial legume with bright pink flowers, deep taproots and several lateral roots. Germplasm collected in Utah. Selected for seedling vigor, site adaptability, persistence, seed production, nitrogen fixation, and stability. Recommended for erosion control, beautification, forage for livestock and wildlife and pollinator habitat. Grows best in areas with 15+" precipitation.

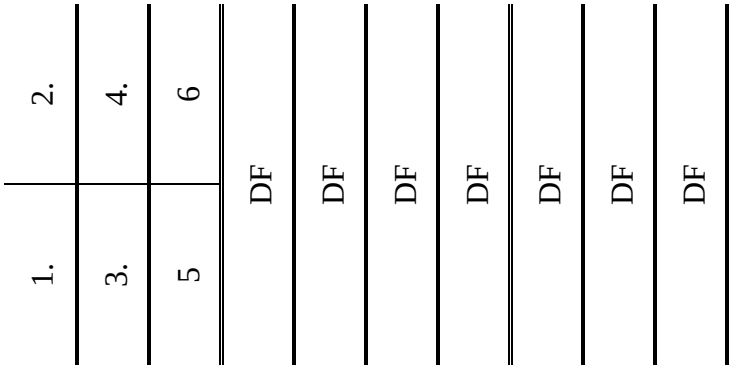
48 9033982 Canadian milkvetch *Astragalus canadensis*

Pullman WA PMC 2012?

Native perennial legume with cream colored flowers. Adapted to wide range of habitats throughout North America. Looks similar to closely related poisonous locoweeds, so its use as forage is not recommended unless positive identification can be made. However, is recommended for native community revegetation and pollinator habitat.

Lind Tree & Shrub Demo Planting: Lind Dryland Research Unit

N↑



1. Snake River Plains fourwing saltbush, *Atriplex canescens*, 5 ea planted 5/12/05. Source: Aberdeen PMC
2. gray rabbitbrush (2004) #1, #2 (from S.) replanted 5/12/05. Source: Plants of the Wild.
3. Rocky Mountain juniper (2004). Replanted plant #1 5/12/05. Source: Bridger PMC.
4. Basin big sage (2004) Replanted #3, #5 5/12/05.
5. golden currant planted, 5 ea 1 gal pots 5/12/05.
6. existing Douglas fir planting. Originally 10 rows of Douglas fir were planted in 2001.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

I. Study Title: Alfalfa: Comparison of Syn-B alfalfa germplasm to commercial varieties

Study Number: WAPMC-P-0607-CP

II. Problem: Alfalfa typically does not grow below 10" MAP. We identified 11 plants growing on a site that receives 7" MAP. These plants were cloned, crossed, and recrossed (Syn-B). .

III. Objective: Determine if Syn-B has inherent superior drought tolerance.

IV. Procedure:

Duration of Study:	2006-2008
Study Leader:	Mark Stannard
Location:	Prosser, Lind, Davenport, and Othello
Cooperators:	WSU
Experimental Design	RCB; 5 replications, 11 treatments, 4 sites

Treatments:

a. Melton
b. Wrangler
c. Vernal
d. Shaw
e. Ladak
f. Magnagraze
g. Rangelander
h. WL357HQ
i. Ranger
j. Syn-B
k. Ladak Plus

V. Progress:

Fields were sprayed immediately prior to seeding with 2 pt/acre Eptam and incorporated. Hege 90 plot drill used to seed plots. Each plot 20' long. All sites were dryland.

Seeding dates were: Othello 4/25/06
Prosser 4/25/06
Lind 4/27/06
Davenport 4/27/06

Biomass was measured in 2007 and 2008. Green-up differences were compared in spring 2008.

- Syn-B had no significant yield advantage over any of the other varieties at all 4 sites. Furthermore, differences in yields for all 11 treatments were nonsignificant.
- There were differences in spring green-up dates at all 4 sites.
- No further evaluations are planned.

NATURAL RESOURCES CONSERVATION SERVICE
PLANT MATERIALS CENTER
PULLMAN, WASHINGTON

PMC STUDY PLAN

I. Study Title: Buffers: Horse Heaven Hills Highway 221 buffer management study

Study Number: WAPMC-T-0501-CP

II. Problem: Wind erosion creates saltated soil particles that dislodge other soil particles. These particles become fugitive dust problems downwind.

III. Objective: Determine if a grass buffer strip will withstand farm traffic

IV. Procedure:

A 75' wide x 700' long fallowed field was identified adjacent to Hwy 221 in Beton Co. This plot lies immediately north of Sellards road on the west side of Hwy 221.

The field was conventional fallowed and had ~ 500 lb/acre residue along with Russian thistle carcasses.

The south half of the strip was broadcast seeded to 10 lb/ac Nordan crested wheatgrass + 3 lb/ac Sherman big bluegrass.

The north half was broadcast seeded to 3 lb/ac Secar Snake River wheatgrass + 3 lb/ac Sherman big bluegrass + 4 lb/ac Schwendimar thickspike wheatgrass + 4 lb/ac Nordan crested wheatgrass.

The entire strip was rolled immediately after seeding on November 12, 2004.

V. Progress:

The strip was mowed in spring 2005 while the cheatgrass was fully headed and heads still green. Stands of the seeded grasses at mowing were excellent.

Stand data were taken in 6/2/05. Random 1 sq ft frames.

Farmer drove tracks and tractors on plot for 2 seasons to simulate actual use. Stand counts were taken on May 6, 2008 in the "tracked up" areas.

6/2/2005

South

	Cwg	Sherman	Cheat	Mustard	thicksp	Ruth	Secar
1	7	2			-		-
2	10				-		-
3	2	2			-		-
4	10	2			-		-
5	9	2			-		-
6	11	3			-		-
7	13	2			-		-
8	4				-		-
9	6	2			-		-
10	10	4			-		-

North

	Cwg	Sherman	Cheat	Mustard	thicksp	Ruth	Secar
1	5	5					
2	4						
3	2	2					2
4	7	4					8
5	8	8					
6	4	2					2
7	5						
8	10	3					
9	5	3					
10	8	4	5				

5/6/2008

South

	Cwg	Sherman	Cheat	Mustard	thicksp	Ruth	Secar
1	41	2	1	0	-	0	-
2	15	3	3	0	-	0	-
3	5	0	2	4	-	0	-
4	8	0	0	0	-	0	-
5	5	0	1	3	-	0	-
6	9	1	1	0	-	0	-
7	10	1	2	0	-	0	-
8	6	1	0	0	-	0	-
9	10	0	0	0	-	0	-
10	8	1	23	3	-	0	-

North

	Cwg	Sherman	Cheat	Mustard	thicksp	Ruth	Secar
1	1	1	0	0	5	0	0
2	1	1	5	1	0	0	0
3	3	0	2	0	0	0	0
4	8	1	0	0	1	0	0
5	2	0	1	0	18	0	0
6	5	0	0	0	0	0	0
7	12	2	18	2	4	0	0
8	7	0	2	0	0	0	0
9	6	0	0	0	0	0	0
10	5	0	2	1	3	0	0

A grass buffer seeded November 2004 adjacent to Highway 221 south of Prosser, Washington.

Photo taken early May 2005.

The same buffer in late August 2006.

Field borders provide ideal travel lanes for grain trucks during harvest, provide cover for upland birds, and reduce weed movement from adjacent fields.

NATURAL RESOURCES CONSERVATION SERVICE
PLANT MATERIALS CENTER
PULLMAN, WASHINGTON

PMC STUDY PLAN

I. Study Title: Buffers: Horse Heaven Hills windward tall grass study.

Study Number: WAPMC-T-0601-CP

II. Problem: Wind erosion creates saltated soil particles that dislodge other soil particles. These particles become fugitive dust problems downwind.

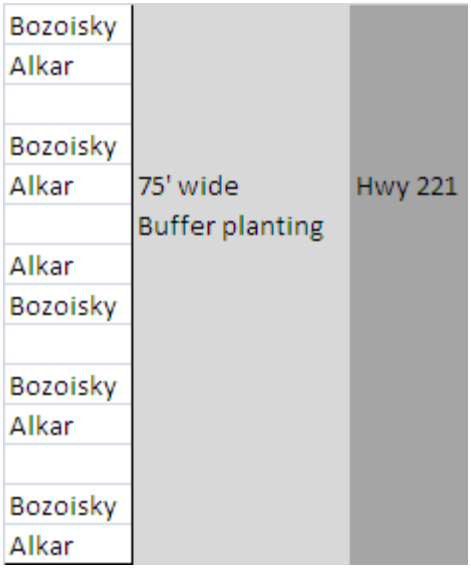
III. Objective: Determine if tall grasses rows on the windward side of a grass buffer strip will reduce wind velocities near the soil surface thereby allowing saltated particles to drop out of the air column.

IV. Procedure:

A 6' wide strip of cropland on the windward side of a 75' wide grass buffer was cultivated in October 26, 2005. A split-wheel packer was built at the PMC to create a furrow to seed the treatments. Seeding occurred the same day.

Treatments: Bozoisky RWR
Alkar TWG

Five replications – 25' treatment grasses, 25' unplanted check
Design—modified RCB



V. Progress:

Created wheatgrass readily volunteered in the furrows. Emergence of Alkar was fair and emergence of Bozoisky was nonexistent in spring 2006. Spring moisture was very good in April and May. Nonetheless, the seeded grasses were unable to survive. No living grasses of Alkar or Bozoisky were found in July 2006.

Cultivated ground

Example of the deep furrow created by split packer wheel. Seed was drilled into the furrow using a Hege single row cone seeder.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN
Pullman Plant Materials Center

TITLE: Initial Evaluation of *Caragana* species
STUDY NUMBER: WAPMC-T-0802-CP

NATIONAL PROJECT NUMBER: Cropland 3.1 Controlling erosion on cropland by crop conversion to perennial crops or less erosive annuals

STUDY TYPE: Initial Evaluation for Technology Development
LOCATION: Horse Heaven Hills study site on the Mike Schmidt farm.
STUDY LEADER: Mark Stannard
DURATION OF STUDY: 2008-2013
COOPERATORS: Washington Benton County CD, Mike Schmidt.
LAND USE: Cropland
VEGETATIVE PRACTICES: 386 – Field Border, 422 – Hedgerow Planting, 380 – Windbreak/Shelterbelt Establishment, 645 – Upland Wildlife Habitat Management

PROBLEM: *Caragana arborescens* Lam. is a drought hardy, deciduous, nitrogen-fixing shrub adapted to less than 10 and up to 20+ inch precipitation areas in Washington State. It has long been used for windbreaks, hedges and secondarily for wildlife food.

Currently *C. arborescens* is being tested in the Horse Heaven Hills area of Washington State for wind erosion control and dust abatement. Other source materials for *C. arborescens* in addition to other *Caragana* species need to be tested in the area for adaptation and wind protection attributes.

OBJECTIVE: Collect *Caragana* species including different *C. arborescens* accessions, propagate and install an initial evaluation planting in the Horse Heaven Hills area. Determine adaptability and suitability for wind erosion/dust abatement.

STUDY DESIGN: 6 plants per accession, spacing 8 feet. Spring plant in 2008. Plant in 6 foot wide weed barrier.

MATERIALS AND METHODS: Deepot potted plants of *Caragana* species, additional commercial source plants of *Caragana*, weed barrier. Install weed barrier and plant *Caragana* plants into it.

EVALUATIONS: Assess growth rate (height and canopy measurements), form, adaptability to the site, ability to reduce wind erosion/blowing dust, disease and insect problems and other pertinent parameters.

TECHNOLOGY TRANSFER PRODUCTS: Plant guide(s)/fact sheet(s), Current Developments article, revision of Technical Notes or new Technical Note, local newspaper or other appropriate news article geared to landowners.

REFERENCES: *Caragana* literature review, 2007

Progress:

List of Accessions Collected

Source	Species	plant symbol	acc. no.	their acc. no.	origin
NC RPI Sta	C. arborescens	CAAR18	9080252	Ames 17776	Poland
"	"	CAAR18	PI 310390	--	Uzbekistan
"	"	CAAR18	PI 369217	--	Russian Federation
"	"	CAAR18	PI 371524	--	Former Soviet Union
"	"	CAAR18	PI 483449	--	US Michigan
"	"	CAAR18	PI 633648	--	Russian Federation, Irkutsk
"	"	CAAR18	PI 636378	--	Lublin, Poland
"	C. frutex	CAFR80	9080250	Ames 13823	US Iowa
"	C. manschurica	CAMA60	PI 107663	--	China
East Lansing PMC	C. arborescens var. pendula	CAAR18	PI 483449	--	
Bridger PMC	*Caragana*	CARAG	9078680	--	Anaconda, MT
Lawyer Nursery	C. arborescens	CAAR18	9080253	--	
Lincoln-Oakes Nursery	C. arborescens	CAAR18	9019579	--	Lincoln-Oakes local collection
DLEG	C. boisii	CABO19	9080254	940005	
DLEG	C. brevispina	CABR40	9080255	940006	
DLEG	C. intermedia	-	9080256	940135	
DLEG	C. korshinskii	CAKO6	9080257	940136	
DLEG	C. zahlbruckneri subsp. zahlbruckneri var. pekinensis	CAZAP	9080258	940009	Jamie Wahl

NC RPI Sta – USDA ARS North Central PI Station, Ames, IA
DLEG – Desert Legume Program, Tucson, AZ

January 16, 2007: Planted available seed. On January 22, 2007 most of the seed was beginning to germinate. (9 ARS accessions were planted with 25 cones each. 4 other accessions were planted with 42 cones each. Five accessions from DLEG arrived late. They were planted on February 8, 2007. Germination occurred on 9080256 and 9080257.

June 4, 2007: Counts were made on available plants as follows:

Acc. No.	Species	Source	No. avail plants	Comments
483449	C. arborescens	USDA, ARS, PI, Ames, IA	25	
633648	C. arborescens	same	25	
636378	C. arborescens	same	25	
9078680	*Caragana*	Bridger PMC	31	
483449	C. arborescens var. pendula	MI PMC	42	
9080253	C. arborescens	Lawyer Nursery	42	
9019579	C. arborescens	Lincoln-Oakes Nursery	42	
9080250	C. frutex	USDA, ARS, PI, Ames, IA	25	
369217	C. arborescens	same	25	
371524	C. arborescens	same	25	
107663	C. manschurica	same	25	
9080252	C. arborescens	same	25	
310390	C. arborescens	USDA, ARS, PI, Ames, IA	25	
9080256	C. intermedia	DLEG	10	
9080257	C. korshinskii	DLEG	12	

	Block	position	accesn code	Accession	Vigor 0-5 * 5/28/2008	Survival 5/7/2009 0=dead, 1=alive	Replant 10/28/2009 0=no, 1=yes
	1	1	1	9019579	0	0	1
	1	2	1		1	0	1
North	1	3	1		1	0	1
^	1	4	1		2	0	1
	1	5	2	9078680	4	0	1
South	1	6	2		4	0	1
	1	7	2		1	0	1
	1	8	2		1	0	1
8 feet spacings	1	9	3	9080250	1	1	
1200 feet length	1	10	3		3	1	
date planted	1	11	3		1	0	1
4/16/2008	1	12	3		2	0	0
	1	13	4	9080252	4	0	1
	1	14	4		4	0	1
	1	15	4		5	0	0
	1	16	4		5	0	0
	1	17	5	9080253	3	0	1
	1	18	5		3	0	1
	1	19	5		1	0	1
	1	20	5		3	0	1
	1	21	6	107663	4	0	1
	1	22	6		5	0	1
	1	23	6		4	0	1
	1	24	6		4	0	1
	1	25	7	310390	5	0	1
	1	26	7		1	0	0
	1	27	7		5	0	0
	1	28	7		3	0	0
	1	29	8	369217	3	0	1
	1	30	8		2	0	1
	1	31	8		1	0	1
	1	32	8		4	1	
	1	33	9	371524	2	0	1
	1	34	9		3	0	1
	1	35	9		0	0	1
	1	36	9		1	0	1
	1	37	10	483449	3	0	1
	1	38	10		3	0	1
	1	39	10		4	0	1
	1	40	10		4	0	1

1	41	11	633648	3	0	1
1	42	11		5	0	1
1	43	11		5	0	1
1	44	11		1	0	0
1	45	12	636378	3	1	
1	46	12		2	1	
1	47	12		2	0	1
1	48	12		2	0	1
1	49	13	9080256	5	1	
1	50	13		5	1	
1	51	13		4	0	0
1	52	13		3	0	0
1	53	14	9080257	5	0	0
1	54	14		5	1	
1	55	14		0	0	0
1	56	14		5	0	0
1	57	15	dnr	5	0	0
1	58	15		5	0	0
1	59	15		0	0	0
1	60	15		5	1	
2	61	5		3	1	1
2	62	5		4	0	1
2	63	5		4	1	
2	64	10		5	1	
2	65	10		1	1	
2	66	10		3	1	
2	67	15		5	1	
2	68	15		5	1	
2	69	15		5	0	0
2	70	13		2	1	
2	71	13		3	0	0
2	72	13		2	1	
2	73	7		2	0	1
2	74	7		5	1	
2	75	7		3	1	
2	76	9		1	0	1
2	77	9		2	0	1
2	78	9		1	0	1
2	79	1		2	1	1
2	80	1		2	1	
2	81	1		2	0	1
2	82	6		3	0	1
2	83	6		1	0	1

2	84	6	2	0	1
2	85	4	2	0	0
2	86	4	1	0	0
2	87	4	0	0	0
2	88	12	1	0	1
2	89	12	2	0	0
2	90	12	5	0	0
2	91	11	3	1	
2	92	11	2	1	
2	93	11	5	0	0
2	94	2	2	0	1
2	95	2	5	0	1
2	96	2	2	0	1
2	97	14	4	0	0
2	98	14	5	0	0
2	99	14	4	0	0
2	100	8	2	0	1
2	101	8	5	0	0
2	102	8	4	0	0
2	103	3	2	0	1
2	104	3	3	1	
2	105	3	2	1	
3	106	12	1	0	0
3	107	12	1	0	0
3	108	12	0	0	0
3	109	3	1	0	0
3	110	3	1	0	0
3	111	3	1	0	0
3	112	7	2	0	1
3	113	7	4	0	0
3	114	7	3	0	0
3	115	1	3	0	1
3	116	1	3	0	1
3	117	1	3	0	1
3	118	14	4	0	
3	119	14	5	0	0
3	120	14	5	0	0
3	121	9	0	0	1
3	122	9	3	0	1
3	123	9	1	0	1
3	124	6	4	0	0

3	125	6	1	0	0
3	126	6	1	0	0
3	127	2	5	0	1
3	128	2	4	0	1
3	129	2	1	0	1
3	130	8	1	0	0
3	131	8	2	0	0
3	132	8	4	0	0
3	133	15	5	0	0
3	134	15	5	0	0
3	135	15	5	0	0
3	136	4	2	0	0
3	137	4	4	0	0
3	138	4	3	0	0
3	139	13	4	0	0
3	140	13	4	1	
3	141	13	5	1	
3	142	5	3	1	1
3	143	5	3	0	1
3	144	5	2	0	1
3	145	10	2	0	1
3	146	10	2	0	1
3	147	10	2	0	1
3	148	11	5	1	
3	149	11	4	1	
3	150	11	3	0	0

* 0= dead, 1= regrowth from base, 2= stagnate growth, 3= minor growth, 4= mod. Growth, 5= hi vigor good growth

NATURAL RESOURCES CONSERVATION SERVICE
PLANT MATERIALS CENTER
PULLMAN, WASHINGTON

PMC STUDY PLAN

I. Study Title: CFT: Ely-parker native grass comparison

Study Number: WAPMC-F-0405-BU

II. Problem: Numerous native grasses have been developed and not tested in Washington.

III. Objective: Determine adaptation of several natives grasses in a WHIIP planting near Dayton, WA.

IV. Procedure:

Seedbed Prepared by producer spring 2004. Each plot comprised of 10 rows, each row 10' long, 1' spacing between rows, each plot separated from adjacent plot with 5' wide plot of either Durar, or Anatone.

Location: NE1/4, Sec. 17, T9N, R38E

Established 3/19/04 Stannard and Fortner

Approximately 6 miles southwest of Dayton on the west side of Whisky Creek Road. Approximately ½ miles south of the Whisky Creek Rd – Lowe Hogeye road intersection. Plots are 100 feet north of the Ely farmstead.

N
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Plot 14 SECAR
Snake River Wheatgrass

Plot 13 ANATONE
Bluebunch Wheatgrass

Plot 12 P-7
Siberian Wheatgrass

Plot 11 WHITMAR
Beardless Wheatgrass

Plot 10 JIM CREEK
Bluebunch Wheatgrass

Plot 9	GOLDAR Bluebunch Wheatgrass
Plot 8	MAGNAR Basin Wildrye
Plot 7	JIM CREEK Basin Wildrye
Plot 6	TRAILHEAD Basin Wildrye
Plot 5	WINCHESTER Idaho fescue
Plot 4	SHERMAN Big Bluegrass
Plot 3	HIGH PLAINS Sandberg Bluegrass
Plot 2	CANBAR Canby Bluegrass
Plot 1	WALLOWA SOURCE Sandberg Bluegrass

V. Progress:

All materials established well. Local Field Office will collect data.

NATURAL RESOURCES CONSERVATION SERVICE
PLANT MATERIALS CENTER
PULLMAN, WASHINGTON

PMC STUDY PLAN

I. Study Title: CFT: Horse Heaven Hills buffer demo planting.

Study Number: WAPMC-F-0406-BU

II. Problem: The Horse Heaven Hills lie between the Columbia and Yakima rivers in southcentral Washington. Rain fall is some the lowest in the Pacific Northwest, and dryland wheat growers almost exclusively utilize a crop-fallow system. Wind erosion is a serious concern, and growers need more options to protect their soil resource.

III. Objective: Initiate a project in 2004 to evaluate and demonstrate a number of conservation plant species.

IV. Procedure:

HORSE HEAVEN HILLS BUFFER DEMO PLANTING

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CROPLAND

6’ WIDE WEED FABRIC	6’ WIDE WEED FABRIC	6’ WIDE WEED FABRIC	6’ WIDE WEED FABRIC + BARE GRD	6’ WIDE WEED FABRIC
17 CARAGANA ON 6’ SPACING	17 JUNIPERS ON 6’ SPACING	21 BIG SAGE ON 5’ SPACING	21 RABBITBRUSH ON 5’ SPACING	15 SALTBUSH ON 6’ SPACING ---
6’ WIDE WEED FABRIC	6’ WIDE WEED FABRIC	6’ WIDE WEED FABRIC	6’ WIDE WEED FABRIC	6’ WIDE WEED FABRIC
MAG VOLG BOZ ALKR CLEM	MAG VOLG BOZ ALKR CLEM	MAG VOLG BOZ ALKR CLEM	MAG VOLG BOZ ALKR CLEM	MAG VOLG BOZ ALKR
MAG VOLG BOZ ALKR CLEM	MAG VOLG BOZ ALKR CLEM	MAG VOLG BOZ ALKR CLEM	MAG VOLG BOZ ALKR CLEM	MAG VOLG BOZ ALKR
CLEAN TILL 6’ WIDE	CLEAN TILL 6’ WIDE	CLEAN TILL 6’ WIDE	CLEAN TILL 6’ WIDE	CLEAN TILL 6’ WIDE

GRASSES ARE PAIRED ROWS WITH 2’ SPACINGS IN THE ROW, 3’ BETWEEN ROW
CLEMATIS ARE A SINGLE ROW OF 5 PLANTS WITH 4’ SPACINGS

TOTAL LENGTH OF DEMO IS 484’ LONG

APRIL 7, 2004 CARAGANA, JUNIPER, BIG SAGE, RUBBER RABBITBRUSH PLANTED AND WATERED
APRIL 8, 2004 ALL GRASSES PLANTED AND WATERED,
MAY 18, 2004 SALTBUSH AND CLEMATIS PLANTED AND WATERED

CARAGANA (1 GAL POT) PROVIDED BY POW
JUNIPERS (40 CU IN) PROVIDED MY MT FOREST NURSERY
BIG SAGE (10 CUIN) PROVIDED BY POW
RUBBER RABBITBRUSH (10 CUIN) PROVIDED BY POW
SALTUSH (40 CUIN, PMC STOCK

V. Progress:

Establishment:

Rooted plants of 8 of 10 species were transplanted into fallowed soil on April 7-8, 2004. Western clematis and fourwing saltbush plants were transplanted on May 18, 2004.

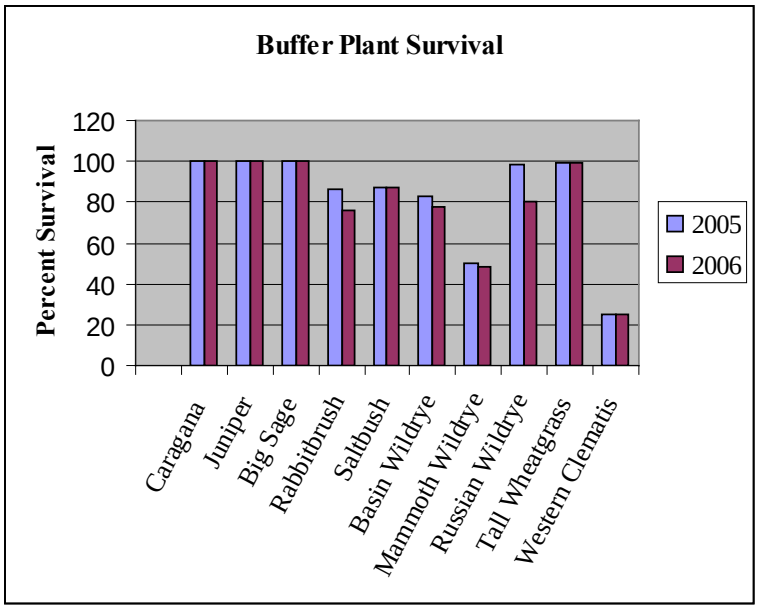
The entire planting was space planted to minimize competition. The shrubs were spaced 5-6 feet apart. Weed barrier cloth was laid in the shrub row to reduce weed growth and conserve moisture. The effective width of the barrier cloth was 10 feet (5 feet on each side of the row). The grasses were spaced 2 feet apart with a row and 3 feet between rows, and the western clematis was spaced 4 feet apart. The grass and clematis rows were maintained with clean tillage.

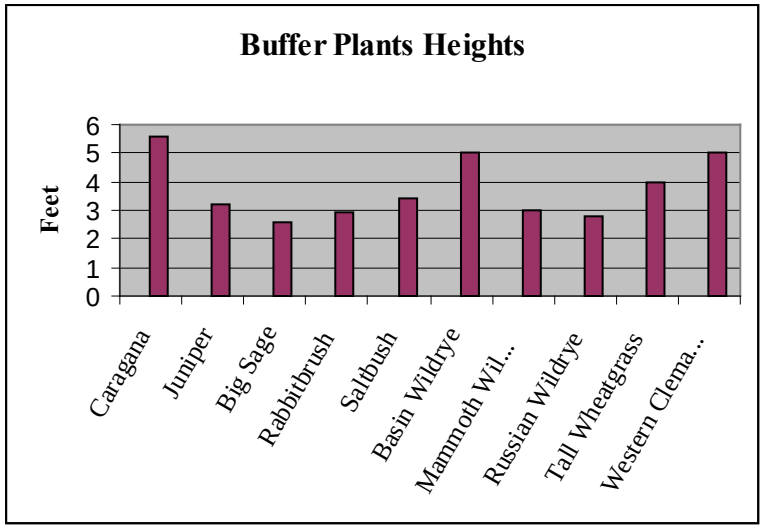
Each plant was watered the day of transplanting. Additional watering occurred on April 20th, May 5th, May 26th, June 18th, and August 4th, 2006. A 200 gallon tank of water in the bed of a pick up supplied each plant with approximately 1 liter of water at each watering.

Survival of all the plants was outstanding the year of establishment.

Rocky Mountain Juniper Seedling

Growth and Survival:


Buffer Plant Survival
Percent Survival
120
100
80
60
40
20
0
2005
2006
Caragana
Juniper
Big Sage
Rabbitbrush
Saltbush
Basin Wildrye
Mammoth Wildrye
Russian Wildrye
Tall Wheatgrass
Western Clematis


Buffer Plants Heights
Feet
6
5
4
3
2
1
0
Caragana
Juniper
Big Sage
Rabbitbrush
Saltbush
Basin Wildrye
Mammoth Wil...
Russian Wildrye
Tall Wheatgrass
Western Clema...

Caragana is one of the best performing plants in the planting. We pruned it back in the fall of 2004 to a height of 18-inches to stimulate stem numbers. Some of the plants are now 8-feet tall. Most of the plants were 2-4 feet wide and the canopy should close within a few years. While a closed canopy within the row will reduce wind, it will catch more Russian thistle carcasses and hand removal of the carcasses will be needed. The landowner reported that it tolerated 2,4-D herbicide drift quite well.

Rocky Mountain Juniper is performing very well. It is not as fast as growing as the caragana but it more trouble free. It did not require pruning and it catches far fewer Russian thistle carcasses.

Big Sage is one of the fastest growing shrubs in the planting and probably is reaching its maximum height. The plants vary considerably in size, shape, leaf density, and seed production. Some very tall native big sage plants occur a few miles west of the planting. These tall native plants should have better genetic potential for use as a buffer plant material.

Rubber Rabbitbrush is the most variable shrub in the planting. None of the plants are over 4 feet tall and a few are only 18 inches tall. Survival is not great and would be worse had barrier cloth not been laid to reduce weed competition.

Fourwing Saltbush should achieve a maximum height of 6 feet in the Horse Heaven Hills. This plant grows wider than tall and should reach a width of 10 feet.
Survival and growth are excellent considering that the seedlings were not well developed at planting. A major concern about saltbush is its ability to catch Russian thistle carcasses. As many as 22 carcasses were pulled from a single saltbush plant in the spring of 2005!

'Magnar' Basin Wildrye is the tallest grass in the planting. Basin wildrye occurs naturally in moist draws in the Horse Heaven Hills and scattered plants can be found on upland CRP plantings. While it is tall, it lacks sufficient stem density to be a useful herbaceous wind barrier in the Horse Heaven Hills.

'Volga' Mammoth Wildrye is not performing well in this planting. Survival is poor, stem density is poor, and its height is inadequate. It is spreading via rhizomes so it has some potential for stilling blow-out areas along roadsides in the area.

'Bozoisky' Russian Wildrye is performing fairly well. It is too short and the stem density is only fair which make it marginally useful as an herbaceous wind barrier in the Horse Heaven Hills. It is very competitive and weeds are noticeably reduced around the plants.

'Alkar' Tall Wheatgrass is the best performing grass in this planting. It has excellent stem density and the stems are very robust. It competes very well with weeds in the row. Since this plant normally needs higher precipitation, clean tillage around the plants is needed to reduce competition during the first growing season.

'Trailar' Western Clematis is a slow growing on this site. Weed growth around the plants was heavy and difficult to control without injuring the plants. Layering (rooting at the stem nodes) is not occurring. This plant frequently climbs fences and other upright structures. Placing a short upright support at the base of each plant should enable this plant to climb and provide some wind barrier effect. Our research has shown this plant to be very persistent once established. The crown is below the soil surface and the plant tolerates fire well. This might prove useful for Russian thistle carcass management.

The shrub row was roto-tilled immediately prior to planting. Six-foot wide **Weed Barrier Cloth** was laid and the edges were buried to prevent wind throw. Shrub plants were planted along the east edge of the weed barrier. A layer of weed barrier cloth was then laid along the west edge of the shrub row. This effectively eliminated all weed competition in the row and retarded soil moisture evaporation. Some tearing of the weed barrier is occurring after three years but it is holding up well. Dust accumulating on the surface of the barrier is reducing UV damage to the barrier cloth.

Russian thistle and mustard carcasses are a major issue in this planting. The grasses were planted on the windward side of the shrubs, and we hoped that the grasses would catch the carcasses. This did not occur. Hand removal of carcasses in the shrub row has been needed each spring. **Cheatgrass** numbers have been generally low in the planting but they are very large and produce huge amounts of seed.

Where Do We Go From Here?

1. Expand the 'Alkar' Tall Wheatgrass planting
    a. Remove the other grasses this fall.
    b. Evaluate transplanting Alkar in November, February, and March (all w/o irrigation)
    c. Initiate a study to determine which herbicides can be legally and safely applied to the soil to control cheatgrass and Russian thistle.
2. Initiate a study at the Lind Dryland Experiment Station to evaluate new collections of Caragana made in central Asia.
3. Initiate dialog with other governmental agencies such as WA DNR, and develop a plan to expand testing of herbaceous wind barriers in the Horse Heaven Hills.

4. Continue to evaluate the shrubs.
5. Install upright supports at the base of each Western Clematis plant and evaluate wind reduction potential.

NATURAL RESOURCES CONSERVATION SERVICE
PLANT MATERIALS CENTER
PULLMAN, WASHINGTON

PMC STUDY PLAN

I. Study Title: CFT: Evaluation of fall dormant seeding of Bozoisky Russian wildrye, DM Ranches

Study Number: WAPMC-F-0603-RA

II. Problem: Bozoisky Russian wildrye has not been adequately tested in Washington. Most seedings have been completed in the spring and failed.

III. Objective: Determine if Bozoisky Russian wildrye can be established via fall dormant seeding.

IV. Procedure:

Seed of Bozoisky Russian wildrye was acquired from the MTPMC.
The field was poor condition pasture that was mostly comprised of cheatgrass, bulbous bluegrass and Sandberg bluegrass. The field was fall disked to a depth of 8 inches.
A small patch of Boziosky was broadcast seeded on the east end of the field (12' x 60'; N 46.85804, W 119.25410, elev. 853') and packed. The remainder of the field was redisked and packed immediately prior to seeding. Seven pounds PLS Bozoisky, 30 pounds Vavilov, 20 pounds of Sherman were seeded to 5 acres using a JD disk drill set to place the seed at ¾". The seedbed was loose and after soil settling, the depth of seed placement should be ¼". Seeding took place on Nov. 23, 2005.

V. Progress:

The Bozoisky failed to establish. Vavilov and Sherman established very well.

06/08/2006

06/08/2006

06/08/2006

06/08/2006

06/08/2006

06/08/2006

06/08/2006

NATURAL RESOURCES CONSERVATION SERVICE
PLANT MATERIALS CENTER
PULLMAN, WASHINGTON

PMC STUDY PLAN

I. Study Title: CFT: City of Othello dryland grass trial for weed suppression.

Study Number: WAPMC-F-0609-BU

II. Problem: Annual weeds are a fire hazard on vacant lots in the City of Othello. Annual rainfall is under 8" and the soils are coarse.

III. Objective: Determine if perennial grasses are suitable for suppressing weeds and reduce the fire hazard.

IV. Procedure:

Field was rock picked by BSA and soil berm removed in March.

24 oz/ac Roundup on April 4th to control bulbous bluegrass was applied 4/3/2006. Spray conditions were calm and 45 degrees.

Plot area was cultivated + harrowed a 25' wide strip of ground along S. Broadway (between Elm and Soda streets) on march 17, 2006. Broadcast seeding took place immediately afterwards and rolled. Doyle Palmer, City Code Enforcement Officer, will arrange for irrigation of the plots until establishment.

The plots start on the south end and progress northward.

Each plot is 70' x 25' with the exception of plot #12 which is 40' long.

1. 'Vavilov' Siberian wheatgrass 14 lb/ac (broadcast)
2. 'Nordan' Crested wheatgrass 14 lb/ac
3. Sand Dropseed 1 lb/ac
4. 'Nezpar' Indian Ricegrass 12 lb/ac
5. Needle-and-thread grass 14 lb/ac
6. Bluebunch wheatgrass 14 lb/ac
7. 'Secar' Snake River wheatgrass 14 lb/ac
8. Crested + Secar + Canbar + Bottlebrush squirreltail 3/3/2/1 lb/ac
9. Secar + Needle-and-thread + Bottlebrush squirreltail 3/5/3 lb/ac
10. Vavilov + Nezpar + Canbar 3/3/3 lb/ac
11. Vavilov + Nezpar + Needle-and-thread + 'Volga' mammoth wildrye + Sand dropseed 2/3/4/.25 lb/ac
12. 'Canbar' Canby Bluegrass Note-- The 'Canbar' plot is only 40' long. 4 lb/ac

V. Progress:

Irrigation was not applied as planned. The only plot that had an acceptable stand was Vavilov Siberian wheatgrass.

NATURAL RESOURCES CONSERVATION SERVICE
PLANT MATERIALS CENTER
PULLMAN, WASHINGTON

PMC STUDY PLAN

I. Study Title: CFT: Wes Durheim Russian wildrye cultivar comparison.

Study Number: WAPMC-F-0610-RA

II. Problem: Russian wildrye has potential for improving pasture conditions in Washington but trials are very limited.

III. Objective: Determine if one or more cultivars of Russian wildrye will establish in Spokane Co.

IV. Procedure:

Field was disked, harrowed, and packed a week prior too seeding.
Field was seeded with 4 Planet Jr seeders on approx 24" row spacings on April 14, 2006.
Soil was moist and firm.

The field was divided into three sections.
The west 1/3 was seeded to Bozoisky Select
The middle 1/3 was seeded to Bozoisky II.
The est 1/3 was seeded to Mankato.

V. Progress:

PMS reports indicate that the field was largely overrun with quackgrass later that season. None of the plantings established.

NATURAL RESOURCES CONSERVATION SERVICE
PLANT MATERIALS CENTER
PULLMAN, WASHINGTON

PMC STUDY PLAN

I. Study Title: CFT: Evaluation of western clematis for windbreak potential, Roger Daniel Farm, LaCrosse.

Study Number: WAPMC-F-0702-CR

II. Problem: Weed carcasses collect in windbreaks and are difficult to manage.

III. Objective: Determine if western clematis planted along a fenceline could serve as a short windbreak and collect weed carcasses. Burning could be used to manage the carcesses because clematis appears to be fairly tolerant of fire.

IV. Procedure:

Thirty fenceposts were selected. At the base of each fencepost, either 'Trailar' western clematis or a wildland source western clematis was planted. The plants were watered at planting and 3 additional times in 2007.

V. Progress:

None of wildland plants were alive in July 2009. Thirteen of the 15 'Trailar' plants were alive and growing.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

STUDY TITLE: Dryland Legumes: Evaluation of the ability of *Astragalus canadensis var brevidens* (Gand.) Barneby, accession 9033982, to establish from direct seeding at Lind, WA

STUDY NUMBER: WAPMC-P-0401-CP
STUDY TYPE: Cultural Evaluation
LAND USES: Range: Perennial grass/permanent vegetative cover

PROBLEM: Canada milkvetch's ability to establish from direct seeding has not been documented.

OBJECTIVE: Determine 1) if direct seeding is a viable method of establishing Canada milkvetch in dryland seedings, 2) which of late fall or spring seedings are best suited to the species and 3) whether scarified seed establish better than non-scarified seed.

DURATION OF STUDY: 2004-2007
STUDY LEADER: Wayne Crowder
LOCATION: Lind, WA Dryland Research Unit
COOPERATORS: Washington State University

STUDY DESIGN: 3 reps, each of 9033982 Canada milkvetch and 9069117 (Bismark PMC), using scarified and unscarified seed.

EVALUATIONS: Date(s) of emergence, numbers emerged, number of survivors, success of establishment

PROGRESS: Fall 2003 to Spring 2004 Fall and spring seedings were done beginning fall 2003 and continuing through spring 2004. Seed was not scarified. No emergence was noted in the Canada milkvetch. Ladak alfalfa germinated and emerged much better. The site was left intact, except it was overseeded with winter wheat with a deep furrow drill in fall 2004.

Fall 2004 This seeding (Nov. 4, 2004) used 9033982 (Pullman) and 9069117 (Bismark PMC) as the accessions, with scarified and unscarified seed of each. Seed was scarified in a Forsberg batch scarifier, with 180 grit wet/dry sandpaper run about 3 to 4 seconds. Only about 3 grams of seed per accession was scarified. No inoculant was included. The seeding was made with a Hege cone seeder (push type).

The seeding was made at the north end of rows previously seeded in fall 2003 and spring 2004. The seeded area was previously chemical fallowed. Soil moisture was excellent with moisture at the surface. The was a slight incidence of frost/frozen soil which did not impede the seeding. The Hege cone seeder was run through each row without seed but with the shoe extended to disturb the soil and level the soil prior to seeding. Then the shoe was pulled all the way up and seed was dispersed without significant soil coverage, except that provided by the press wheel

following the seed. The area had been previously seeded to winter wheat with a deep furrow drill, so this seeding was made between the drilled rows of winter wheat, which was about 3-4 inches tall on Nov. 4. *Astragalus* rows were seeded in the deep furrow drill middles, on every other middle.

Three reps were seeded, with scarified and unscarified seed of each accession used at the rate of 1 gram/20 foot row. There were four 20 foot rows per replication.

SPRING 2005: On March 8, 2005 a spring seeding was made at Lind adjacent to the fall 2004 seeding. Pullman Canada milkvetch and Bismarck Canada milkvetch was used. Both were planted as scarified and unscarified seed. A hand pushed Hege cone seeder was used. Rows were prepped by running the seeder with the shoe extended about 1" twice down the row then seeded with the shoe nearly fully retracted. The seeding was conducted in the same manner as the fall 2004 seeding.

Evaluation: The fall 2003 and spring 2004 seedings were evaluated for spring emergence also on March 8, 2005, with the possibility that ungerminated seed might emerge at this time. No emergence was noted. Soil temperatures may have been too cold for germination. The rows of the fall 2004 seeding were evaluated closely on March 8, 2005 for possible germination and emergence. There was none in any of the rows. Moisture in these areas was ¾" to 1" deep. Standing wheat stubble had moisture at the soil surface. Moisture received since fall 2004 has been well below normal.

On April 20, 2005 the fall 2004 and spring 2005 seedings were evaluated. No emerged plants were found in any of the rows. No emergence was noted on May 12. Winter wheat within the seeded area for fall 2004 and spring 2005 seedings was sprayed with glyphosate on May 12. Also, evaluations for emergence in the fall 2004 and spring 2005 plantings were done on May 26 and June 7. No emergence was noted.

FALL 2005: The fall seeding was done on October 24, 2005. Seed of Pullman 9033982 *Astragalus canadensis* and Bismarck PMC 9069117 were used, with each represented with scarified and unscarified seed. The scarified seed was run in a Forsberg batch scarifier with 180 grit wet/dry sandpaper for 20 seconds. 5 grams of each seed option was used per 20 foot row resulting in approximately 165 seeds per linear foot of row. The seeding was conducted **<u>within</u>** drill rows made by a deep furrow drill a few days prior to the seeding. No rain fell after the deep furrow drill rows were made and prior to the fall 2005 seeding. The planting was seeded approximately ¼ inch deep. An additional 2 rows were seeded, one at ½ inch depth and one at 1 inch depth, these two rows were seeded with scarified Pullman 9033982 seed.

On November 3, 2005, the planting had no emergence.

Evaluation: On March 7and March 15, 2006 the fall 2005 planting was checked. No emergence was evident.

SPRING 2006: Drill rows made with a deep furrow drill in fall 2005 were used for the seeding. A hoe was used to deepen the rows, since some sloughing of soil had happened over winter. A

Planet Junior was run through the rows to level soil across the row and compact the soil prior to seeding. The seeding was made with a Hege cone seeder set at approximately ¼" seeding depth. A small amount of seed was not covered in each row due to the inherent undulations present.

Layout of fall 2004/spring 2005 seedings

Spring 05 Rep 3 ND S	S12		Spring 05 Rep 2 ND S S8
Spring 05 Rep 3 PU U	S11		Spring05 Rep 2 PU S S7
Spring 05 Rep 3 ND U	S10		Spring 05 Rep 2 ND U S6
Spring 05 Rep 3 PU S	S9		Spring 05 Rep 2 PU U S5
Fall 04 Rep 2, PU U	F8		Spring 05 Rep 1 PU U S4
Fall 04 Rep 2, ND U	F7		Spring 05 Rep 1 ND S S3
Fall 04 Rep 2, ND S	F6		Spring 05 Rep 1 PU S S2
Fall 04 Rep 2, PU S	F5		Spring 05 Rep 1, ND U S1
Fall 04 Rep 1, ND U	F4		Fall 04 Rep 3, PU S F12
Fall 04 Rep 1, PU S	F3		Fall 04 Rep 3, ND S F11
Fall 04 Rep 1, ND S	F2		Fall 04 Rep 3, ND U F10
Fall 04 Rep 1, PU U	F1		Fall 04 Rep 3, PU U F9
← 20' →		4'	← 20' →

N →

PU = Pullman PMC accession, 9033982
ND = Bismarck North Dakota PMC accession, 9069117
U = unscarified seed
S = scarified seed

Layout of fall 2005 and spring 2006 seedings **(located west of 1997 snow buckwheat breeder planting)**

	Rep 1	**Rep 2**	**Rep 3**	**Rep 4**
spring 06	YSC	ND	Ladak	PU
	Ladak	PU	ND	YSC
	ND	YSC	PU	Ladak
	PU	Ladak	YSC	ND
fall 05	ND-S	PU-U	ND-S	ND-U
	PU-U	PU-S	ND-U	PU-S
	ND-U	ND-S	PU-S	PU-U
	PU-S	ND-U	PU-U	ND-S
	½ inch depth	½ inch depth	½ inch depth	½ inch depth
	1 inch depth	1 inch depth	1 inch depth	1 inch depth

← N

PU = Pullman PMC accession, 9033982
ND = Bismarck North Dakota PMC accession, 9069117
Ladak = Ladak Alfalfa
YSC = yellow sweetclover
U = unscarified seed
S = scarified seed

FALL 2006 Lind planting

Drill rows made with a deep furrow drill in fall 2006 were used for the seeding. Used same seed sources as previous plantings. Seeded November 8, 2006. Seed was scarified with 180 grit wet/dry sandpaper for 20 seconds on each accession used. Seeding rate was 165 seeds per linear foot of row.

Site was sprayed with Glyphosate on May 10, 2007.

Site was checked on May 30, 2007. The only emerged plants noted were alfalfa, which were 1 ½ inches to 2 inches tall.

Location: Lind west slope area in summer fallowed site

Rep 4		Rep 3		Rep 2		Rep 1
Ladak		ND		PU		YSC
PU		YSC		Ladak		ND
ND		Ladak		YSC		PU
YSC		PU		ND		Ladak
20’	2’	20’	2’	20’	2’	20’

N
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NATURAL RESOURCES CONSERVATION SERVICE
PLANT MATERIALS CENTER
PULLMAN, WASHINGTON

PMC STUDY PLAN

I. Study Title: Dryland legumes: Evaluation of seedpod type for differences in seed type type for germination

Study Number: WAPMC-T-0402-RA

II. Problem: The Pullman PMC selected an accession of Astragalus canadensis for advanced evaluation. There are two types of seed: a large light colored seed and a small dark seed.

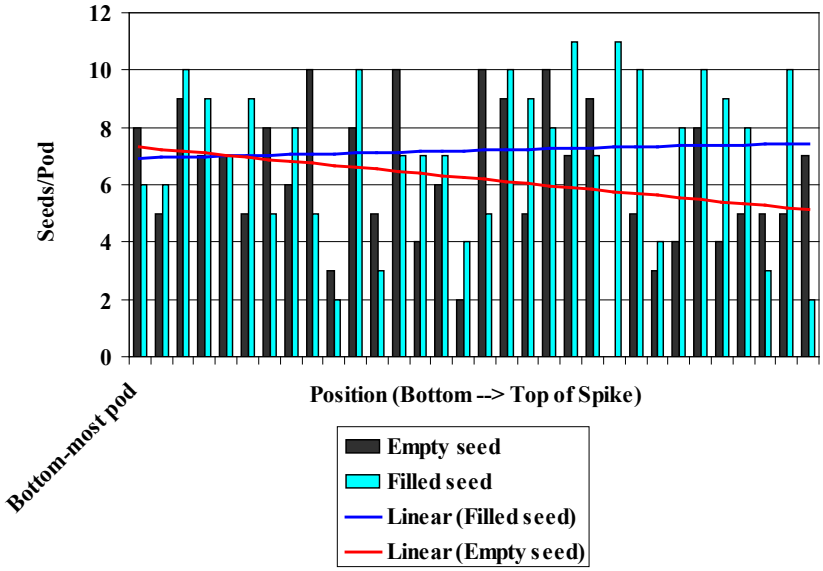
III. Objective: Determine if the different seed types are related to seed pod development.

IV. Procedure: 1. Collect 20 seed pods and carefully open each one. Start at the bottom-most pod and count the number of light and dark seeds in each pod.

V. Progress: Ten spikes were collected from a stand growing at the Pullman Plant Materials Center on August 3, 2003. Five spikes were among the early portion of the flush. Five spikes were among the latest portion of the flush. Seed pods were removed from each spike beginning at the bottom of the spike. The seed contents were tabulated for each pod, and the next pod occurring further up the spike was removed.

Pod position did not significantly (P = .420) effect seed production. Differences in seed production did vary between spikes. The late developing spikes had much higher percentages of filled seed per pod. The reason for the difference in seed set between early and late flowering spikes is unknown and needs further study.

Seed Production Relative to Pod Position on a Spike



A germination study compared both seed types of 9033982 Canada milkvetch. Each seed type was either scarified with 100 weight sandpaper, cold-moist stratified for 14 days at 5C, or simply placed in Petri dishes (check). Each dish contained blotter paper moistened with 5 ml water and sealed with Parafilm. The study utilized 4 replications.

Seed Type	Conditioning	% Germination 14 DAP
Small-dark	Check	0
Small-dark	Cold-moist strat.	4
Small-dar	Scarified	5
Large-lt brn	Check	2
Large-lt brn	Cold-moist strat.	11
Large-lt brn	Scarified	68

This study determined that the small-dark seeds were largely nonviable, and scarification provided highest germination rates. Since the seed size and mass of the small-dark seed are much different from the larger seed, conventional seed cleaning operations are capable of removing small seed from a seed lot. Careful observation under 10X magnification showed that the small-dark seed were unfilled-withered seed.

Seed counts of the large, light-brown seed of Canada milkvetch varied from 660,000 seeds/kg to 770,000 seeds/kg. For comparison, birdsfoot trefoil has 825,000 seeds/kg, alfalfa has 484,000 seeds/kg, and red clover has 605,000 seeds/kg.

NATURAL RESOURCES CONSERVATION SERVICE
PLANT MATERIALS CENTER
PULLMAN, WASHINGTON

PMC STUDY PLAN

I. Study Title: Dryland legumes: Speed of germination of Astragalus Canadensis, alfalfa, and cicer milkvetch.

Study Number: WAPMC-T-0403-RA

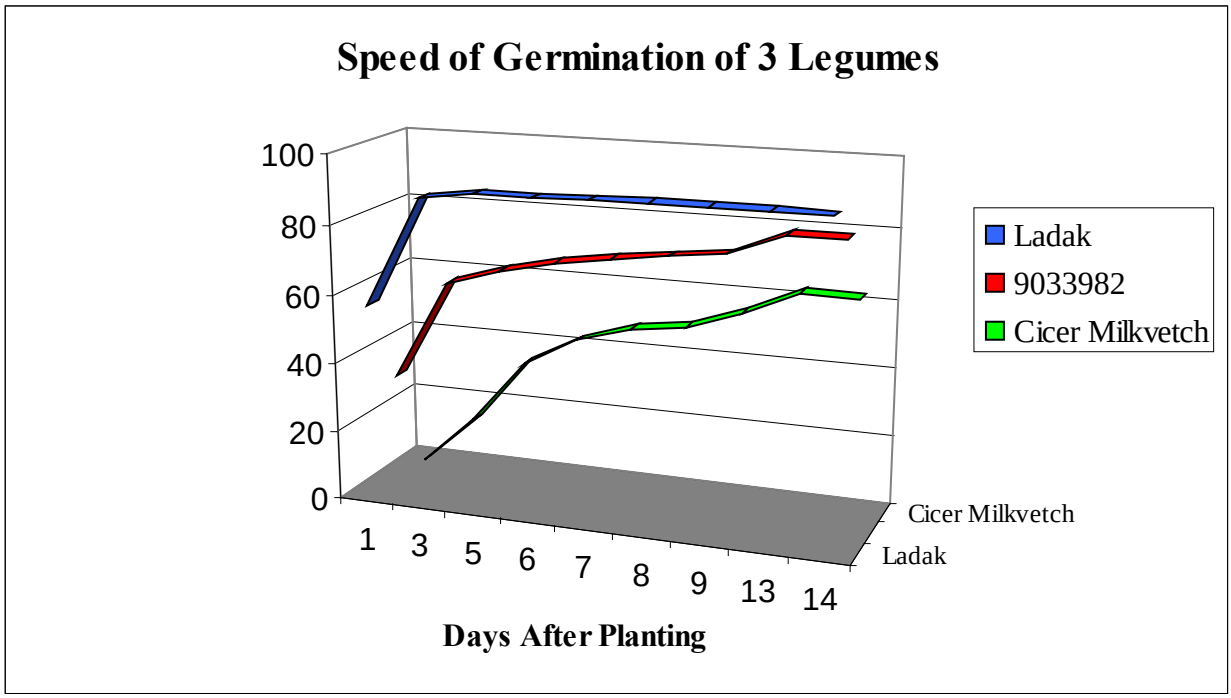
II. Problem: The Pullman PMC selected an accession of Astragalus canadensis for advanced evaluation. Its ability to establish is unknown.

III. Objective: Compare its germination rate against 2 other legumes.

IV. Procedure:

Light-large seed of 9033982 Canada milkvetch, 'Lutana' cicer milkvetch seed, and 'Ladak' alfalfa seed were scarified with 100 weight sandpaper and manually rubbed for 60 seconds. One hundred seeds of each species were placed in Petri dishes. Each dish contained blotter paper moistened with 5 ml water and sealed with Parafilm. Germinating seeds were tabulated daily for 14 days. The study utilized 4 replications.

V. Progress: Germination of alfalfa was more rapid than ASCA and cicer milkvetch.



UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

STUDY TITLE: Dryland Legumes: Evaluation of the ability of *Astragalus canadensis var brevidens* (Gand.) Barneby, accession 9033982, to compete in existing stands of perennial grasses, emphasizing areas with less than 14 inches mean annual precipitation

STUDY NUMBER: WAPMC-P-0409-CP
STUDY TYPE: Cultural Evaluation
LAND USES: Perennial grass/vegetative cover

PROBLEM: Canada milkvetch's ability to compete within existing stands of perennial grasses has not been documented.

OBJECTIVE: Determine if containerized Canada milkvetch plants will survive and compete within existing stands of perennial grasses

DURATION OF STUDY: 2004-2007
STUDY LEADER: Wayne Crowder
LOCATION: Lind, WA Dryland Research Unit and Pullman Plant Materials Center
COOPERATORS: Washington State University

STUDY DESIGN: 4 reps, 9 plant per rep each of Canada milkvetch and Ladak alfalfa as spring transplants.

Perennial grass species:

Lind	Pullman
Secar Snake River wheatgrass	Durar hard fescue
Nordan crested wheatgrass	

Planting: .5 meter spacing between plants each way, 3 x 3 plants per plot

Other: control rodents with bait if necessary
water plants after planting if needed for establishment

Evaluations: Plant survival, growth, vigor ratings, whether seed is produced, etc.

PROGRESS: 2004: February 4 – 5, 2004. Three trays of super cell cone-tainers were seeded with 9033982 and three with Ladak alfalfa. The 9033982 was scarified and inoculated with trefoil inoculant. The Ladak appeared to have been inoculated. Trays were moved to the PMC cold frame on April 23.

The planting at Lind was made on April 30, 2004 in Rep 1 of the old 2-77-U Crested wheatgrass planting in Secar Snake River wheatgrass, P-27 Siberian wheatgrass and Nordan crested wheatgrass plots, with 4 reps of each of the 2 species, 9 plants per plot and 108 plants total of each species.

The Lind planting was watered with 130 gallons of water on May 4, 2004. At this time, some of the plants appeared to be in transplant shock. Usually the *A. canadensis* appears to lose the original leaves and survives by growing additional ones from the crown. Gophers or other burrowing rodents appeared to have taken out some plots.

Four reps of the 2 species were planted into an existing stand of Durar hard fescue in field Q1 at the Pullman PMC on May 7, 2004. Thirty six plants of each species were used, with the same individual plot layout as the Lind planting.

Watering at Lind was done on May 20, June 8, 17, 24, 2004.

The plantings were monitored but not evaluated until September 23, 2004. Survival counts were taken at each site on this date. Apparent survival was poor.

No statistical analysis was run due to obvious lack of supporting numbers in the data.

Spring 2004 planting survival counts, 9/23/04 at Lind

		survival	
Rep		9033982	Ladak
1	P-27	0	3
2	P-27	0	0
3	P-27	0	0
4	P-27	0	0
	total	0/36	3/36
1	Nordan	0	0
2	Nordan	0	0
3	Nordan	0	0
4	Nordan	0	0
	total	0/36	0/36
1	Secar	0	0
2	Secar	0	0
3	Secar	0	0
4	Secar	0	0
	total	0/36	0/36
	grand total	0/108	3/108

Spring 2004 planting survival counts, 9/23/04, at Pullman

Rep		survival 9033982	Ladak
1	Durar	0	0
2	Durar	0	0
3	Durar	0	0
4	Durar	2	0
	total	2/36	0/36

2005: January 7, 2005 Trays of super cell cone-tainers (10 cubic inch) were seeded with 9033982 and Ladak alfalfa. The 9033982 was scarified and inoculated with trefoil inoculant. The Ladak appeared to have been inoculated. Trays were moved to the PMC cold frame on March 11, 2005.

The planting at Lind was made on April 6, 2005 in Rep 2 of the old 2-77-U Crested wheatgrass planting in Secar Snake River wheatgrass and Nordan crested wheatgrass plots, with 4 reps of each of the 2 species, 9 plants per plot and 72 plants total of each species.

Mouse/vole control was attempted by putting out mouse bait in 1 ½" PVC pipe at the time of planting. Pipe was capped on one end. On April 13, all of the previously baited PVC tubes had no bait left. Additional PVC tubes were put out. Bait was replenished on April 20. Subsequent replacement was made on May 12, 26, and June 7. Each time all bait packets were empty. Further bait replacements were made.

On June 7, 2005 an evaluation was made on the survival of the plants in the 2004 and 2005 plantings. In the 2004 planting, no surviving *Astragalus* was noted and the Ladak alfalfa had 9 of 108 initial transplants apparently surviving. In the 2005 planting there appeared to be a near equal number of *Astragalus* and alfalfa surviving.

Further evaluations in 2005 were impossible to make due to hot and dry weather dessicating the existing survivors. Mice/voles were very numerous and active during the growing season.

No statistical analysis was run due to obvious lack of supporting numbers in the data.

Spring 2005 planting survival counts, 6/7/05, at Lind

Rep		survival 9033982	survival Ladak
1	Nordan	6	6
2	Nordan	4	3
3	Nordan	3	1
4	Nordan	7	9
	total	20/36	19/36
1	Secar	5	5
2	Secar	6	7
3	Secar	3	3
4	Secar	2	3
	total	16/36	18/36
	grand total	36/72	37/72

Spring 2004 planting survival counts, 6/7/05, at Lind

Rep		survival 9033982	survival Ladak
1	P-27	0	3
2	P-27	0	0
3	P-27	0	2
4	P-27	0	0
	total	0/36	5/36
1	Nordan	0	1
2	Nordan	0	0
3	Nordan	0	0
4	Nordan	0	0
	total	0/36	1/36
1	Secar	0	2
2	Secar	0	1
3	Secar	0	0
4	Secar	0	0
	total	0/36	3/36
	grand total	0/108	9/108

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

STUDY TITLE: Dryland Legumes: A Comparison of the development of *Astragalus canadensis var brevidens* (Gand.) Barneby, Canada milkvetch accession 9033982; with 9069117 (Bismarck PMC) Canada milkvetch, Ladak alfalfa and yellow sweetclover

STUDY NUMBER: WAPMC-P-0503-CP
STUDY TYPE: Advanced Evaluation
LAND USES: Perennial grass/vegetative cover

PROBLEM: Canada milkvetch's development attributes have not been compared to alfalfa and yellow sweetclover

OBJECTIVE: Compare developmental attributes of 9033982 Canada milkvetch with 9069117 Canada milkvetch, Ladak alfalfa and yellow sweetclover

DURATION OF STUDY: 2005-2007
STUDY LEADER: Wayne Crowder
LOCATION: Pullman, WA
COOPERATORS: Washington State University

STUDY DESIGN: 4 reps, each of 9033982 Canada milkvetch, 9069117 (Bismarck PMC), Ladak alfalfa and yellow sweetclover as 10 cubic inch transplants grown in the PMC growth chamber. Five plants/replication.

Spring plant in clean-tilled seedbed in rows, 5 plants each accession per rep. Two feet apart in the row and 6 feet between rows.

EVALUATIONS: Document plant development such as date of initial growth in spring, flowering dates, seed development and maturity, mature plant foliage height and canopy cover width, mature plant height in flower, etc.

PROGRESS: The planting was installed on May 26, 2005 in field 6B. Soil moisture was excellent, the planting coming a few days after good rains fell.

The planting was checked on June 13, 2005. All plants were alive and growing.

Further evaluations were carried out throughout the growing season.

See the following pages for layout and data summary.

Field 6B layout of *Astragalus* development planting, 5/26/05

		species(plot #)	species(plot #)
existing Bromar breeder spaced planting	10' clean till	YSC (1)	Ladak (26)
		Ladak (2)	ND (25)
		ND (3)	YSC (24)
		PU (4)	Ladak (23)
		Ladak (5)	ND (22)
		YSC (6)	YSC (21)
		PU (7)	PU (20)
		ND (8)	YSC (19)
		ND (9)	PU (18)
		YSC (10)	ND (17)
		Ladak (11)	Ladak (16)
		PU (12)	PU (15)
		PU (13)	ND (14)

Rep 1 = plots 1-4, Rep 2 = plots 5-8, Rep 3 = plots 9-12, Rep 4 = plots 16-19, Rep 5 = plots 20-23

YSC yellow sweet clover
ND Bismarck, ND PMC Canada milkvetch
PU Pullman, WA PMC Canada milkvetch
Ladak Ladak alfalfa

6/29/05 species	mean max ht (cm)	mean canopy width (cm)
ladak	20.5 A	24.1 A
ysc	10.3 B	22.9 A
pu	8.5 BC	18.4 B
nd	7.3 C	12.7 C
	LSD=2.1641	LSD=4.0449
p=.05		

Means within a column followed by the same letters are not significantly different as determined by least significant difference test at p<.05

7/25/05 species	mean no. plants flowering		
ladak	5.0	A	
pu	3.0		B
ysc	3.0		B
nd	0.0			C

LSD = .9329

Means within a column followed by the same letters are not significantly different as determined by least significant difference test at p<.05

7/27/05 species	mean no. stems originating from the crown			
ladak	16.80	A		
ysc	14.04	A		
pu	9.20		B	
nd	4.04			C

LSD = 3.1128

Means within a column followed by the same letters are not significantly different as determined by least significant difference test at p<.05

8/1/05 species		mean plant ht (cm)		
ladak		59.16	A	
ysc		58.12	A	
nd		19.84		B
pu		15.92		B
LSD		8.3255		

Means within a column followed by the same letters are not significantly different as determined by least significant difference test at p<.05

8/1/05		
species		mean canopy width (cm)
ysc		109.20 A
ladak		69.36 B
pu		48.96 C
nd		41.24 C
LSD		10.774

Means within a column followed by the same letters are not significantly different as determined by least significant difference test at p<.05

8/1/05		
species		mean no. plants flowering
ladak		5.0 A
ysc		4.2 A
pu		3.2 B
nd		.2 C
LSD		.8983

Means within a column followed by the same letters are not significantly different as determined by least significant difference test at p<.05

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

I. Study Title: ICST - Evaluation of adaptation of conifers collected by the NDPMC in Russia and China.

Study Number: WAPMC-P-9602-WI

II. Problem: North Dako is developing several Asian conifers for windbreaks. Their range of adaptation is poorly understood.

III. Objective: Determine if the conifers are adapted to the Inland PNW. These materials were compared to the MT Rocky Mountain Juniper

IV. Procedure:

Duration of Study:	1996-2011	
Study Leader:	Mark Stannard	
Location:	Pullman PMC, field M	
Cooperators:	NDPMC, MTPMC	
Experimental Design:	Unreplicated outplanting	
	9069172	Pinus sylvestris
	9069173	Pinus sylvestris
	9069172	Larix olgensis
	9078631	Juniperus scopulorum

1. Seed was obtained from the NDPMC in 1996. Seed was planted to conetainers on 2/22/96 following 30 days of stratification.
2. Additional seed of 9068162 was planted to conetainers on 12/10/96 following 30 days of stratification to increase the number of plants due to initial poor establishment.
3. A 6' wide strip was rototilled in existing Durar hard fescue sod along the road in field M5. Weed barrier was laid down on 5/13/97, and the planting was made on 5/16/97. Left over 9078631 RMJ were also planted in the strip. The planting was watered throughout the summer.

9069162	9069172	9069173	9078631	extras
10 plants	10 plants	10 plants	23 plants	4 plants
10' spacing	14' spacing	14' spacing	10' spacing	

V. Progress: One plant of 9069162 died the year of establishment. Two others died in 1998 and 2 more were lost in 1999.

No detailed evalautions were completed in fy 2000 or 2001. The Larch plants were showing signs of stress in 2001. The study is still active and will be evaluated on a periodic basis over the next several years.

1-82D Evaluation of adaptation of conifers collected by the NDPMC in Russia and China

Accession	Species	Plant #	10/06/1998 HT	10/06/1998 Width (e-w)	10/06/1998 Width (n-s)	09/23/1999 HT
9069162	Laol	1	37	20	20	67
		2	16	10	11	17
		3	20	13	10	32
		4	31	20	20	64
		5	0	0	0	0
		6	64	42	47	90
		7	22	16	12	31
		8	0	0	0	0
		9	13	11	12	0
		10	33	19	22	0
9069172	Pisy	1	43	28	25	69
		2	22	26	22	50
		3	42	24	30	65
		4	32	25	33	60
		5	34	27	28	73
		6	29	27	25	48
		7	36	30	38	68
		8	39	24	30	69
		9	33	30	25	62
		10	40	31	27	72
9069173	Pisy	1	39	35	25	74
		2	26	32	29	62
		3	31	31	26	59
		4	32	32	30	80
		5	32	28	28	72
		6	39	27	24	70
		7	32	27	24	75
		8	38	30	35	79
		9	40	33	25	82
		10	30	20	23	69
MTselect	Juniper	1	119	54	66	179
		2	70	37	46	92
		3	71	30	30	108
		4	60	40	33	90

5	92	32	35	142
6	78	50	46	129
7	73	36	44	127
8	79	30	30	105
9	80	34	34	114
10	81	40	37	126
11	63	40	46	92
12	64	35	36	103
13	59	35	34	96
14	73	27	27	119
15	74	55	45	99
16	79	40	35	114
17	71	28	34	116
18	70	47	49	122
19	109	58	62	150
20	91	68	52	130
21	72	45	41	111
22	97	33	40	140
23	91	50	44	135

4 extra plants (no rating)

1-82D Evaluation of adaptation of conifers collected by the NDPMC in Russia and China

Accession	Species	Plant #	8-15/2002 HT	8-28-2003 HT
9069162	Laol	1	168	210
		2	110	190
		3	170	180
		4	250	270
		5	0	0
		6	264	280
		7	181	200
		8	0	0
		9	0	0
		10	0	0
9069172	Pisy	1	165	190
		2	140	170
		3	148	180
		4	160	190
		5	180	220
		6	148	180
		7	166	210
		8	180	210
		9	175	230

		10	183	230
9069173	Pisy	1	223	280
		2	174	210
		3	176	230
		4	233	250
		5	187	260
		6	155	310
		7	202	250
		8	238	280
		9	222	270
		10	228	280
MTselect	Juniper	1	250	300
		2	180	210
		3	191	210
		4	162	190
		5	219	260
		6	236	270
		7	222	250
		8	197	240
		9	220	250
		10	220	250
		11	170	200
		12	188	200
		13	170	190
		14	230	270
		15	215	260
		16	177	200
		17	208	230
		18	228	280
		19	212	250
		20	214	260
		21	186	230
		22	223	260
		23	227	270

4 extra plants (no rating)

Accession	Species	Plant #	10/98 HT	9/99 HT	8/02 HT	8/03 HT	----8/15/06---- HT	Width
9069162	Laol	1	37	67	168	210	370	250
		2	16	17	110	190	330	260
		3	20	32	170	180	380	300
		4	31	64	250	270	350	220
		5	0	0	0	0	0	0
		6	64	90	264	280	360	240
		7	22	31	181	200	270	200
		8	0	0	0	0	0	0
		9	13	0	0	0	0	0
		10	33	0	0	0	0	0
9069172	Pisy	1	43	69	165	190	280	260
		2	22	50	140	170	280	270
		3	42	65	148	180	300	300
		4	32	60	160	190	260	270
		5	34	73	180	220	350	340
		6	29	48	148	180	320	320
		7	36	68	166	210	340	270
		8	39	69	180	210	330	290
		9	33	62	175	230	300	280
		10	40	72	183	230	340	310
9069173	Pisy	1	39	74	223	280	360	380
		2	26	62	174	210	370	310
		3	31	59	176	230	350	360
		4	32	80	233	250	320	410
		5	32	72	187	260	340	360
		6	39	70	155	310	400	320
		7	32	75	202	250	360	320
		8	38	79	238	280	370	370
		9	40	82	222	270	430	400
		10	30	69	228	280	370	350
MTselect	Juniper	1	119	179	250	300	390	250
		2	70	92	180	210	290	210
		3	71	108	191	210	290	120
		4	60	90	162	190	250	190
		5	92	142	219	260	320	160
		6	78	129	236	270	300	170
		7	73	127	222	250	330	220
		8	79	105	197	240	300	200
		9	80	114	220	250	290	220
		10	81	126	220	250	320	210
		11	63	92	170	200	240	200
		12	64	103	188	200	250	230
		13	59	96	170	190	210	170
		14	73	119	230	270	290	120
		15	74	99	215	260	330	260
		16	79	114	177	200	260	210
		17	71	116	208	230	250	190
		18	70	122	228	280	350	210
		19	109	150	212	250	320	290
		20	91	130	214	260	330	280

21	72	111	186	230	300	230
22	97	140	223	260	350	200
23	91	135	227	270	350	270

4 extra plants (no rating)

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

Study ID Code	**WAPMC-P-0705-CP**
Title	Regional **c**omparative evaluation of selected cool season grasses for potential use in biofuel (liquid, thermal and thermochemical) applications in western states.
National Project No.	Biomass/Biofuel 1.1 *Perennial crops for biofuel production.*
Study Type	Comparative Evaluation
Study Status	**Active**
Location	IDPMC, WAPMC, MTPMC, COPMC, CAPMC, NVPMC
Study Leader	Jim Briggs, WNTSC PMS
Duration	2007 - 2009
Cooperators	Potential Partners: • Agricultural Research Service – Logan, Utah • Agricultural Research Service – Corvallis, Oregon • NRCS Biology consortia representative • NRCS Energy Team, WNTSC
Land Use	Marginal cropland, cropland
Vegetative Practices	Primary 327 Conservation Cover
Resource Concern(s)	Identifying plant species for use in manufacturing of energy which are better adapted and more productive than switchgrass in the western USA.

Resource	Consideration/Problem
Air	Carbon Sequestration
Soil	Carbon Sequestration
Soil	Erosion
Water	Erosion
Human	Energy

Long Range Plan	The **s**tudy is linked to the NRCS 2006 National Strategic Plan, 2006-2010 National PM Strategic Plan, and the FY 2007 west region technology working group business plan.
Description	Commercially available plant releases of blue wildrye and tall wheatgrass will be tested in replicated studies at participating plant material centers.
Status of Knowledge	Evaluation of plant material for use in various biofuel applications has been underway for many years. Recent,

and successful, efforts have focused on using crop residue or stubble such as corn stover and perennial grasses such as switchgrass in production of liquid fuels.
Potential conversion of the 35 million acres of Conservation Reserve Program (CRP) lands to switchgrass production has been discussed to assist in meeting the nations fuel needs. It has been estimated that existing residues from CRP lands and dedicated energy crops could provide 5% of annual energy consumption in the US. This estimate is based on CRP plantings not designed to maximize biomass production. Use of CRP acreage for biofuel feedstock production does not appear to be a viable option west of the Rocky Mountains due to two major factors, geographic distribution of acres under contract and low productivity of cool season grasses in the low rainfall zones associated with suitable CRP acreage.
CRP acreage in se Idaho and Washington - Oregon may be sufficiently large to supply the requisite amounts of biofuel feedstock. These CRP contracts tend to be concentrated in fairly small geographic areas and have as much as 450,000 and 1,000,000 acres respectively. Because of logistics and associated economics of transporting bulky biomass feedstocks feedstock production areas must be located within approximately a 25 mile radius of a biorefinery. Additionally, per acre yields need to be sufficient to provide approx. 625,000 tons of feedstock annually, to operate a 50 million gallon biorefinery, a minimum sized operation. For CRP land to be used for biofuel feedstock production large acreages of CRP lands must be in relative proximity to each other.

Several selected cool season grass species are well adapted to the northwest and great basin states but are low biomass producers, especially in existing areas of CRP contracts. Regions with large numbers of contract acres, areas previously noted, average less than 15 inches precipitation annually, with most acres receiving under 10 inches on an annual basis. Existing CRP contracts have been seeded with the best adapted species and probably cannot be manipulated to produce more biomass without additional inputs such as irrigation.
Switchgrass, is a warm season species and is not well adapted to the great basin, except under irrigated conditions. Irrigated trials on cropland in Washington and Nevada have shown promising results.

Additional studies have evaluated grasses in thermochemical and thermal energy applications and have identified specific chemical attributes that result in improved feedstock performance. A US native, Blue Wildrye, had the lowest accumulations of silicon, a important attribute in thermal and thermochemical applications in one recent study. The European cultivar 'Szarvasi-1', a Tall Wheatgrass, has been evaluated and is being touted as having excellent applications for thermochemical applications. This species has been used in many US conservation applications throughout the west for many years.
Information on individual adaptation and performance of the plants in this study has been documented for use in rangeland and critical area stabilization applications, but yields and chemical attributes having value in biofuel applications has not been systematically tested under irrigated conditions.

Experimental Design Randomized Complete Block

Treatment: **4 L**ines of tall wheatgrass with each seeded as 6" rows and 12" rows

Replications: Each treatment replicated 3 times, plot size 8' x 20'

Materials and methods The WNTSC PMS will assemble seed of releases as follows in January 2007.
Tall wheatgrass: *'Jose', 'Szarvasi-1', 'Alkar', 'Largo'*

Plot area is located on the Rosa Unit of the Prosser Agriculture Experiment Station. It was fallowed in 2005 and 2006. Round up was applied on August 29th, 2007 to control barnyardgrass. The plot area was shallow rototilled on September 5, 2007. It was immediately rolled north to south then rolled diagonally. A drag was pulled north to south to smooth the surface as final seedbed preparation. Forty-five minutes of irrigation was applied to further firm the seedbed.

Plots were laid out on September 5, 2007. Each plot was 8' x 20'.

Seeding occurred on September 6, 2007. A Planet jr was calibrated to seed 14 lb/acre. Six inch row spacings had 13-14 seeds/lineal fee (hole #26). The 12-inch rows had 25 seeds/lineal foot (hole #31).

The entire area was sprinkle irrigated for 4 hours on September 7, 2007 and irrigated weekly there after until October 10, 2007 (4 hr sets)

Year 1:

- Stand (plants per square foot)
- Digital photos from established photo points monthly (1 per entry)
- Biomass production (each plot sampled at 3 different maturity levels). Capture wet and air dry weights.
- Comments (disease, insects, nutrient problems)

Year 2:

- Stand (plants per square foot – 30 days after spring growth onset)
- Biomass production (each plot sampled at 3 different maturity levels)
- Digital photos from established photo points at harvest (1 per entry)
- Comments (disease, insects, nutrient problems)
- Subject to funds -- Forage quality for biofuel application (parameters TBD but may include percent N, silicon, percent ash, ADF and NDF).

Year 3:

- Stand (note any changes from prior year)
- Biomass production (each plot sampled at 3 different maturity levels)
- Comments (disease, insects, nutrient problems)
- Digital photos from established photo points at harvest (1 per entry)
- Subject to funds -- Forage quality for biofuel application (parameters TBD but may include percent N, silicon, percent ash, ADF and NDF(CESU contract?))
-

Final Evaluations

Evaluations will be submitted to WNTSC PMS who will develop an annual report for submission into all participating PMC annual reports.

Technology Transfer Products Tech Note, revise FOTG standards, current events article, journal publication

Literature Cited PMC release documentation, Commercial literature, University research results

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11.

http://content.fsa.usda.gov/crpstorpt/rmepehh/MEPEHHR1.HTM Acres of CRP enrolled by county

Prosser Experiment Station, Rosa Unit

Rosa unit Main road

Dryland Alfalfa Trial, Seeded 4-25-06

Orchardgrass Trial, Seeded 4-25-06

5 rows of Alkar

5 rows Alkar

301	**302**	**303**	**304**	**305**	**306**	**307**	**308**
LARGO	JOSE	SZARVASI-1	ALKAR	SZARVASI-1	JOSE	LARGO	ALKAR
6"	12"	12"	6"	6"	12"	12"	12"
201	**202**	**203**	**204**	**205**	**206**	**207**	**208**
SZARVASI-1	LARGO	ALKAR	JOSE	LARGO	ALKAR	SZARVASI-1	JOSE
12"	6"	6"	12"	12"	12"	6"	6"
101	**102**	**103**	**104**	**105**	**106**	**107**	**108**
JOSE	ALKAR	LARGO	SZARVASI-1	JOSE	LARGO	ALKAR	SZARVASI-1
12"	6"	12"	6"	6"	6"	12"	12"

5 rows Alkar

Nordan

5 rows of Alkar

NORTH
^
WEST | EAST
|
SOUTH

plot size 8' x 20'
seeded 9/6/07

	var	row	Stand 9/27/2007	Stand 2/22/2008	Leaf Stage 9/27/2007	9/17/2008 wet wt *
101	jose	12	5	3	1	2.2
102	alkar	6	10	8	2	2.55
103	largo	12	10	10	2	2.7
104	szar	6	5	4	1.5	1.7
105	jose	6	4	4	1.5	2
106	largo	6	10	9	2	2.4
107	alkar	12	8	6	2	1.5
108	szar	12	5	3	1	1.45
201	szar	12	5	3	1.5	2.85
202	largo	6	10	10	2	3.75
203	alkar	6	9	9	2	3.6
204	jose	12	3	2	1.5	2.6
205	largo	12	8	9	2	2.8
206	alkar	12	5	6	2	2.6
207	szar	6	3	4	1.5	3.1
208	jose	6	3	2	1	3.05
301	largo	6	4	8	2.5	1.3
302	jose	12	3	2	2	3.2
303	szar	12	3	5	1	3.05
304	alkar	6	9	9	2	3.4
305	szar	6	5	4	1	3.5
306	jose	12	4	2	1.5	3.05
307	largo	12	10	10	2.5	2.5
308	alkar	12	6	6	2	1.9

stand 10=best

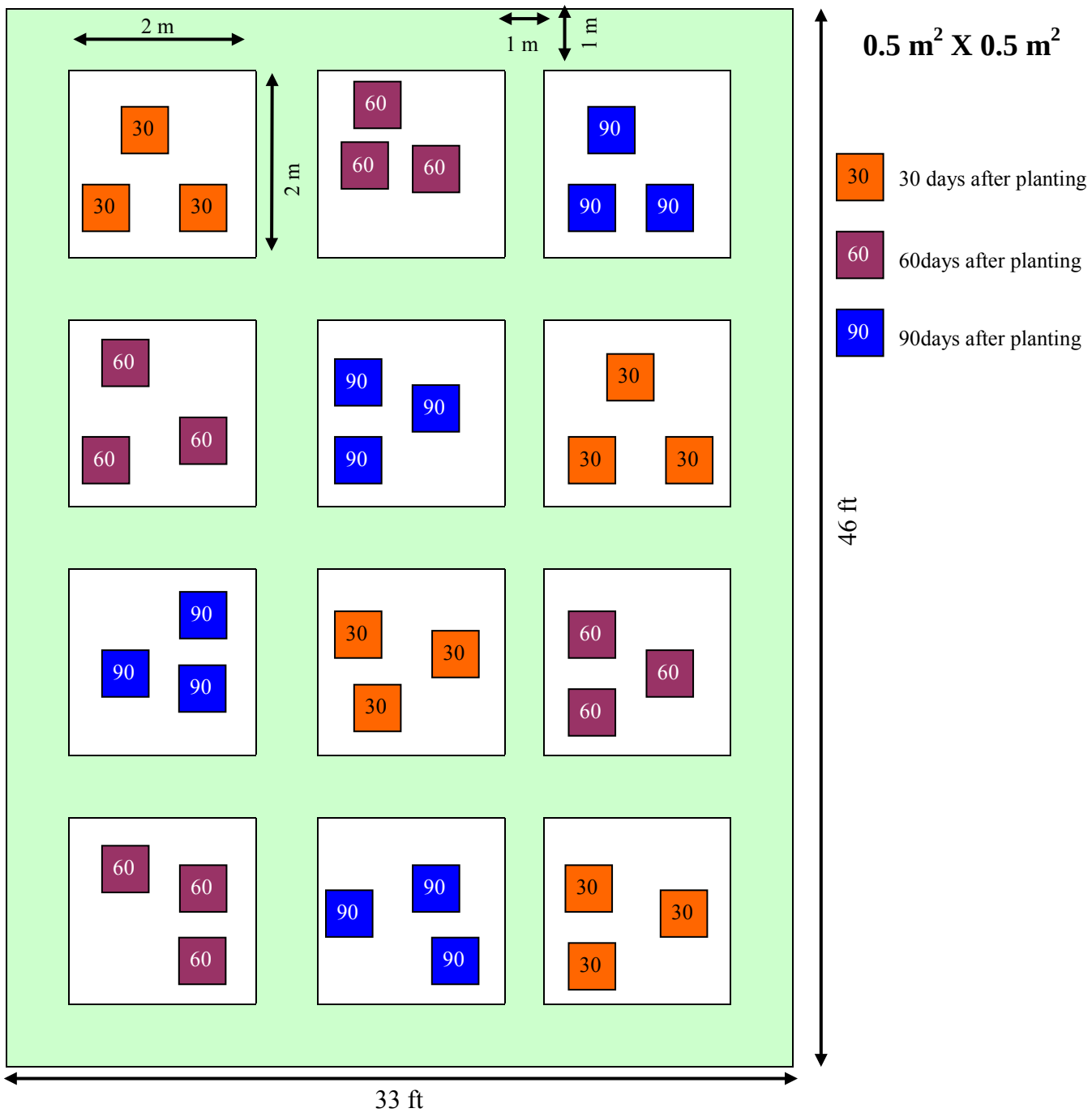
* 9 sqft sample.

UNITED STATES DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE STUDY PLAN	
Study ID Code	WAPMC-T-0906-CP
Title	Adaptability of 'Tropic Sun' Sunn Hemp
National Project No.	PM-T-0901
Study Type	ICST
Study Status	Active
Location	Tucson, AZ; Boonville, AK; Lockford, CA; Meeker, CO; Brooksville, FL; Americus, GA; Aberdeen, ID; Manhattan, KS; Galliano, LA; Beltsville, MD; East Lansing, MI; Coffeeville, MS; Elsberry, MO; Bridger, MT; Fallon, NV; Cape May, NJ; Los Lunas, NM; Corning, NY; Bismark, ND; Corvallis, OR; Kingsville, TX; Nacogdoches, TX; Knox City, TX; Pullman, WA; Alderson, WV.
Study Leader	
Duration	2009
Cooperators	AZPMC, ARPMC, CAPMC, UCEPC, FLPMC, GAPMC, IDPMC, KSPMC, LAPMC, MDPMC, MIPMC, MSPMC, MOPMC, MTPMC, NVPMC, NJPMC, NMPMC, NYPMC, NDPMC, ORPMC, STXPMC, NTXPMC, ETXPMC, WAPMC, WVPMC
Land Use	
Vegetative Practices	Primary Secondary
Description	Sunn Hemp (*Crotalaria juncea)* has been touted as a great green manure and cover crop since the 1930s, when it was reported to be an excellent soil-improving crop. Sunn hemp produces high organic matter yields while fixing large amounts of nitrogen. However, the difficulty in acquiring seed and cheap fertilizer prices caused many farmers to abandon the use of this crop. Energy costs have brought leguminous cover crops back to the forefront for sustainable agriculture production and have led to efforts to increase production of sunn hemp seed. This study attempts to determine the areas of the country with the potential to use sunn hemp for green manure and cover crops. The anticipated use of sunn hemp is as a 30-45 day green manure crop. Sunn hemp does not produce seed above 28 degrees N latitude (southern tip or Florida or Texas). Since it does not produce seed through most of the US and is sensitive to frost it has little potential to be weedy. In order to merge the data from all centers it is important that we keep methodology as uniform as possible. This study attempts to determine the areas of the country with the potential to use

	sunn hemp for green manure and cover crops. In order to merge the data from all centers it is important that we keep methodology as uniform as possible.
Status of Knowledge	Sunn hemp is a tropical or sub-tropical plant that acts like a summer annual when grown in the continental United States. Sunn hemp's adaptation to a wide range of soils and superior performance on poor sandy soils has attracted attention. As a cover crop, sunn hemp can produce 5,000-6,000 pounds of biomass per acre in southern climates in 60-90 days. It also can produce 120-140 pounds of nitrogen in the same amount of time.
Experimental Plan	Each plant materials center will receive seed to plant an approximately 33' X 46' block 1. The planting should be done after any chance of frost has past. The planting date for tomatoes would be a good guide. 2. The block will be drilled at a seeding rate of 50 lbs/acre. Row spacing of approximately 8". The seed bed will be well prepared and weed free. 3. The seed will be inoculated with a cow pea type *Bradyrhizobium* sp. which will be sent along with the seed. Heat and direct sunlight kill bacteria in stored inoculum, even while packaged. Since a short period of heat can reduce the number of live bacteria the package should be kept in a cool place and out of direct sunlight - even when taking it to the field (keep it off the dashboard). The preferred storage place for inoculum is the refrigerator (do not freeze). 4. The seed should be thoroughly coated with inoculum to achieve the best distribution; the inoculum should be mixed with seed in a large tub or bucket not the planter seedbox. Seed should be coated with an adhesive (sticker) before inoculant is added. Commercial adhesives are available, but sticker can be made from a 1:10 mixture of corn syrup, sugar water (2 cups sugar:1 quart of water) or from a dilute soda (make sure the soda is flat). Mix seed with enough sticker to moisten all seed. To the moistened seed add inoculant and mix to thoroughly coat the seed. Air dry by spreading the coated seed in a cool shaded place. The seed will need to be dry to flow through the seeder. If the seed does not flow, it can be coated with corn starch. Give yourself time for the seed to dry but the seed must be used within 24 hours of inoculation. 5. Irrigation after planting is up to you, some will have to others may not have that option. Just record as much information about when and amounts of irrigation and natural precipitation as possible. Watering should follow the schedule for a forage crop in your area. 6. It may beneficial to put up a fence to protect the plot from deer. 7. Record planting date, date of emergence and date of complete stand. 8. Record height of plant at time of clipping. 9. Clipping dates will be 30 days, 60 days and 90 days after planting date. Three, 0.5 m^2 per clipping date per rep will be clipped just above the soil surface (total of 12 per harvest). Fresh clipped material will be

	weighed for each harvest and reported in the "Data Collection Form". A grab samples will be collected from each of the three, 0.5 m^2 from each replication and bulked to achieve a sample size of ~250 grams. Grab sample wet weighs will reported in the Data Collection Form. After the grab sample is dry, report the dry weight in the Data Collection Form. Samples can be either air-dried or dried in a forced-air oven at 60ºC for 24-30 hrs. If air dried, dry the sample loosely for 1 week then weigh the sample every 2 days until the weigh is near stable. **DO NOT** allow the sample to mold. 10. Record the date first flowers appear. 11. Record the date of last frost. 12. Record the height of the material when it is killed by frost. 13. Repeat samples from borders within the plot.
Technology Transfer Products	national tech note, state tech notes, referred journal article
Literature Cited	Rotar, P.P. and R.J. Joy. 1983. 'Tropic Sun' sunn hemp (*Crotalaria juncea* L.)Res. Ext. Ser. 36. Hawaii Inst. Trop. Agric. and Human Resour., Univ. of Hawaii, Honolulu. USDA-NRCS. 1999 Sunn Hemp: A Cover Crop for Southern and Tropical Farming Systems. Technical Note No.10 Soil Quality Institute, Auburn, AL

Plot Plan
National Plant Materials Sunn Hemp Evaluation



Sunn hemp tends to have a dramatic edge affect. Make sure you have room between clip sites to avoid the effect.

Sunn hemp will regrow after clipping. Make sure you mark the clipped sites to avoid them when doing and after frost harvest.

2009 Plant Materials Sun Hemp Project
(*click on boxes; type in blanks*)

Plant Materials Center:	WAPMC - Pullman site
Pre-Plant Tillage:	☐ no Till ☒ tillage (*specify*) rototilled
Method of Planting	☒ drill row spacing 8" ☐ broadcast ☐ other (*specify*) _____
Planting Date	5/24/09
Irrigation	☒ dryland ☐ irrigated rate _____ interval _____
Weed Control	☐ herbicide (*specify herbicides and rates*) _____ ☒ mechanical (*specify type and interval*) hand hoe
Fertilizer	rate _____ application method _____ ☒ none applied
Wildlife Protection	☐ fence ☒ no Fence
Harvest Date	1st harvest 6/24/09 2nd harvest 7/23/09 3rd harvest 8/24/09 final harvest 10/13/09
Harvest Method	describe pruning shears
Drying Method	☐ oven Temperature _____ ☒ air dry method (*describe*)in sacks in temp controlled room
No Result	reason (*describe in detail*) poor establishment
Describe in detail any deviations from the prepared study plan (*this will help to explain data outside the normal distribution*): 1st harvest 0.71 x 0.71m plots (0.5 sq m) other plots 0.5 x 0.5	

2009 Plant Materials Sun Hemp Project
(*click on boxes; type in blanks*)

Plant Materials Center:	WAPMC - Othello site
Pre-Plant Tillage:	☐ no Till ☒ tillage (*specify*) rototilled
Method of Planting	☒ drill row spacing 8" ☐ broadcast ☐ other (*specify*) _____
Planting Date	5/25/09
Irrigation	☐ dryland ☒ irrigated rate 0.4"/hr interval 3 hrs once/wk
Weed Control	☒ herbicide (*specify herbicides and rates*) 1.5 pt Poast 6/12/09 ☐ mechanical (*specify type and interval*) _____
Fertilizer	rate _____ application method _____ ☒ none applied
Wildlife Protection	☐ fence ☒ no Fence
Harvest Date	1st harvest 6/24/09 2nd harvest 7/22/09 3rd harvest 8/27/09 final harvest 10/15/09
Harvest Method	describe pruning shears
Drying Method	☐ oven Temperature _____ ☒ air dry method (*describe*)in paper sacks in temp controlled room
No Result	reason (*describe in detail*) _____
Describe in detail any deviations from the prepared study plan (*this will help to explain data outside the normal distribution*): 1st harvest 0.71 x 0.71 m plots (0.5 sq m) other plots 0.5 x 0.5	

Sunn Hemp Adaptation Trial

PMC: WA - Othello Experiment Station

Planting Date: 5/25/2009

Plot#	Rep	Harvest date	Plt ht (in)	0.5 m^2 Plot wt Sample 1 (g)	0.5 m^2 Plot wt Sample 2 (g)	0.5 m^2 Plot wt Sample 3 (g)	0.5 m^2 Avg. plot wt (g)	grab sample Wet wt (g)	grab sample Dry wt (g)	Pct dry weight of sample (decimal %)	Avg. 0.5m^2 plot dry weight (g)	Yield (lb/acre)
WAO30	*1	6/24/2009	5	62.9	39	82.7	61.533	180.1	39.4	0.218767351	13.461	480
WAO30	*2	6/24/2009	5	68.1	45.3	49.4	54.267	159.1	35.4	0.222501571	12.074	431
WAO30	*3	6/24/2009	4.5	36.3	31.4	60	42.567	124.8	27	0.216346154	9.2091	329
WAO30	*4	6/24/2009	4.5	42.1	42.1	55.6	46.6	134.5	31.5	0.234200743	10.914	389
WAO60	1	7/22/2009	35.5	601.6	551.7	413.2	522.17	261.9	85.3	0.325696831	170.07	6067
WAO60	2	7/22/2009	40	281.1	387.3	503.9	390.77	255.1	83.4	0.326930615	127.75	4558
WAO60	3	7/22/2009	35	283.7	232.8	373.5	296.67	249.9	45.9	0.183673469	54.49	1944
WAO60	4	7/22/2009	39	301.7	393.9	528.5	408.03	262.1	51.1	0.194963754	79.552	2838
WAO90	1	8/27/2009	74	607.1	649.6	813	689.9	257.5	73.1	0.283883495	195.85	6987
WAO90	2	8/27/2009	75	606.4	516.8	839.2	654.13	258	83.9	0.325193798	212.72	7589
WAO90	3	8/27/2009	75	1227.3	964.3	662.2	951.27	262.1	69.3	0.2644029	251.52	8973
WAO90	4	8/27/2009	73	551.7	899.7	748.5	733.3	258.9	84.4	0.325994593	239.05	8528
WAOAF	1	10/15/2009	82	467.5	358.1	368.4	398	254	158.9	0.625590551	248.99	8882
WAOAF	2	10/15/2009	89	454.8	674.4	338.6	489.27	248.6	136.1	0.547465809	267.86	9556
WAOAF	3	10/15/2009	95	407.2	270.5	567.1	414.93	247.9	142.3	0.574021783	238.18	8497
WAOAF	4	10/15/2009	101	287.4	651	539.5	492.63	257	164.6	0.640466926	315.52	11256

Note: You will need to change the Plot numbers to correspond to your PMC (e.g., AZ, ET, MD, NM, etc.)

GA= Georgia PMC

GA 30, GA 60, GA 90 = yield taken at 30, 60 and 90 days after planting

GAAF = yield taken after frost

Sunn Hemp Adaptation Trial

PMC: WA - Pullman PMC

Planting Date: 5/24/2009

Plot#	Rep	Harvest date	Plt ht (in)	0.5 m^2 Plot wt Sample 1 (g)	0.5 m^2 Plot wt Sample 2 (g)	0.5 m^2 Plot wt Sample 3 (g)	0.5 m^2 Avg. plot wt (g)	grab sample Wet wt (g)	grab sample Dry wt (g)	Pct dry weight of sample (decimal %)	Avg. 0.5m^2 plot dry weight (g)	Yield (lb/acre)
WAP30	*1	6/24/2009	3	15.9	16.9	24.1	18.967	55.2	10.4	0.188405797	3.5734	127
WAP30	*2	6/24/2009	2.5	23.6	9.5	5.6	12.9	36.9	7.3	0.197831978	2.552	91
WAP30	*3	6/24/2009	3	19.9	10.7	19.3	16.633	48.5	9	0.18556701	3.0866	110
WAP30	*4	6/24/2009	2.5	14.6	10.9	9.5	11.667	33.8	6.2	0.183431953	2.14	76
WAP60	1	7/23/2009	12	26.1	63.7	37.2	42.333	127.3	25.4	0.199528672	8.4467	301
WAP60	2	7/23/2009	10	67.9	68.4	47	61.1	184.7	38.5	0.208446129	12.736	454
WAP60	3	7/23/2009	10	48.8	33.6	30.9	37.767	113.7	19.8	0.17414248	6.5768	235
WAP60	4	7/23/2009	6	11.9	0	5.5	5.8	18.1	4.4	0.243093923	1.4099	50
WAP90	1	8/24/2009	20	0	0	5.4	1.8	5.4	1.8	0.333333333	0.6	21
WAP90	2	8/24/2009	32	14.3	59.9	125.2	66.467	197.6	70.3	0.355769231	23.647	844
WAP90	3	8/24/2009	40	143.3	39.4	142	108.23	255.2	89.1	0.349137931	37.788	1348
WAP90	4	8/24/2009	28	41.1	96.8	98.6	78.833	236.4	78.6	0.33248731	26.211	935
WAPAF	1	10/13/2009	30	0	38.3	10.2	16.167	48.4	41.6	0.859504132	13.895	496
WAPAF	2	10/13/2009	35	32.2	0	54	28.733	84.7	75.9	0.896103896	25.748	919
WAPAF	3	10/13/2009	32	36.6	45.4	0	27.333	81.3	68.3	0.840098401	22.963	819
WAPAF	4	10/13/2009	45	6.1	40.4	36.8	27.767	83.8	72.4	0.863961814	23.989	856

Note: You will need to change the Plot numbers to correspond to your PMC (e.g., AZ, ET, MD, NM, etc.)

GA= Georgia PMC

GA 30, GA 60, GA 90 = yield taken at 30, 60 and 90 days after planting

GAAF = yield taken after frost

NATURAL RESOURCES CONSERVATION SERVICE
PLANT MATERIALS CENTER
PULLMAN, WASHINGTON
PMC STUDY PLAN

I. Study Title: Invasive Species: Suppression of Ventenata.

Study Number: WAPMC-T-0606-IN

II. Problem: Ventenata is a winter annual grass that is invading pastures, conservation cover plantings, critical areas, and rangelands in north-central Idaho and eastern Washington. This grass has little forage value and it prevents recruitment of desirable plants in areas that it has invaded.

III. Objective:
1) Determine which management practices retard the spread of Ventenata.
2) Determine which grasses/legumes species are least/most invaded by Ventenata.
3) Determine which grasses/legumes have the highest potential for establishment in areas infested by Ventenata.

IV. Procedure:

The plots are located approximately 4 miles east of Grangeville on Fourmile Road. The plot area is located approximately 300 yards north of the Highway and situated on the west side of Fourmile road.

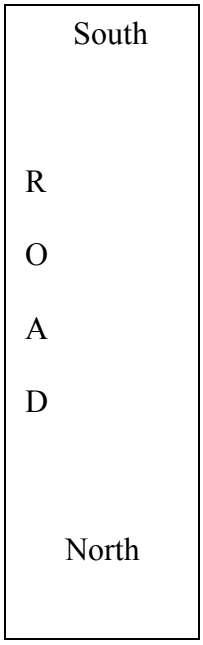
Plot area (70' x 150') was disked in the fall of 2006 and rototilled on May 5, 2007 to control vegetation and prepare seedbed.

Plot area was lightly rototilled again on May 8 to further break up sod pieces and then rolled & harrowed.

The seeding was installed on May 8 using a Plant-it junior seeder. Each plot was 60 feet long and 7 feet wide. Six or 7 seven rows were made in each plot. The plots were rolled after seeding.

Layout-

1. Delar small burnet
2. Pryor slender wheatgrass
3. Secar Snake river wheatgrass
4. Union Flat blue wildrye
5. Regar meadow brome
6. Covar sheep fescue
7. Latar orchardgrass
8. Bromar mountain brome
9. Alkar tall wheatgrass
10. Durar hard fescue
11. Sherman big bluegrass
12. Winchester Idaho fescue
13. Foothills Canada bluegrass
14. Bozoisky-Select Russian wildrye
15. Rush intermediate wheatgrass
16. Tuscany tall fescue
17. Rosana western wheatgrass
18. Sodar streambank wheatgrass
19. Vavilov Siberian wheatgrass
20. Lutana cicer milkvetch
21. Syn-1 alfalfa



V. Progress

species	rating (1-10) 7/26/07	stand vigor (1-10) 7/1/08	stand uniformity (1-10) 7/1/08	of ventenata (1-10) 7/1/08	presence of foxtail (1-10) 7/1/08	stand vigor (1-10) 7/9/09	stand uniformity (1-10) 7/9/09	presence of VEDU (1-10) 7/9/09	presence of foxtail (1-10) 7/9/09
1. Delar small burnet	10	4	7	10	3	3	3	0	9
2. Pryor slender wheatgrass	5	1	2	10	3	6	2	0	9
3. Secar Snake River wheatgrass	5	1	1	10	3	2	1	0	9
4. Union Flat blue wildrye	7	2	1	10	3	5	2	0	9
5. Regar meadow brome	7	0	0	10	3	3	1	0	9
6. Covar sheep fescue	4	4	3	10	3	1	2	0	9
7. Latar orchardgrass	8	4	4	10	3	2	2	0	9
8. Bromar mountain brome	5	2	4	10	5	1	0	0	9
9. Alkar tall wheatgrass	5	4	6	10	5	4	6	0	9
10. Durar hard fescue	5	2	1	9	5	2	1	0	9
11. Sherman big bluegrass	5	5	2	9	5	3	1	0	9
12. Winchester Idaho fescue	2	0	0	9	6	4	0	0	9
13. Foothills Canada bluegrass	5	6	5	9	6	5	5	0	9
14. Bozoisky-Select Russian wildrye	5	0	0	9	6	0	0	0	9
15. Rush intermediate wheatgrass	7	2	3	8	6	2	4	0	9
16. Tuscany II tall fescue	5	5	6	6	8	2	3	0	9
17. Rosana western wheatgrass	5	2	4	6	8	4	5	0	9
18. Sodar streambank wheatgrass	6	3	3	6	8	2	5	0	9
19. Vavilov Siberian wheatgrass	8	5	4	6	7	5	3	0	9
20. Lutana cicer mildvetch	8	2	1	6	6	1	3	0	9
21. Syn-1 Alfalfa	10	2	5	7	5	1	3	0	9

1 = poor 10 = excellent

2008 NOTES: Ventenata infestestation made evaluation challenging.
Ventenata competition was highest in southern plots (#s 1 - 9) and in eastern 1/2 to 3/4 of
Foxtail competition was highest in northern plots (#s 16 - 19) and in western 1/2 to 1/4 of
Where Ventenata competition was highest, stand uniformity was poor, however where foxtail competition was highest, stand uniformity was better.
Many plants appeared yellowish, particularly Latar orchardgrass and Tuscany II tall fescue. Likely cause: competition with Ventenata for nutrients.

MANAGEMENT PLAN fall 2008 - spring 2009: Plots will be hayed with rest of field after Sencor + Diurex will be sprayed in early spring. Foxtail may be rogued out by hand or plots cultivated between rows. Possible fertilization.

2009 NOTES: No Ventenata, eradicated by 6 oz Sencor + 1 pt Diurex applied by Rich Gribble 3/20/09
Garrison creeping foxtail taking over plots. Recommend abandoning study.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

Title	Invasive Species: Determination of rate of infestation of ventenata dubia in three vegetation regimes
Study Number	WAPMC-T-0806-IN
Study Leader	Pamela Scheinost, WAPMC Agron.
Duration	2008 - 2013
Description	Plots will be established at the PMC in three vegetation regimes having three levels of existing Ventenata infestation. The plots will be monitored annually to determine infestation trends.
Status of Knowledge	Within the last 10 years, Ventenata (*Ventenata dubia* (Leers) Coss.) has invaded the Pacific Northwest. Ventenata first occupied disturbed areas, and more recently has moved into areas with established perennial vegetation. Little is known about the rate of infestation in various vegetation regimes, such as rhizomatous grasses, bunch grasses or a mixture of rhizomatous and bunch grasses. If a difference in infestation rate of Ventenata can be determined, this information could be used to make recommendations to land managers for preventing or managing infestations. In addition, little is known about the effect Ventenata may have on the existing perennial vegetation, such as by robbing water and nutrients from the system. This study will provide an opportunity to monitor not only the rate of the spread of Ventenata, but also the rate of perennial vegetation growth or decline. At the Pullman PMC, trends in invasion of Ventenata have paralleled the PNW. The PMC is an ideal location for this study because of the variances in the levels of Ventenata, as well as variances in vegetation regimes throughout the landscape.

Experimental Design

Three 1 m x 1 m plots will be established randomly in each of three vegetation regimes: 1) rhizomatous grass, 2) bunch grass and 3) mixture of rhizomatous and bunch grasses, all having three levels of current Ventenata infestation: 1) low, 2) medium and 3) high. Total number of plots = 27.

Materials and methods

The plots will be established using 1 m long fiberglass rods set into the ground in each corner of the plot.

The rhizomatous grass plots consist of intermediate wheatgrass (*Thinopyrum intermedium*), meadow foxtail (*Alopecurus pratensis*), tall oatgrass (*Arrhenatherum elatius*), or bluebunch wheatgrass (*Pseudoroegnaria spicata*). The bunch grass plots consist of hard fescue (*Festuca brevipila*) and one or more of the rhizomatous grasses.

The plots will be rated on a scale of 0 – 10 for level of Ventenata infestation, and grouped into three catagories: low (0 – 3), medium (4 – 7) and high (8 – 10). Three plots with each of the three levels of infestation will be chosen initially for each vegetation type to establish benchmark conditions.

The plots will also be rated on cover of perennial vegetation to determine if it is being replaced by Ventenata over time. 0 = 0%, 10 = 100% cover.

The plots will be rated and pictures of each plot will be taken in August every year during the study.

Technology Transfer

The information generated in this study could potentially be useful in developing recommendations for land managers.

Progress

Plot severely infested with ventenata, August 2009, Pullman PMC, Pamela Scheinost

Plot		2008 Scale of Infestation	2009 Scale of Infestation		2008 % Perennial Cover	2009 % Perennial Cover
1		0	0		4	4
2		1	0		4	4
3		2	3		3	3
4		4	2		3	3
6		4	2		3	3
7		0	0		2	4
8		2	1		1	3
9		3	1		3	2
10		4	2		3	3
11		0	0		4	3
12		0	0		4	3
13		3	2		4	4
14		0	2		4	3
15		3	0		2	3
16		0	0		3	4
17		0	0		5	4
18		3	2		4	4
19		4	4		3	4
20		2	3		4	4
21		5	5		1	4
22		2	3		2	4
23		0	0		4	4
24		4	2		3	3
25		2	0		3	4
26		4	2		3	3
27		5	4		2	4

Scale of Infestation: 1 = low, 5 = high

Percent Perennial Cover: 1 = 1-20%; 2 = 21-40%; 3 = 41-60%; 4 = 61-80%; 5 = 81-100%

	Perennial Grass Type		
Scale of Infestation	Rhiz	Bunch	Rhiz + Bunch
High (4-5)	19, 21, 27	4, 6, 10	24, 26
Medium (2-3)	5, 20, 22	3, 9, 15	8, 13, 18, 25
Low (0-1)	2, 7, 17	1, 11, 16	12, 14, 23

notes: harder to find med + high vent infestation sites in rhiz grass, therefore may come in slower to these sites. However less rhiz @ farm; bunch (FEBR7) covers larger % of ground. Sites did find with med + high vent in rhiz were in low areas, not hillsides.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

Title	Invasive Species: Evaluation of plant species and cultivation techniques on shallow soil sites that have been infested with ventenata (*Ventenata dubia*)
Study Number	WAPMC-P-0902-IN
Study Leader	Pamela Scheinost, WAPMC Agron.
Duration	2008 - 2012
Description	Five species of legumes and 11 species of grasses will be evaluated for their ability to outcompete ventenata (*Ventenata dubia*) on sites that have been infested with this weed and have shallow soils. Tillage and no-till cultivation methods will also be examined. Two trials will be established; one in Whitman, County, WA and one in Asotin Co, WA, both on private land and in cooperation with the respective NRCS Field Offices.
Status of Knowledge	Within the last 10 years, Ventenata (*Ventenata dubia* (Leers) Coss.) has invaded the Pacific Northwest. It first occupied disturbed, open areas and more recently has moved onto land with established perennial vegetation, such as pastures, range, hay and CRP fields. Ventenata is undesirable because it has no forage value for livestock or wildlife, causes soil to be prone to erosion due to its shallow rooting depth, limits functions of waterways, causes a decline in productivity and degrades land values. It has proven very difficult to control with chemical and mechanical treatment. Where infestation is severe, reseeding is the only viable management option. Landowners have expressed an urgent need to know what species will out-compete ventenata and what methods of cultivation, where feasible, should be used.
Experimental Design	These trials will be established using a strip-plot design, with tillage as the horizontal factor and plant species as the vertical factor, and four replications of each interaction. Tillage treatments include tilled and untilled. Plant species include 5 legumes and 11 grasses, which will be

randomized within separate blocks in order to prevent herbicide damage. These blocks will be treated as side-by-side trials.

Materials and methods

In October of 2008, the trials will be laid out and plots with tillage will be roto-tilled. All plots will be harrowed and packed with a roller. In April of 2009, plots will be sprayed with glyphosate to control weeds. In May 2009, plots will be planted with a Plant-it Junior on the Asotin County site and with a Hege small plot planter on the Whitman County site. Seeding rate for each species will be based on rates provided in Tech Note 24. Species to be evaluated are:

Cultivar	Common name	Species name	Species code
Lutana	Cicer Milkvetch	*Astragalus cicer*	ASCI4
Ladak	Alfalfa	*Medicago sativa*	MESA
Delaney	Sanfoin	*Onobrychis viciifolia*	ONVI
Delar	Small burnet	*Sanguisorba minor*	SAMI3
Dutch	White Clover	*Trifolium repens*	TRRE3
Regar	Meadow brome	*Bromus biebersteinii*	BRBI2
Paiute	Orchardgrass	*Dactylis glomerata*	DAGL
Union Flat	Blue wildrye	*Elymus glaucus*	ELGL
Sodar	Streambank wheatgrass	*Elymus lanceolatus*	ELLA3
Pryor	Slender wheatgrass	*Elymus trachycaulus*	ELTR7
Tuscany II	Tall fescue	*Schedonorus phoenix*	SCPH
Foothills	Canada bluegrass	*Poa compressa*	POCO
Sherman	Big bluegrass	*Poa secunda*	POSE
Canbar	Canby bluegrass	*Poa secunda*	POSE
Whitmar	Bluebunch wheatgrass	*Psuedoroegneria spicata*	PSSP6
Rush	Intermediate wheatgrass	*Thinopyrum intermedium*	THIN6

Grass plots will be sprayed with broad-leaf herbicide to control weeds on an as-needed basis. Nitrogen and potassium will be surface applied at a rate based in fertilizer guide recommendations to all plots in 2010 and 2011.

To determine seed availability in the soil, four to six 1" samples will be collected in each of the tilled and non-tilled

treatments and grown out in a growth chamber during the first and last years of the study (2008 and 2011).

Composite soil samples (to 1 foot) will also be taken in the tilled and untilled plots prior to tillage in the first year (2008) and following data collection in the last year of the study (2011). The samples will be analyzed for organic matter and nutrient content.

The plants will be evaluated annually in July 2009 – 2011 for stand vigor, stand uniformity, and presence of ventenata; each rated on a scale of 1 – 10, 1 = poor, 10 = excellent. Photos will be taken of each plot at the time of evaluation. Biomass of each plot will be measured during the last year of the study (2011). Data will be analyzed to determine statistical differences among the species' performance.

Technology Transfer

The information generated in this study will be used to develop species and tillage recommendations for reseeding.

Progress

Species for 2009 Ventenata Revegetation Study

Cultivar	Common name	Species name	PLS rate (lb/ac)	Anatone Rows-Ranges	Kamiak Rows-Ranges
Lutana	Cicer Milkvetch	*Astragalus cicer*	7	1-4, 2-1, 3-3, 5-1	1-4, 2-1, 3-3, 5-2
Ladak	Alfalfa	*Medicago sativa*	10	1-3, 2-4, 3-1, 4-2	1-3, 2-4, 4-2, 5-1
Delaney	Sanfoin	*Onobrychis viciifolia*	34	2-2, 3-4, 4-1, 5-3	2-2, 3-4, 4-1, 5-3
Delar	Small burnet	*Sanguisorba minor*	20	1-2, 2-3, 4-4, 5-2	1-2, 2-3, 4-4, 5-2
Dutch	White clover	*Trifolium repens*	4	1-1, 3-2, 4-3, 5-4	1-1, 3-2, 4-3, 5-4
Regar	Meadow brome	*Bromus biebersteinii*	10	6-4, 9-2, 12-3, 14-1	6-4, 9-2, 12-3, 14-1
Paiute	Orchardgrass	*Dactylis glomerata*	4	7-4, 10-3, 13-2, 16-1	7-4, 10-3, 13-2, 16-1
Union Flat	Blue wildrye	*Elymus glaucus*	8	6-3, 8-4, 10-1, 14-2	6-3, 8-4, 10-1, 14-2
Sodar	Streambank wheatgrass	*Elymus lanceolatus*	6	8-1, 9-4, 12-2, 16-3	8-1, 9-4, 12-2, 16-3
Pryor	Slender wheatgrass	*Elymus trachycaulus*	8	6-2, 10-4, 11-1, 14-3	6-2, 10-4, 11-1, 14-3
Tuscany II	Tall fescue	*Schedonorus phoenix*	10	7-3, 9-1, 11-4, 15-2	7-3, 9-1, 11-4, 15-2
Foothills	Canada bluegrass	*Poa compressa*	3	6-1, 10-2, 12-4, 15-3	6-1, 10-2, 12-4, 15-3
Sherman	Big bluegrass	*Poa secunda*	3	9-3, 12-1, 13-4, 16-2	9-3, 12-1, 13-4, 16-2
Canbar	Canby bluegrass	*Poa secunda*	3	8-2, 11-3, 13-1, 14-4	8-2, 11-3, 13-1, 14-4
Whitmar	Bluebunch wheatgrass	*Psuedoroegneria spicata*	8	7-1, 8-3, 11-15, 15-4	7-1, 8-3, 11-15, 15-4
Rush	Intermediate wheatgrass	*Thinopyrum intermedium*	10	7-2, 13-3, 15-1, 16-4	7-2, 13-3, 15-1, 16-4

NORTH
V

SPECIES ARRANGEMENT - ANATONE

RANGE V	legumes										grasses						
4	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	till
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	no till
3	2	4	1	5	3	8	11	15	13	7	14	6	16	10	12	9	no till
	2	4	1	5	3	8	11	15	13	7	14	6	16	10	12	9	till
2	4	3	5	2	4	10	16	14	6	12	15	9	7	8	11	13	till
	4	3	5	2	4	10	16	14	6	12	15	9	7	8	11	13	no till
1	5	1	2	3	1	12	15	9	11	8	10	13	14	6	16	7	no till
	5	1	2	3	1	12	15	9	11	8	10	13	14	6	16	7	till
ROW >	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	

^
NORTH

SPECIES ARRANGEMENT - KAMIAK

RANGE V	legumes										grasses						
4	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	till
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	no till
3	2	4	1	5	3	8	11	15	13	7	14	6	16	10	12	9	no till
	2	4	1	5	3	8	11	15	13	7	14	6	16	10	12	9	till
2	4	3	5	2	1	10	16	14	6	12	15	9	7	8	11	13	till
	4	3	5	2	1	10	16	14	6	12	15	9	7	8	11	13	no till
1	5	1	4	3	2	12	15	9	11	8	10	13	14	6	16	7	no till
	5	1	4	3	2	12	15	9	11	8	10	13	14	6	16	7	till
ROW >	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	

Anatone Ventenata Revegetation Study Planted 5/26/09
Row 1-Range 1 on NE corner

					20 Days After Planting	54 Days After Planting		
Row	Range	Cultivation	Cultivar	Species	No. of Leaves	No. of Leaves	Percent Stand Potential	Comments
1	1	cultivated	Dutch	White clover	2	0	0	
1	1	non-cultivated	Dutch	White clover	2	0	0	
1	2	non-cultivated	Delar	Small burnet	3	4	70	
1	2	cultivated	Delar	Small burnet	3	4	50	
1	3	cultivated	Ladak	Alfalfa	3	5	70	
1	3	non-cultivated	Ladak	Alfalfa	3	5	80	
1	4	non-cultivated	Lutana	Cicer milkvetch	3	4	50	
1	4	cultivated	Lutana	Cicer milkvetch	3	4	10	
2	1	cultivated	Lutana	Cicer milkvetch	2	4	10	
2	1	non-cultivated	Lutana	Cicer milkvetch	2	4	5	
2	2	non-cultivated	Delaney	Sanfoin	3	4	50	
2	2	cultivated	Delaney	Sanfoin	3	4	10	
2	3	cultivated	Delar	Small burnet	3	5	90	
2	3	non-cultivated	Delar	Small burnet	3	5	70	
2	4	non-cultivated	Ladak	Alfalfa	3	5	50	
2	4	cultivated	Ladak	Alfalfa	3	5	30	
3	1	cultivated	Ladak	Alfalfa	3	5	20	
3	1	non-cultivated	Ladak	Alfalfa	3	5	20	
3	2	non-cultivated	Dutch	White clover	3	12	50	
3	2	cultivated	Dutch	White clover	3	10	20	
3	3	cultivated	Lutana	Cicer milkvetch	2	5	10	
3	3	non-cultivated	Lutana	Cicer milkvetch	2	5	10	
3	4	non-cultivated	Delaney	Sanfoin	3	5	80	browse damage
3	4	cultivated	Delaney	Sanfoin	3	5	60	browse damage
4	1	cultivated	Delaney	Sanfoin	3	5	40	
4	1	non-cultivated	Delaney	Sanfoin	3	5	60	
4	2	non-cultivated	Ladak	Alfalfa	3	6	40	browse damage
4	2	cultivated	Ladak	Alfalfa	3	6	40	browse damage
4	3	cultivated	Dutch	White clover	3	8	5	
4	3	non-cultivated	Dutch	White clover	3	8	40	
4	4	cultivated	Delar	Small burnet	3	12	40	
4	4	non-cultivated	Delar	Small burnet	3	12	50	
5	1	cultivated	Lutana	Cicer milkvetch	2	4	5	
5	1	non-cultivated	Lutana	Cicer milkvetch	2	4	5	
5	2	non-cultivated	Delar	Small burnet	3	12	40	
5	2	cultivated	Delar	Small burnet	3	12	80	
5	3	cultivated	Delaney	Sanfoin	3	6	70	browse damage
5	3	non-cultivated	Delaney	Sanfoin	3	6	70	flowering
5	4	non-cultivated	Dutch	White clover	3	12	10	
5	4	cultivated	Dutch	White clover	3	12	5	
6	1	cultivated	Foothills	Canada Bluegrass	3	0	0	
6	1	non-cultivated	Foothills	Canada Bluegrass	3	0	0	
6	2	non-cultivated	Pryor	Slender Wheatgrass		5	50	
6	2	cultivated	Pryor	Slender Wheatgrass		3	10	
6	3	cultivated	Union Flat	Blue wildrye		0	0	
6	3	non-cultivated	Union Flat	Blue wildrye		8	10	
6	4	non-cultivated	Regar	Meadow brome		6	5	
6	4	cultivated	Regar	Meadow brome		6	5	
7	1	cultivated	Whitmar	Bluebunch wheatgrass		0	0	
7	1	non-cultivated	Whitmar	Bluebunch wheatgrass		4	5	
7	2	non-cultivated	Rush	Intermediate wheatgrass		6	40	browse damage
7	2	cultivated	Rush	Intermediate wheatgrass		6	40	browse damage
7	3	cultivated	Tuscany II	Tall Fescue	2	8	20	browse damage
7	3	non-cultivated	Tuscany II	Tall Fescue	2	8	10	browse damage
7	4	non-cultivated	Paiute	Orchardgrass		0	0	
7	4	cultivated	Paiute	Orchardgrass		0	0	
8	1	cultivated	Sodar	Streambank wheatgrass		0	0	
8	1	non-cultivated	Sodar	Streambank wheatgrass		4	20	
8	2	non-cultivated	Canbar	Canby bluegrass	2	0	0	
8	2	cultivated	Canbar	Canby bluegrass	2	0	0	
8	3	cultivated	Whitmar	Bluebunch wheatgrass		0	0	
8	3	non-cultivated	Whitmar	Bluebunch wheatgrass		0	0	
8	4	non-cultivated	Union Flat	Blue wildrye		0	0	
8	4	cultivated	Union Flat	Blue wildrye		0	0	
9	1	cultivated	Tuscany II	Tall Fescue		10	5	
9	1	non-cultivated	Tuscany II	Tall Fescue		12	50	
9	2	non-cultivated	Regar	Meadow brome		0	0	
9	2	cultivated	Regar	Meadow brome		0	0	
9	3	cultivated	Sherman	Big bluegrass		0	0	
9	3	non-cultivated	Sherman	Big bluegrass		0	0	
9	4	non-cultivated	Sodar	Streambank wheatgrass		10	20	
9	4	cultivated	Sodar	Streambank wheatgrass		0	0	
10	1	cultivated	Union Flat	Blue wildrye		0	0	
10	1	non-cultivated	Union Flat	Blue wildrye		0	0	
10	2	non-cultivated	Foothills	Canada Bluegrass		0	0	
10	2	cultivated	Foothills	Canada Bluegrass		0	0	
10	3	cultivated	Paiute	Orchardgrass	3	0	0	
10	3	non-cultivated	Paiute	Orchardgrass	3	6	20	
10	4	non-cultivated	Pryor	Slender Wheatgrass		6	30	
10	4	cultivated	Pryor	Slender Wheatgrass		0	0	
11	1	cultivated	Pryor	Slender Wheatgrass		0	0	
11	1	non-cultivated	Pryor	Slender Wheatgrass		0	0	
11	2	non-cultivated	Whitmar	Bluebunch wheatgrass		5	5	
11	2	cultivated	Whitmar	Bluebunch wheatgrass		0	0	
11	3	cultivated	Canbar	Canby bluegrass		0	0	
11	3	non-cultivated	Canbar	Canby bluegrass		0	0	
11	4	non-cultivated	Tuscany II	Tall Fescue	3	10	80	
11	4	cultivated	Tuscany II	Tall Fescue	3	0	0	
12	1	cultivated	Sherman	Big bluegrass		0	0	
12	1	non-cultivated	Sherman	Big bluegrass		0	0	
12	2	non-cultivated	Sodar	Streambank wheatgras	3	3	10	
12	2	cultivated	Sodar	Streambank wheatgras	3	3	10	
12	3	cultivated	Regar	Meadow brome		4	5	browse damage
12	3	non-cultivated	Regar	Meadow brome		4	5	
12	4	non-cultivated	Foothills	Canada Bluegrass		0	0	
12	4	cultivated	Foothills	Canada Bluegrass		0	0	
13	1	cultivated	Canbar	Canby bluegrass		0	0	
13	1	non-cultivated	Canbar	Canby bluegrass		0	0	
13	2	non-cultivated	Paiute	Orchardgrass		3	20	browse damage
13	2	cultivated	Paiute	Orchardgrass		0	0	
13	3	cultivated	Rush	Intermediate wheatgrass		0	0	
13	3	non-cultivated	Rush	Intermediate wheatgrass		0	0	
13	4	non-cultivated	Sherman	Big bluegrass		0	0	
13	4	cultivated	Sherman	Big bluegrass		0	0	
14	1	cultivated	Regar	Meadow brome		0	0	
14	1	non-cultivated	Regar	Meadow brome		0	0	
14	2	non-cultivated	Union Flat	Blue wildrye		0	0	
14	2	cultivated	Union Flat	Blue wildrye		0	0	
14	3	cultivated	Pryor	Slender Wheatgrass		3	5	
14	3	non-cultivated	Pryor	Slender Wheatgrass		3	10	
14	4	non-cultivated	Canbar	Canby bluegrass		0	0	
14	4	cultivated	Canbar	Canby bluegrass		0	0	
15	1	cultivated	Rush	Intermediate wheatgrass		0	0	
15	1	non-cultivated	Rush	Intermediate wheatgrass		0	0	
15	2	non-cultivated	Tuscany II	Tall Fescue		0	0	
15	2	cultivated	Tuscany II	Tall Fescue		0	0	
15	3	cultivated	Foothills	Canada Bluegrass		0	0	
15	3	non-cultivated	Foothills	Canada Bluegrass		0	0	
15	4	non-cultivated	Whitmar	Bluebunch wheatgrass		0	0	
15	4	cultivated	Whitmar	Bluebunch wheatgrass		0	0	
16	1	cultivated	Paiute	Orchardgrass		0	0	
16	1	non-cultivated	Paiute	Orchardgrass		0	0	
16	2	non-cultivated	Sherman	Big bluegrass		0	0	
16	2	cultivated	Sherman	Big bluegrass		0	0	
16	3	cultivated	Sodar	Streambank wheatgrass		0	0	
16	3	non-cultivated	Sodar	Streambank wheatgrass		0	0	
16	4	non-cultivated	Rush	intermediate wheatgrass		0	0	
16	4	cultivated	Rush	Intermediate wheatgrass		0	0	

7/30/09 other plants present
yarrow, horsemint, small burnet, erect pigweed, brome grass, mullein, intermediate wheatgrass, ventenata, wavy leaf thistle, plant w/ pods, prickly plant

Ventenata Revegetation Study, Anatone, WA, July 2009, Pamela Scheinost

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

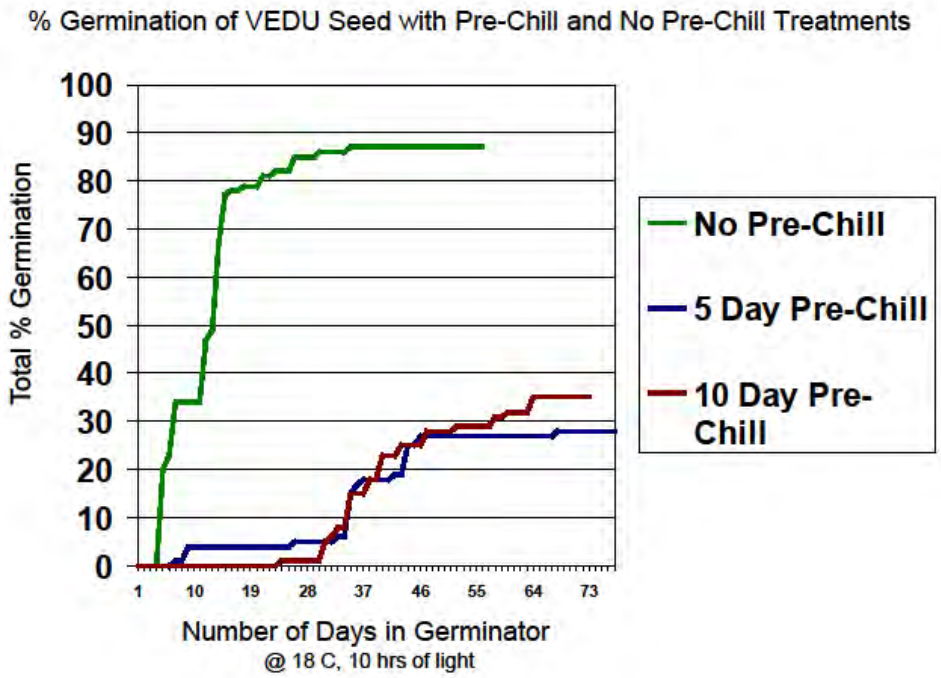
Title	Invasive Species: Seed Dormancy of Ventenata dubia
Study Number	WAPMC-T-0903-IN
Study Leader	Pamela Scheinost, WAPMC Agron.
Duration	2010 - 2011
Description	Ventenata seed will be collected on the farm in 2010 and 2011, and subjected to various treatments to determine the dormancy period and optimum conditions for seed germination.
Status of Knowledge	Little is known about the biology of ventenata seed. Northam and Callihan published and abstract of a seed germination study, which included ventenata, in the Proceedings of the Western Society of Weed Science in 1986. However the study was never published in a peer-reviewed journal or repeated by other scientists. There is no other information in the literature regarding the biology of ventenata seed. Information generated by this study, in particular how seed dormancy is affected by chilling, after-harvest ripening period and temperature, is vitally needed for development of effective ventenata control methods.
Experimental Design	The experiment will be a 2 x 5 x 4 factorial study (split-split-plot design), with 2 prechill treatments (none and 5 days at 5º C) (subplots), 5 after harvest intervals (0, 10, 30, 90 and 270 days after harvest) (sub-subplots) and 4 germination temperatures (10, 20, 30, 40º C) (main plots). Each experimental unit will consist of 50 seeds and replicated 3 times. The entire experiment will be conducted in two consecutive years.
Materials and methods	Ventenata seed will be harvested at the Pullman Plant Materials Center in July 2010 and 2011. The seed will be immediately cleaned using a hammermill and electrostatic blower (or Office Clipper). Seed will be divided into 36 experimental groups (150 seeds in each group) and further subdivided into 3 replications (50 seeds in each rep). The 0

days after harvest treatments will not be subjected to chilling, however will be immediately placed in a germination chamber at 4 temperatures. The remaining experimental units will be stored in the seed storage room, and undergo chilling and germination temperature treatments at the proper intervals. Percent germination will be recorded once a week for four weeks, and results will be analyzed using statistical methods to determine correlations among treatments.

Technology Transfer

Information obtained from this study will be shared with NRCS Field Office Staff, the WSU Extension Ventenata List Serve, and WSU and University of Idaho researchers. In addition, results from this study may be combined with results from other studies also concerning the seed biology of ventenata for publication in a scientific journal.

Progress



10-Day Chill - Moved to Germinator 11/2

	25-Nov	26-Nov	27-Nov	28-Nov	29-Nov	30-Nov	1-Dec	2-Dec	3-Dec	4-Dec	5-Dec	6-Dec	7-Dec	8-Dec	9-Dec
Rep	Day 24	Day 25	Day 26	Day 27	Day 28	Day 29	Day 30	Day 31	Day 32	Day 33	Day 34	Day 35	Day 36	Day 37	Day 38
1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0
2	1	0	0	0	0	0	0	0	1	1	0	3	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
4	0	0	0	0	0	0	0	0	0	1	0	3	0	0	1
5	0	0	0	0	0	0	0	3	0	0	0	0	0	0	1
TOTAL	1	0	0	0	0	0	0	4	1	2	0	7	0	0	3
CUM	1	1	1	1	1	1	1	5	6	8	8	15	15	15	18

	10-Dec	11-Dec	12-Dec	13-Dec	14-Dec	15-Dec	16-Dec	17-Dec	18-Dec	19-Dec	20-Dec	21-Dec	22-Dec	23-Dec	24-Dec
Rep	Day 39	Day 40	Day 41	Day 42	Day 43	Day 44	Day 45	Day 46	Day 47	Day 48	Day 49	Day 50	Day 51	Day 52	Day 53
1		3			1				2					1	
2		1			0				0					0	
3		0			0				1					0	
4		1			1				0					0	
5		0			0				0					0	
TOTAL		5			2				3					1	
CUM		23			25				28					29	

	25-Dec	26-Dec	27-Dec	28-Dec	29-Dec	30-Dec	31-Dec	1-Jan	2-Jan	3-Jan	4-Jan	5-Jan	6-Jan	7-Jan	8-Jan
Rep	Day 54	Day 55	Day 56	Day 57	Day 58	Day 59	Day 60	Day 61	Day 62	Day 63	Day 64	Day 65	Day 66	Day 67	Day 68
1					0		0				0				
2					0		1				1				
3					0		0				0				
4					2		0				0				
5					0		0				2				
TOTAL					2		1				3				
CUM					31		32				35				

	9-Jan	10-Jan	11-Jan	12-Jan	13-Jan	14-Jan	15-Jan	16-Jan	17-Jan	18-Jan	19-Jan	20-Jan	21-Jan	22-Jan	23-Jan
Rep	Day 69	Day 70	Day 71	Day 72	Day 73	Day 74	Day 75	Day 76	Day 77	Day 78	Day 79	Day 80	Day 81	Day 82	Day 83
1					0						0				
2					0						0				
3					0						0				
4					0						0				
5					0						0				
TOTAL					0						0				
CUM					35						35				

	24-Jan	25-Jan	26-Jan	27-Jan	28-Jan	29-Jan	30-Jan	31-Jan	1-Feb	2-Feb	3-Feb	4-Feb	5-Feb	6-Feb	7-Feb
Rep	Day 84	Day 85	Day 86	Day 87	Day 88	Day 89	Day 90	Day 91	Day 92	Day 93	Day 94	Day 95	Day 96	Day 97	Day 98
1		0													
2		0													
3		0													
4		0													
5		0													
TOTAL		0													
CUM		35													

END

	8-Feb	9-Feb	10-Feb	11-Feb	12-Feb	13-Feb	14-Feb	15-Feb	16-Feb	17-Feb	18-Feb	19-Feb	20-Feb	21-Feb	22-Feb
Rep	Day 99	Day 100	Day 101	Day 102	Day 103	Day 104	Day 105	Day 106	Day 107	Day 108	Day 109	Day 110	Day 111	Day 112	Day 113
1															0
2															0
3															0
4															0
5															0
TOTAL															0
CUM															35

Day	Cum.
24	1
25	1
26	1
27	1
28	1
29	1
30	1
31	5
32	6
33	8
34	8
35	15
36	15
37	15
38	18
39	18
40	23
41	23
42	23
43	25
44	25
45	25
46	25
47	28
48	28
49	28
50	28
51	28
52	29
53	29
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UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

Title	Invasive Species: Seed Longevity of Ventenata dubia
Study Number	WAPMC-T-0905-IN
Study Leader	Pamela Scheinost, WAPMC Agron.
Duration	2009-2019
Description	Ventenata seed will be collected on the farm in 2009, buried, and tested for viability 1, 6 and 13 months after burial, then once a year for the following 9 years.
Status of Knowledge	The WAPMC Farm Manager has observed ventenata seed to be viable for 2 – 3 years, however this observation has not been tested using scientific methods. There is no information in the literature regarding the longevity of ventenata seed.
Experimental Design	The experiment will be a 2 x 12 x 2 factorial study (split-split-plot design) with 2 burial depths (2 and 8 cm) (subplots) 12 sampling times (1, 6 months and 1 – 9 years after burial) (sub-subplots), and 2 burial locations (Pullman Plant Materials Center and U of I location) (main plots). There will be 4 replications of each treatment.
Materials and methods	In July 2009, seed will be collected from mature ventenata plants at the PMC. Seed will be immediately separated from the plants using a hammer mill and office clipper. Seed will then be hand separated and counted into groups of 100 and placed into envelopes. A total of 240 envelopes (24,000 seeds) are needed. Seed in 192 envelopes (2 burial depths x 12 sampling times x 2 locations x 4 replications) will be placed into packets constructed of 4 x 4 inch nylon mesh fabric squares containing 2 tsp of soil. The packets will be closed with zip ties and 20 cm wire will be attached to 96 of the packets for easy retrieval from the 8 cm burial depth. The remaining 48 envelopes of seed will be kept in the seed storage room as controls (12 sampling times x 4 replications).

On or around September 30, the packets will be buried in side-by-side pits in ventenata-infested areas at both locations. The soil type, aspect, slope, and existing vegetation of each location will be recorded. The locations will be well marked and protected from farm equipment operations.

Seed Burial: 9/30/09

Retrieval Intervals:

11/20/09	1 month
4/20/10	6 months
10/20/10	1 year
10/20/11	2 years
10/20/12	3 years
10/20/13	4 years
10/20/14	5 years
10/20/15	6 years
10/20/16	7 years
10/20/17	8 years
10/20/18	9 years
10/20/19	10 years

* The selection of timing of the seed burial and retrieval correlate with how the seed may be treated in natural conditions. Seed may be buried by tillage operations around 9/30. For maximum germination the seed may need to be exposed to fluctuation or decline in temperature that occurs in early fall.

At the above-mentioned intervals, one packet from each depth for each replication at both locations will be retrieved. The seeds will be removed from the packets, separated from the soil, air dried and counted. All seeds, including control seeds will be surface sterilized using 5% bleach solution (0.25% sodium hypochlorite) for 5 – 10 seconds and rinsed with deionized water 3 times. Seeds will be placed in 9mm diameter petri dishes on top of two pieces of moistened germination paper. All seeds will be wetted and prechilled for 5 days at 5º C in the dark to promote seed germination. Petri dishes will be moved to a germinator set at 18º C (Based on findings by Northam and Callihan, 1986). Percent germination will be recorded once a week for 4 weeks.

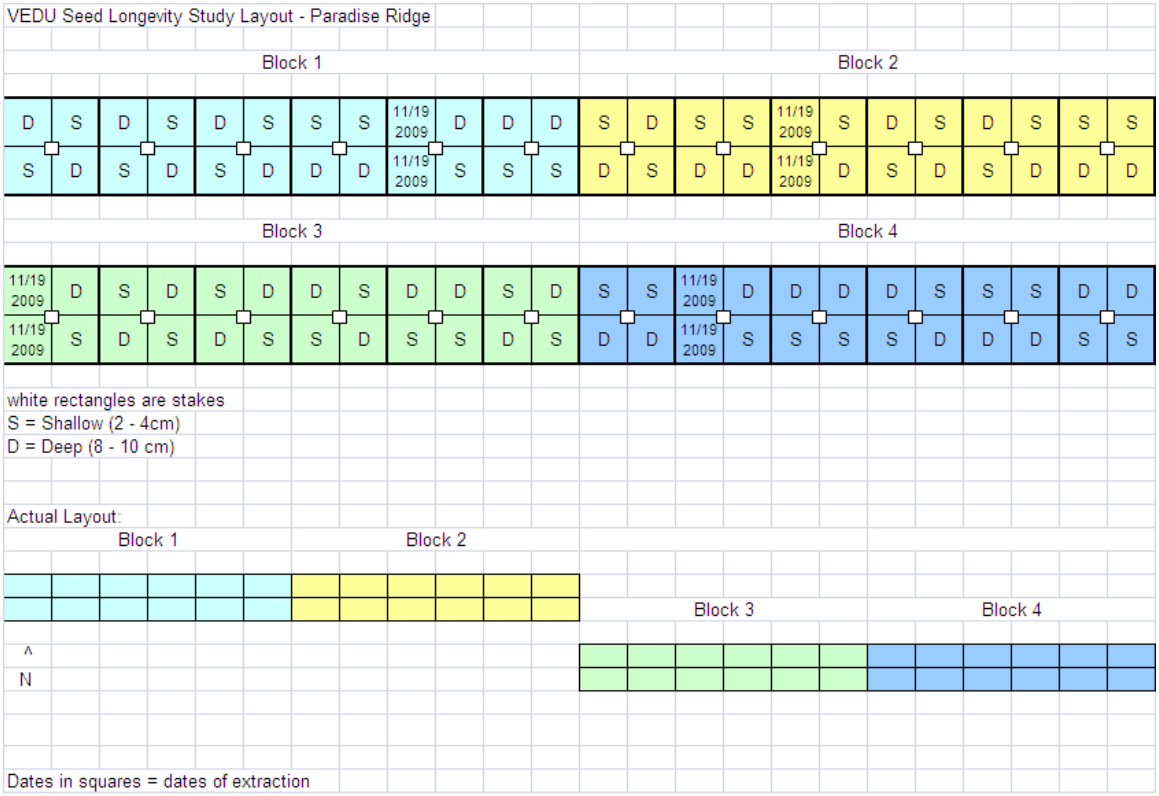
If germination is found to be below 1% for two years in a row, this study will cease and the remaining buried seeds will be retrieved and tested for viability using tetrazolium chloride.

Results will be analyzed using statistical methods to determine percent germination differences between burial depth, duration and location.

Technology Transfer

Information obtained from this study will be shared with Field Office Staff, the WSU Extension Ventenata List Serve, and WSU and University of Idaho researchers. In addition, results from this study may be combined with results from other studies on the seed biology of ventenata for publication in a scientific journal.

Progress



VEDU Seed Longevity Study Layout - Pullman Plant Materials Center

Block 1

S	D	D	S	D	D	11/20 2009	11/20 2009	S	D	S	S
D	S	S	D	S	S	D	S	D	S	D	D

Block 2

D	S	D	S	S	S	S	D	11/20 2009	D	S	D
S	D	S	D	D	D	D	S	11/20 2009	S	D	S

Block 3

D	S	D	D	D	S	D	D	S	11/20 2009	D	D
S	D	S	S	S	D	S	S	D	11/20 2009	S	S

Block 4

S	11/20 2009	S	D	D	D	D	S	S	D	S	S
D	11/20 2009	D	S	S	S	S	D	D	S	D	D

SPRUCE TREE

ROAD

This is the actual layout

^

N

white rectangles are stakes
S = Shallow (2 - 4cm)
D = Deep (8 - 10 cm)

Dates in squares = dates of extraction

All seeds non-germinated at time of retieval placed in germinator on 11/20

Paradise Ridge Shallow

Rep	Germinated at time of retrieval	Non-germinated	24-Nov Day 4	25-Nov Day 5	30-Nov Day 10	23-Dec Day 33	13-Jan Day 54			
1	83	17	0	0	0	0	0			
2	81	19	0	0	0	0	0			
3	86	14	0	0	0	0	0			
4	81	19	2	0	0	0	0			
AVE	83	17								

Paradise Ridge Deep

Rep	Germinated at time of retrieval	Non-germinated	24-Nov Day 4	25-Nov Day 5	30-Nov Day 10	23-Dec Day 33	13-Jan Day 54			
1	81	17	0	0	0	0	0			
2	79	18	2	0	0	0	0			
3	79	18	0	0	0	0	0			
4	82	18	0	0	0	0	0			
AVE	80	18								

PMC Shallow

Rep	Germinated at time of retrieval	Non-germinated	24-Nov Day 4	25-Nov Day 5	30-Nov Day 10	2-Dec Day 12	18-Dec Day 28	23-Dec Day 33	13-Jan Day 54	
1	87	13	0	0	0	0	0	0	0	
2	80	16	0	0	0	0	1	0	0	
3	82	17	0	0	0	0	0	0	0	
4	75	22	0	1	0	1	0	0	0	
AVE	81	17								

PMC Deep

Rep	Germinated at time of retrieval	Non-germinated	24-Nov Day 4	25-Nov Day 5	30-Nov Day 10	23-Dec Day 33	13-Jan Day 54			
1	78	17	0	0	0	0	0			
2	85	12	0	0	0	0	0			
3	74	18	0	0	0	0	0			
4	83	17	0	0	0	0	0			
AVE	80	16								

NATURAL RESOURCES CONSERVATION SERVICE
PLANT MATERIALS CENTER
PULLMAN, WASHINGTON

PMC STUDY PLAN

Study Title: The Adaptation, Production and Longevity of Dryland Range Species, Seeded Alone and With Understory Grasses.

Study Number: WAPMC-T-7601-PA

Problem: Previous trials have shown the maximum production and longevity on range and dryland sites is obtained from 12 to 14 inch row spacings of adapted grasses. These spacings leave room for erosion and weed invasion.

Objective: To determine production, cover and longevity of each species seeded alone and with understory grasses.

Procedure: Eleven grass species and one legume, Ladak alfalfa, Medicago sativa, were seeded alone and as an overstory with 7 grasses at the Dry Land Research Unit in Adams County, Washington. The planting was replicated three times in a randomized block design. Overstory species were seeded with a standard double disc drill on 12-inch row spacings. The planting was cross-seeded with understory species using the same drill but with 6-inch row spacings.

Species Seeded as Overstory	Species Seeded as Understory
Nordan, *Agropyron desertorum*	P-1822, *Agropyron dasystachyum*
Alkar, *Agropyron elongatum*	Nordan, *Agropyron desertorum*
Greenar, *Agropyron intermedium*	Sodar, *Agropyron riparium*
P-27, *Agropyron sibiricum*	Covar, *Festuca ovina*
Secar, *Agropyron spicatum*	P4874, *Poa bulbosa*
Whitmar, *Agropyron spicatum f. inerme*	Sherman, *Poa ampla*
Luna, *Agropyron trichophorum*	Canbar, *Poa canbyi*
Topar, *Agropyron trichophorum*	
Magnar, *Elymus cinereus*	
P-210, *Psathyrostachys juncea*	
Ladak, *Medicago sativa*	
Sherman, *Poa ampla*	

The planting was made February 28, through March 1, 1977 on summer fallowed land. It was sprinkler irrigated 24 hours (approximately 5 inches) on May 1, 1977 to insure establishment.

This study shows that several species are not competitive on this site even though often seeded alone with some apparent success. Sherman is the dominant and most aggressive species on the

site and in fact receives very little competition from any of the other species seeded except Whitmar and Secar, both *Agropyron spicatums.*

A complete copy of the study plan appears in the 1976 Annual Technical Report.

Progress: No detailed evaluations were conducted in 1997. The plot area was maintained in an idle condition in 1997. Casual observations made in June 1997 indicate that little change in species distributions has occurred since the last detailed evaluation. Sherman big bluegrass continues to dominate the planting and appears to respond well to small disturbances such as rabbit burrows. No evaluations were made from 1998 to 2001.

The study was evaluated in May 2006. Of notable interest, native sandberg bluegrass is colonizing many of the plots.

Figure 1.

Study 1-76

Location Map

1977 Lind Seeding Overstory-Understory Grasses

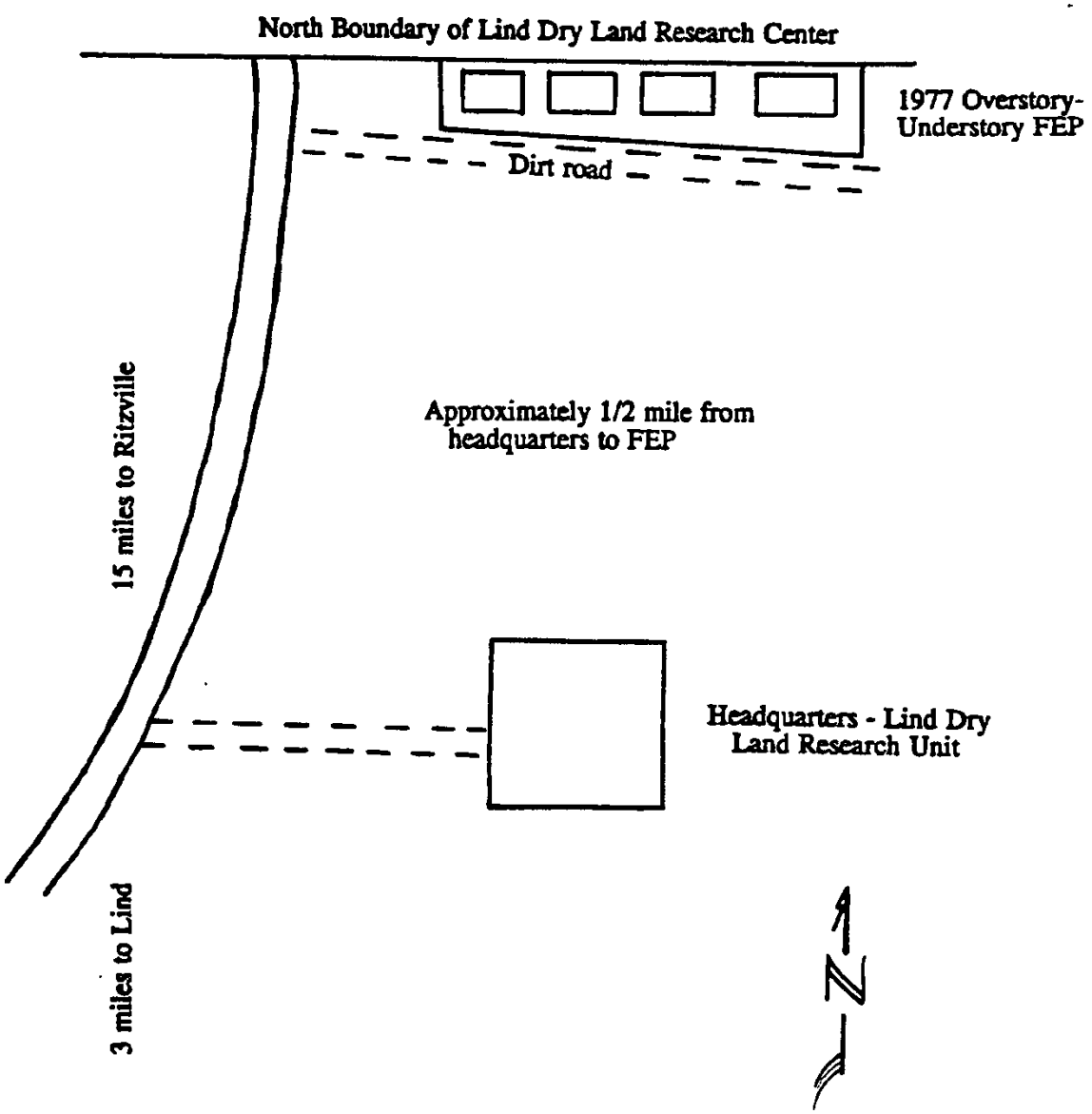


Figure 2.

Study 1-76 Plot Design

1977 Lind Seeding Overstory-Understory Grasses

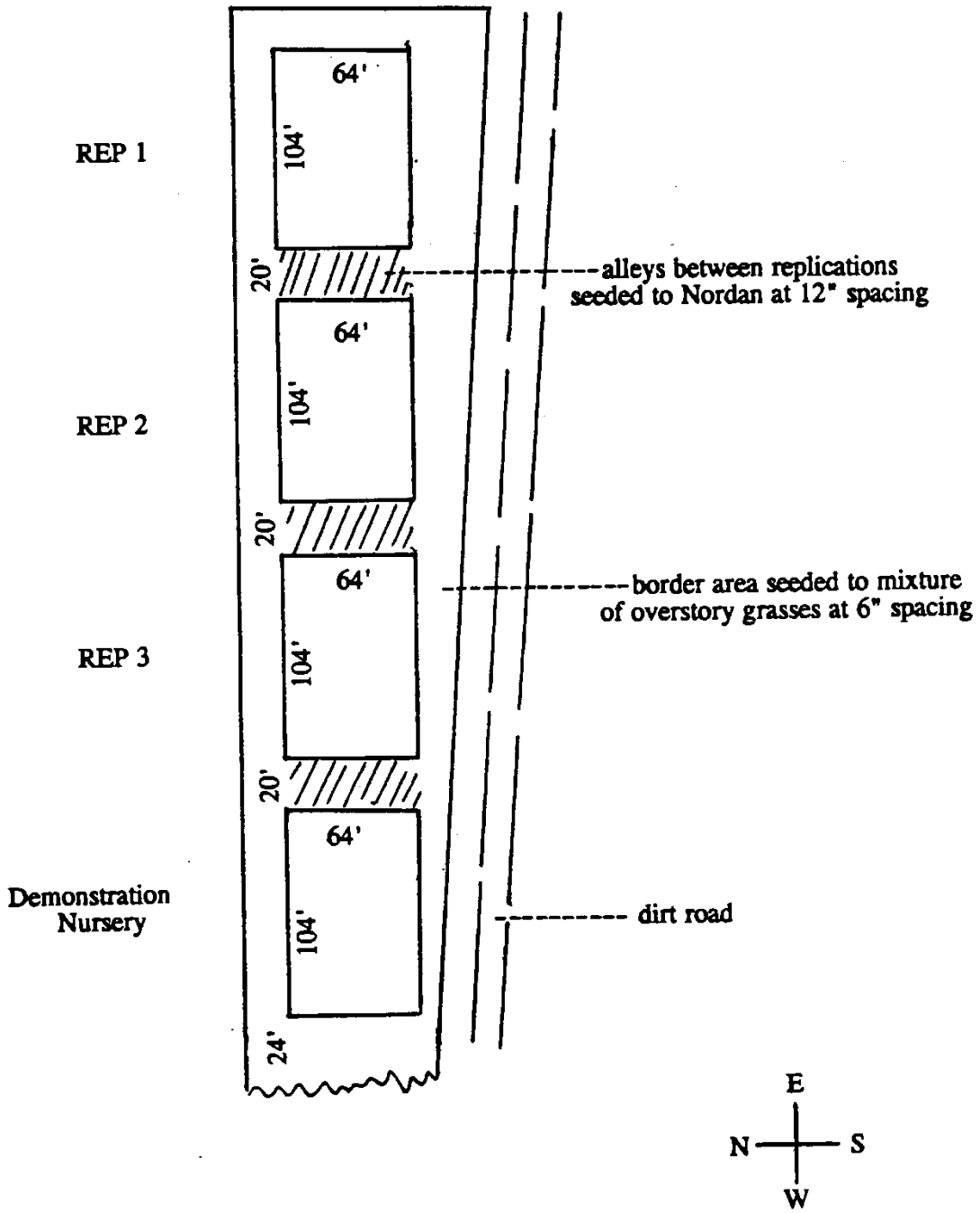


Figure 3.
Study 1-76

Overstory-Understory Study; Lind, Washington; Replication I

NORTH

Check Control Plots	Check P-210	Check Whitmar	Check Secar	Check Topar	Check Luna	Check Alkar	Check P-27	Check Nordan	Check Magnar	Check Check	Check Sherman	Check Greenar	Check Ladak
Nordan Crested Wheatgrass	Nordan P-210	Nordan Whitmar	Nordan Secar	Nordan Topar	Nordan Luna	Nordan Alkar	Nordan P-27	Nordan Nordan	Nordan Magnar	Nordan Check	Nordan Sherman	Nordan Greenar	Nordan Ladak
Covar Sheep Fescue	Covar P-210	Covar Whitmar	Covar Secar	Covar Topar	Covar Luna	Covar Alkar	Covar P-27	Covar Nordan	Covar Magnar	Covar Check	Covar Sherman	Covar Greenar	Covar Ladak
P-4874 Bulbous Bluegrass	P-4874 P-210	P-4874 Whitmar	P-4874 Secar	P-4874 Topar	P-4874 Luna	P-4874 Alkar	P-4874 P-27	P-4874 Nordan	P-4874 Magnar	P-4874 Check	P-4874 Sherman	P-4874 Greenar	P-4874 Ladak
Sodar Streambank Wheatgrass	Sodar P-210	Sodar Whitmar	Sodar Secar	Sodar Topar	Sodar Luna	Sodar Alkar	Sodar P-27	Sodar Nordan	Sodar Magnar	Sodar Check	Sodar Sherman	Sodar Greenar	Sodar Ladak
Canbar Canby Bluegrass	Canbar P-210	Canbar Whitmar	Canbar Secar	Canbar Topar	Canbar Luna	Canbar Alkar	Canbar P-27	Canbar Nordan	Canbar Magnar	Canbar Check	Canbar Sherman	Canbar Greenar	Canbar Ladak
Sherman Big Bluegrass	Sherman P-210	Sherman Whitmar	Sherman Secar	Sherman Topar	Sherman Luna	Sherman Alkar	Sherma P-27	Sherman Nordan	Sherman Magnar	Sherman Check	Sherman Sherman	Sherman Greenar	Sherman Ladak
P-1822 Thickspike Wheatgrass	P-1822 P-210	P-1822 Whitmar	P-1822 Secar	P-1822 Topar	P-1822 Luna	P-1822 Alkar	P-1822 P-27	P-1822 Nordan	P-1822 Magnar	P-1822 Check	P-1822 Sherman	P-1822 Greenar	P-1822 Ladak

EAST

P-210 Russian Wildrye
Whitmar Beardless Wheatgrass
Secar Bluebunch Wheatgrass
Topar Pubescent Wheatgrass
Luna Pubescent Wheatgrass
Alkar Tall Wheatgrass
P-27 Siberian Wheatgrass
Nordan Crested Wheatgrass
Magnar Basin Wildrye
Check Control Plots
Sherman Big Bluegrass
Greenar Intermediate Wheatgrass
Ladak Alfalfa

Figure 4.
Study 1-76

Overstory-Understory Study; Lind, Washington; Replication II

NORTH

Nordan Crested Wheatgrass	Nordan Whitmar	Nordan P-27	Nordan Greenar	Nordan Luna	Nordan Secar	Nordan Check	Nordan P-210	Nordan Magnar	Nordan Nordan	Nordan Sherman	Nordan Topar	Nordan Ladak	Nordan Alkar
Sodar Streambank Wheatgrass	Sodar Whitmar	Sodar P-27	Sodar Greenar	Sodar Luna	Sodar Secar	Sodar Check	Sodar P-210	Sodar Magnar	Sodar Nordan	Sodar Sherman	Sodar Topar	Sodar Ladak	Sodar Alkar
P-1822 Thickspike Wheatgrass	P-1822 Whitmar	P-1822 P-27	P-1822 Greenar	P-1822 Luna	P-1822 Secar	P-1822 Check	P-1822 P-210	P-1822 Magnar	P-1822 Nordan	P-1822 Sherman	P-1822 Topar	P-1822 Ladak	P-1822 Alkar
Covar Sheep Fescue	Covar Whitmar	Covar P-27	Covar Greenar	Covar Luna	Covar Secar	Covar Check	Covar P-210	Covar Magnar	Covar Nordan	Covar Sherman	Covar Topar	Covar Ladak	Covar Alkar
Check Control Plots	Check Whitmar	Check P-27	Check Greenar	Check Luna	Check Secar	Check Check	Check P-210	Check Magnar	Check Nordan	Check Sherman	Check Topar	Check Ladak	Check Alkar
P-4874 Bulbous Bluegrass	P-4874 Whitmar	P-4874 P-27	P-4874 Greenar	P-4874 Luna	P-4874 Secar	P-4874 Check	P-4874 P-210	P-4874 Magnar	P-4874 Nordan	P-4874 Sherman	P-4874 Topar	P-4874 Ladak	P-4874 Alkar
Sherman Big Bluegrass	Sherman Whitmar	Sherman P-27	Sherman Greenar	Sherman Luna	Sherman Secar	Sherman Check	Sherma P-210	Sherman Magnar	Sherman Nordan	Sherman Sherman	Sherman Topar	Sherman Ladak	Sherman Alkar
Canbar Canby Bluegrass	Canbar Whitmar	Canbar P-27	Canbar Greenar	Canbar Luna	Canbar Secar	Canbar Check	Canbar P-210	Canbar Magnar	Canbar Nordan	Canbar Sherman	Canbar Topar	Canbar Ladak	Canbar Alkar

EAST

Whitmar Beardless Wheatgrass
P-27 Siberian Wheatgrass
Greenar Intermediate Wheatgrass
Luna Pubescent Wheatgrass
Secar Bluebunch Wheatgrass
Check Control Plots
P-210 Russian Wildrye
Magnar Basin Wildrye
Nordan Crested Wheatgrass
Sherman Big Bluegrass
Topar Pubescent Wheatgrass
Ladak Alfalfa
Alkar Tall Wheatgrass

rep	overstory	understor	Tcover	Ocover	Ucover	Sherman	CG	Yarrow	SB	secar	aster	Astrag	BBG	Canbar	Covar	crested	Mus	RB
1	1	21	70	0	0	50	10	0.1	0	0	0	0	0	0	0	0.1	10	0
1	1	22	70	0	10	45	0	0.1	0.1	0	0	0	0	0	0	0	0	0.1
1	1	23	70	0	10	45	0.1	0.1	5	0	0	0	0	0	0	10	0	0
1	1	24	60	0	0	35	0	0.1	5	0	0	0	0	0	0	15	0	0
1	1	25	50	0	0	30	0	0.1	0	0	0.1	0	0	0	0	10	0	0
1	1	26	50	0	0	30	0	0	0	0	0	0	0	0	0	5	0	0
1	1	27	60	0.1	55	0	0	0.1	0.1	0	0	5	0.1	0	0	0	0	0
1	1	28	60	0	0.1	40	0	0.1	0	20	0	0	0	0	0	0	0	0
1	2	21	60	45	0	15	0.1	0	0.1	0	0.1	0	0	0	0	0	0	0
1	2	22	65	15	0	45	0.1	0.1	5	0	0	0	0	0	0	0	0.1	0
1	2	23	65	25	15	20	0.1	0.1	5	0	0.1	0	0	0	0	0	0	0
1	2	24	60	10	0.1	45	0	0	0	5	0	0	0	0	0	0	0	0
1	2	25	55	20	0	30	0	0.1	0	5	0.1	0.1	0	0	0	0.1	0	0
1	2	26	50	25	0.1	20	0	0.1	5	0	0	0	0	0	0	0	0	0.1
1	2	27	55	5	50	0	0.1	0.1	0	0	0.1	0	0	0	0	0	0	0
1	2	28	60	20	10	30	0.1	0.1	0.1	0.1	0.1	0	0	0	0	0	0.1	0
1	3	21	70	40	0	25	0.1	0.1	5	0	0	0	0	0	0	0	0	0
1	3	22	70	30	0	35	0	0	5	0	0.1	0.1	0	0	0	0	0	0
1	3	23	65	20	10	35	0	0.1	0.1	0	0	0	0	0	0	0	0	0
1	3	24	55	25	0.1	25	0.1	0.1	5	0	0.1	0	0	0	0	0	0	0
1	3	25	60	10	0	45	0	0.1	5	0	0.1	0.1	0	0	0	0	0.1	0
1	3	26	50	30	0.1	20	0	0.1	0	0	0.1	0	0	0	0	0	0	0
1	3	27	55	35	15	0	0.1	0.1	5	0	0	0	0	0	0	0	0	0
1	3	28	55	25	0.1	20	0	0.1	10	0	0.1	0	0	0	0	0	0	0
1	4	21	75	0.1	0	50	0	0.1	20	5	0	0	0	0	0	0.1	0.1	0
1	4	22	75	0.1	5	45	0	0.1	15	10	0.1	0.1	0	0	0	0	0	0.1
1	4	23	60	0.1	5	45	0	0	0	10	0.1	0	0	0	0	0	0	0.1
1	4	24	65	0	0	40	0	0	15	10	0	0	0	0	0	0	0	0
1	4	25	70	0	0	35	0.1	0	15	20	0.1	0	0	0	0	0.1	0.1	0
1	4	26	60	0	5	45	5	0.1	0.1	5	0	0	0	0	0	0	0	0
1	4	27	75	0.1	60	0	10	0.1	0	5	0.1	0	0	0	0	0	0	0
1	4	28	75	0.1	10	35	0	0.1	5	0	0	0	0.1	0	0	0	0	0
1	5	21	85	15	0	50	5	0.1	10	0	0	0.1	0	0	0	5	0	0
1	5	22	60	0.1	10	45	0	0.1	5	0.1	0	0.1	0	0	0.1	0	0	0
1	5	23	55	0.1	5	40	0	0	0.1	10	0	0	0	0	0	0.1	0	0
1	5	24	65	5	0.1	40	0	0	10	10	0	0	0	0	0	0.1	0	0
1	5	25	75	0	0	45	0.1	0.1	25	5	0.1	0	0	0	0	0.1	0	0
1	5	26	70	0.1	10	60	0.1	0.1	0.1	0	0	0.1	0	0	0	0	0	0
1	5	27	80	5	50	0	15	0.1	10	0	0	0	0.1	0	0	0	0	0
1	5	28	85	0.1	5	40	15	0.1	10	0	0	0	0	0	0	0	0	0
1	6	21	80	5	0	35	0	0.1	25	5	0	0	0	0	0	10	0	0
1	6	22	75	5	5	45	0	0.1	15	5	0	0	0	0	0	0	0	0
1	6	23	70	0.1	0.1	40	0	0	10	20	0	0	0.1	0	0	0.1	0	0.1
1	6	24	70	5	5	55	0	0.1	0	5	0	0	0	0	0.1	0	0	0
1	6	25	75	0	0.1	70	0	0	0.1	0	0	0	0	5	0	0	0	0
1	6	26	70	0	10	55	0	0.1	0	5	0.1	0	0	0	0	0.1	0	0
1	6	27	65	0	50	0	10	0.1	0	0	0	0	0	5	0	0	0	0
1	6	28	75	0	5	50	10	0.1	5	5	0	0	0	0	0	0	0	0
1	7	21	80	5	0	55	0.1	0.1	10	0	0.1	0	0	0	0	0	0	0
1	7	22	80	5	0.1	65	0	0.1	10	0	0	0	0	0	0	0	0	0
1	7	23	75	5	0	65	0.1	0	5	0	0	0	0	0	0	0.1	0.1	0
1	7	24	70	10	0.1	50	0	0.1	10	0	0.1	0	0	0	0	0	0	0
1	7	25	70	5	0.1	65	0	0.1	0	0	0	0	0	0	0	0	0	0
1	7	26	70	0.1	5	65	0.1	0.1	0	0	0	0	0	0	0	0	0	0
1	7	27	70	0	70	0	0.1	0	0	0	0	0	0	0.1	0	0	0	0
1	7	28	80	5	10	50	15	0.1	0	0	0.1	0	0.1	0	0	0	0	0
1	8	21	65	15	0	35	0.1	0	15	0.1	0	0	0	0	0	0	0	0
1	8	22	80	35	0	30	0	0.1	15	0	0	0	0	0	0	0	0	0
1	8	23	65	25	0	25	0	0	15	0	0	0	0	0	0	0	0	0
1	8	24	70	20	0	40	0.1	0.1	10	0	0	0	0	0	0	0	0	0
1	8	25	70	0.1	5	55	5	0.1	5	0	0	0	0	0	0	0	0	0
1	8	26	70	0.1	10	55	0.1	5	0.1	0	0	0	0	0	0	0	0	0
1	8	27	80	0.1	80	0	0.1	0.1	0.1	0	0.1	0	0	0	0	0	0	0
1	8	28	90	0	5	65	20	0.1	0.1	0.1	0	0	0	0	0	0	0	0
1	9	21	75	0.1	0	55	0.1	0.1	15	0	0	0	0	0	0	5		0
1	9	22	80	5	15	35	0.1	0.1	25	0	0	0	0	0	0	0	0	0
1	9	23	85	0.1	0	25	0.1	0.1	20	0	0	0	0	0	0	20	0	0
1	9	24	80	15	0	40	0	0.1	10	0	0	0	0	0	0	15	0	0
1	9	25	70	5	5	50	0.1	5	5	0	0	0	0	0	0	0.1	0	0
1	9	26	80	15	0.1	60	5	0.1	0	0	0	0	0	0	0	0	0	0
1	9	27	75	10	55	0	10	0.1	0	0	0	0	0	0	0	0	0	0
1	9	28	80	5	5	60	10	0.1	0.1	0.1	0	0	0	0	0	0	0	0
1	10	21	75	0	0	70	0.1	0.1	5	0	0.1	0	0	0.1	0	0.1	0	0
1	10	22	80	0	5	55	5	0.1	10	0	0	0	0	0	0	0	0	0.1
1	10	23	85	0	15	35	5	0.1	10	0	0	0	0	0	0	0.1	0	0
1	10	24	80	0	0.1	25	5	0	5	0	0	0	0	0	0	5	0	0
1	10	25	70	0	0.1	65	5	0.1	0	0	0.1	0	0	0.1	0.1	0	0	0
1	10	26	70	0	5	65	0.1	0.1	0	0	0.1	0	0	0	0	0	0	0
1	10	27	80	0	75	0	5	0.1	0	0	0	0	0	0.1	0	0	0	0
1	10	28	85	0	10	60	15	0.1	0	0	0	0	0	0	0	0	0	0
1	11	21	70	70	0	0	0.1		0.1	0	0	0	0	0	0	0	0	0
1	11	22	70	50	0.1	0	15	0.1	5	0	0	0	0	0	0.1	0	0	0
1	11	23	85	50	0.1	0	20	0	0	0	0	0	5	0	0	0.1	0	0
1	11	24	90	45	0.1	0	20	0.1	20	0	0	0	0.1	0	0	5	0	0
1	11	25	65	55	0	0	5	0.1	5	0	0.1	0	0.1	0	0	0	0.1	0
1	11	26	70	70	0.1	0	0.1	0.1	0	0	0	0	0.1	0	0	0.1	0	0
1	11	27	85	80	0	0	5	0.1	0	0	0	0	0	0	0	0	0	0
1	11	28	90	55	15	0	15	0.1	5	0	0	0	0	0	0	0.1	0	0
1	12	21	80	0	0	70	10	0.1	0.1	0	0.1	0	0	0	0	0	0	0
1	12	22	80	0	5	65	5	0.1	5	0	0	0	0	0	0	0	0	0
1	12	23	85	0	0	40	10	0.1	10	0	0	0	5	0	0	20	0	0
1	12	24	90	0	0.1	40	25	0	0	0	0	0	0	0	0	15	5	0
1	12	25	85	0	0	60	0.1	0.1	20	0	0	0	0	0	0	5	0	0
1	12	26	75	0	0.1	60	0.1	0.1	5	0	0.1	0	0.1	0	0	15	0.1	0
1	12	27	75	0	65	0	5	0.1	5	0	0	0	0.1	0	0.1	0	0.1	0
1	12	28	80	0	5	55	0.1	0.1	20	0.1	0	0	0.1	0	0	0	0	0
1	13	21	70	0	0	50	0	0.1	15	0	0.1	0	0	0	0	5	0	0
1	13	22	85	0	15	35	0.1	0	35	0	0	0	0	0	0	0	0	0
1	13	23	70	0	0.1	20	10	0.1	15	0	0	0	0.1	0	0	25	0	0
1	13	24	80	0	0.1	30	25	0.1	0	0	0.1	0	0	0	0	25	0.1	0
1	13	25	60	0	0	35	0.1	0.1	5	0	0.1	0	0.1	0	0	20	0	0
1	13	26	70	0.1	0.1	35	0.1	0.1	10	0	0	0	5	0	0	15	5	0
1	13	27	85	0	35	0	0	0	0	0	0	0	5	0	0	5	40	0
1	13	28	75	0	5	65	0.1	0.1	0	5	0	0	0	0	0	0	0.1	0

2	2	22	90	0	15	45	25	0.1	5	0	0	0	0	0	0	0	0.1	0
2	2	25	90	20	0	25	0	0	30	0	0.1	0	0.1	0	0	15	0	0
2	2	28	65	20	5	25	0.1	0	10	0	0.1	0	0	0	0	5	0	0
2	2	23	85	15	20	35	5	0.1	0	0	0	0	0	0	0	5	0	0
2	2	21	60	30	0	20	0	0	10	0	0	0	0	0	0	0.1	0	0
2	2	24	60	20	0	40	0.1	0.1	0.1	0	0	0	0	0	0	0	0	0.1
2	2	27	70	5	65	0	0.1	0	0	0	0.1	0.1	0	0	0	0	0	0
2	2	26	55	30	0.1	25	0.1	0.1	0	0	0	0	0	0	0	0.1	0	0
2	7	22	85	15	0.1	50	5	0.1	15	0	0.1	0	0	0	0	0	0	0.1
2	7	25	80	10	0	45	0.1	0	15	0	0	0.1	0	0	0	0	0	10
2	7	28	85	0.1	35	45	0.1	0.1	5	0	0.1	0	0	0	0	0	0	0
2	7	23	75	10	10	45	0.1	0.1	5	0	0	0	0.1	0	0	0	0	0
2	7	21	70	10	0	45	0.1	0.1	10	0	0	0	0.1	0	0	0	0	0
2	7	24	65	0.1	0.1	65	0.1	0	0.1	0	0	0	0	0	0	0	0	0.1
2	7	27	65	0.1	60	0	5	0.1	0	0.1	0.1	0	0.1	0	0	0	0	0
2	7	26	55	20	0.1	35	0	0.1	0.1	0.1	0.1	0	0.1	0	0	0	0	0
2	12	22	75	0	20	35	0.1	0.1	15	0	0.1	5	0	0	0	0	0	0
2	12	25	80	0	0	5	0.1	0.1	15	0	0.1	0.1	0	0	0	0	0	0.1
2	12	28	90	0	50	10	0	0.1	30	0	0.1	0	0	0	0.1	0	0	0
2	12	23	75	0	10	35	0.1	0.1	10	0	0.1	0	0.1	0	0	0	0	0
2	12	21	85	0	0	50	0.1	0.1	25	0	0.1	0	0	0	0	0	0	0.1
2	12	24	80	0	0.1	45	0.1	0.1	20	0	0	0	0.1	0	0	0	0	5
2	12	27	80	0	80	0	0.1	0.1	0.1	0	0	0	0.1	0	0	0	0	0
2	12	26	65	0	0.1	40	0	0.1	5	5	0.1	0	0.1	0	0	0	0	0
2	5	22	70	0	15	30	0.1	0.1	20	0	0.1	0	0	5	0	0	0	0.1
2	5	25	80	0	0	45	0.1	0.1	30	0.1	0.1	0	0	0	0	0	0	0
2	5	28	80	0	15	30	0.1	0	25	0	0.1	5	0	0	0	0	0	0
2	5	23	80	0	0.1	25	0.1	0	10	10	0	5	0.1	0	0	0	0	0
2	5	21	75	0	0	55	0.1	0	15	5	0.1	0.1	0	0	0	0	0	0.1
2	5	24	65	0	0	55	0.1	0.1	10	0	0.1	0	0	0.1	0	0	0	0.1
2	5	27	75	0	75	0	0.1	0.1	0.1	0	0	0	0	0	0	0	0	0
2	5	26	55	0	0	30	0	0.1	0.1	0	0.1	0	0	0	0	25	0.1	0
2	3	22	80	40	10	5	0.1	0.1	25	0	0.1	0	0	0	0	0	0	0
2	3	25	75	40	0	10	0.1	0	25	0	0.1	0.1	0	0	0	0	0	0
2	3	28	50	25	0	15	0.1	0.1	10	0	0	0	0.1	0	0	0	0	0
2	3	23	55	35	0.1	10	0.1	0.1	5	0	0.1	0	0.1	0	0	0	0	5
2	3	21	60	30	0	20	0.1	0.1	10	0	0	0.1	0.1	0	0	0	0	0.1
2	3	24	60	30	0	25	0.1	0.1	5	0	0	0.1	0	0	0	0	0	0.1
2	3	27	60	30	30	0	0.1	0.1	0.1	0	0.1	0	0	0	0	0	0	0
2	3	26	65	20	0	45	0.1	0.1	0.1	0	0.1	0	0.1	0	0	0	0	0
2	10	22	80	0	30	15	5	0.1	20	5	5	0	0	0	0	0	0	0
2	10	25	80	0	0	10	0.1	0.1	15	50	0.1	0	0.1	0	0	5	0	0
2	10	28	75	0	30	25	0.1	0.1	5	15	0.1	0	0.1	0	0	0	0	0
2	10	23	70	0	5	20	0.1	0.1	0	40	0.1	5	0.1	0	0	0	0	0
2	10	21	60	0	0	10	0.1	0.1	5	45	0.1	0	0	0	0	0	0	0.1
2	10	24	75	0	0	40	5	0.1	10	15	0.1	0.1	0	0	0	0	0	0.1
2	10	27	85	0	60	0	10	0.1	0	15	0	0	0	0	0	0	0	0
2	10	26	60	0	0.1	30	0.1	0.1	0	30	0.1	0	0	0	0	0.1	0	0
2	1	22	85	0.1	25	25	5	0	30	0	0.1	0	0	0	0	0	0	0
2	1	25	80	0	0	30	5	0	20	10	0	5	0	0	0	5	0	0
2	1	28	75	0	0	40	0.1	0.1	5	25	0.1	0	5	0	0	0	0	0
2	1	23	75	0	5	55	0.1	0.1	0.1	15	0.1	0	0	0	0	0	0	0
2	1	21	65	0	0	45	0	0.1	15	0	5	0	0.1	0	0	0	0	0.1
2	1	24	75	0	0	70	0	0.1	5	0	0.1	0	0	0	0	0	0	0
2	1	27	80	0	80	0	0.1	0.1	0.1	0	0.1	0	0	0	0	0	0	0
2	1	26	60	0	0.1	25	0.1	0	10	15	0.1	0.1	0	0	0	10	0	0
2	9	22	85	0	30	25	0.1	0	30	0	0.1	0	0	0	0	0	0	0
2	9	25	85	0	0	50	0.1	0.1	0	5	0.1	0	0	0	0	5	0	0
2	9	28	75	0	15	20	0.1	0	20	0	0	0	0.1	0	20	0	0	0.1
2	9	23	75	20	40	5	0	0.1	5	0	0	0	0	0	0	0	0	0
2	9	21	65	10	0	45	0.1	0.1	10	0	0.1	0.1	0	0	0	0.1	0	0
2	9	24	75	15	0	55	0.1	0.1	0.1	5	0	0	0	0	0	0	0	0
2	9	27	85	0	85	0	0.1	0.1	0	0	0.1	0	0.1	0	0	0	0	0
2	9	26	65	15	0.1	5	0.1	0.1	10	10	0	0	0	0	0	25	0	0
2	8	22	80	20	0	35	5	0.1	15	0	0	0	0	0	0	0	0	5
2	8	25	85	10	0	35	5	0.1	10	0.1	0	0	0	0	0	0	0	20
2	8	28	65	5	0.1	40	0.1	0.1	10	10	0	0	0	0	0	0	0	0
2	8	23	50	5	5	40	0.1	0.1	0.1	0	0.1	0	0	0	0	0	0	0
2	8	21	65	0.1	0	55	0.1	0.1	0.1	0	0.1	0	0	0	0	0	0	0.1
2	8	24	55	0.1	0	35	5	0.1	10	0	0	0	0	0	0	0	0	0
2	8	27	80	0.1	65	0	5	5	0.1	0	0.1	0	0.1	0	0	0	0	0
2	8	26	65	5	0.1	55	0.1	0.1	0.1	5	0.1	0	0	0	0	0	0	0
2	11	22	80	75	0.1		5	0.1	0.1	0	0	0	0	0	0	0	0	0.1
2	11	25	90	65	0	0	10	0	5	0	5	5	0	0	0	0	0	0.1
2	11	28	90	55	20	0	15	0.1	0	0	0.1	0	0	0	0	0	0.1	0
2	11	23	75	45	0.1	0	0.1	0.1	0.1	0	0.1	0	0	0	0	0	0	0
2	11	21	70	70	0	0	0.1	0.1	0	0	0	0	0.1	0	0	0.1	0	0
2	11	24	65	65	0	0	0.1	0.1	0.1	0	0	0.1	0	0	0	0	0	0
2	11	27	75	75	0	0	0.1	0.1	0	0	0.1	0	0	0	0	0	0	0
2	11	26	85	85	0.1	0	0.1	0.1	0	0	0	0	0	0	0	0	0	0
2	4	22	70	0	0	70	0.1	0.1	0.1	0	0	0	0	0	0	0	0	0
2	4	25	80	0	0	70	5	0.1	5	0	0	0	0	0	0	0	0	0.1
2	4	28	85	0	15	60	10	0.1	0	0	0.1	0	0.1	0	0	0	0	
2	4	23	85	0	0	45	5	0.1	5	0	0.1	0.1	0.1	0	0	0	0	0
2	4	21	55	0	0	50	0.1	0.1	0.1	0	0	5	0	0	0	0.1	0	0
2	4	24	50	0	0	20	0.1	0.1	5	0	0.1	0	0	0	0	25	0.1	0
2	4	27	65	0	65	0	0.1	0.1	0	0	0.1	0	0	0	0	0	0	0
2	4	26	70	0	0.1	55	0.1	0.1	0	10	0	5	0	0	0	0.1	0	0
2	13	22	75	0	0.1	70	5	0.1	0.1	0	0	0	0	0	0	0	0.1	0
2	13	25	85	0	0	70	10	0.1	0.1	0	0	0	0	0	0	0	5	0
2	13	28	85	0	5	70	10	0.1	0	0	0	0	0	0	0.1	0.1	0	0
2	13	23	80	0.1	5	45	10	0.1	0.1	0	0	0	0	0	0	20	0	0
2	13	21	80	0	0	50	10	5	5	0	0	0	0	0	0	10	0.1	0
2	13	24	85	0	0	80	0.1	0.1	0	0	0	0	0	0	0	0.1	5	0
2	13	27	70	0	65	0	0.1	5	0.1	0.1	0	0	0	0	0	0.1	0	0
2	13	26	75	0	0	70	0.1	0.1	0	0	0	0.1	0	0	0	5	0.1	0
2	6	22	60	0	0.1	55	0.1	0.1	5	0	0.1	0	0	0	0	0	0	0
2	6	25	70	0	0	55	0.1	0.1	10	0	0.1	0	0	0	0	5	0	0
2	6	28	80	0	5	40	10	0.1	15	0	0	0	0	0	0.1	10	0	0
2	6	23	60	0	0.1	15	5	0.1	10	0	0	0	0	0	0	30	0	0
2	6	21	65	0	0	35	0.1	0.1	0	0	0	0.1	0	0	0	30	0	0
2	6	24	55	0	0	35	0.1	0.1	0.1	0	0	0	0	0	0	20	0	0
2	6	27	55	0	35	0	0.1	0.1	20	0	0	0	0	0	0	0	0	0
2	6	26	65	0	0	40	0.1	0.1	5	0	0	5	0	0	0	15	0	0

3	4	26	50	0	0.1	20	0.1	0	0.1	0	0.1	5	0	0	0	10	5	10
3	4	24	55	0	0.1	5	0.1	0.1	0.1	0	0	0	0	0.1	0	10	0	25
3	4	28	80	0	25	25	0.1	0.1	0.1	0	0	15	0.1	0	0	5	0	10
3	4	22	70	0	5	20	5	0	5	0	0	0	0	0	0	0	5	30
3	4	27	65	0	65	0	0.1	0.1	0	0	0.1	0	0	0	0	0.1	0.1	0
3	4	25	60	0	0	25	0.1	0.1	0.1	5	0.1	0	0	0	0	30	0.1	0.1
3	4	21	65	0	0	15	0.1	0.1	0	0	0.1	0	0	0	0	40	0.1	5
3	4	23	50	0	5	10	0.1	0.1	0	0	10	0	0	0	0	25	0.1	0.1
3	10	26	65	0	0.1	15	0.1	0.1	15	15	0	0	0	0	0	15	0	5
3	10	24	90	0	0.1	5	0.1	0	15	0	5	0	0.1	0	0	5	0.1	20
3	10	28	85	0	40	15	0.1	0.1	10	0	0.1	5	0	0	0	0	0	0.1
3	10	22	65	0	0.1	55	0.1	0.1	0.1	0	0.1	0	0	0	0	0	0.1	0
3	10	27	65	0	50	0	5	0.1	0.1	0	5	5	0	0	0	0.1	0.1	0
3	10	25	60	0	0	30	10	0	5	5	10	0	0	0	0	0.1	0.1	0
3	10	21	70	0	0	40	0.1	0.1	0.1	0	5	0	0	0	0	15	5	5
3	10	23	50	0	5	10	0.1	0.1	0	0	0.1	0	0.1	0	0	35	0	0.1
3	7	26	55	5	0.1	10	0.1	0.1	5	0	0.1	0	0	0	0	0	0.1	30
3	7	24	80	0.1	0	30	0.1	0.1	5	0	5	0	0	0	0	0	0.1	30
3	7	28	85	0	15	50	0.1	0.1	10	0.1	0.1	10	0	0	0	0	0.1	0
3	7	22	70	0.1	0.1	40	0.1	0.1	0	5	0.1	5	0	0	0	0	0	0.1
3	7	27	65	5	35	0	10	0.1	0.1	5	10	0	0	0	0	0	0	0
3	7	25	75	5	0	45	0.1	0.1	15	0	5	0	0.1	0	0	0	0	5
3	7	21	55	10	0	20	0.1	0.1	0.1	0	5	0	0	0	15	0.1	0.1	5
3	7	23	65	0.1	10	30	0.1	0.1	10	0	0	0	0	0	0	15	0	0.1
3	3	26	50	45	0.1	5		0.1	0.1	0	0.1	0	0	0	0	0.1	0	0.1
3	3	24	60	50	0.1	5	0.1	0.1	0	0	0.1	5	0.1	0	0	0	0	0
3	3	28	80	65	0.1	10	0.1	0.1	0.1	0	0	0	0	0	0	0	0.1	5
3	3	22	75	45	0	15	0.1	0.1	5	0	5	0	0	0	0	0	0.1	5
3	3	27	70	35	15	0	0.1	0.1	5	0	5	10	0	0	0	0	0	0
3	3	25	70	25	0	5	0.1	0.1	5	0	0	0	0	0	0	0.1	5	30
3	3	21	60	25	0	5	0.1	0.1	0.1	0	0.1	0	0	0	0.1	5	0.1	25
3	3	23	65	40	0.1	10	0.1	0.1	10	0	0.1	0	0	0	0	5	0.1	0.1
3	11	26	50	30	5		0.1	0.1	0	10	0.1	0	0	0	0	0	0	0.1
3	11	24	60	20	0	0	0.1	0.1	5	15	5	0	0	0	0	5	0	5
3	11	28	80	25	35	0	5	0.1	10	0	0	0	0.1	0	0	0.1	0	5
3	11	22	80	30	0	0	0.1	0.1	0	20	0	0	0	0	0	0	0	15
3	11	27	75	25	0	0	5	0.1	5	15	0.1	5	0	0	0	0	0.1	20
3	11	25	85	35	0	0	20	0.1	5	5	5	0	5	0	0	0	0	10
3	11	21	60	20	0	0	0.1	0.1	5	20	5	0	0	0	0	0	0	5
3	11	23	70	30	0.1	0	10	0.1	0.1	30	0.1	0	0.1	0	0	0	0.1	0
3	2	26	45	30	5	10	0	0.1	0.1	0	0.1	0	0	0	0	0	0	0.1
3	2	24	70	15	0	35	0.1	0.1	10	0.1	10	0	0	0.1	0	0.1	0.1	0.1
3	2	28	85	15	20	25	10	0.1	0.1	0	0.1	0.1	0	0	0	0	0	15
3	2	22	80	10	0.1	40	5	0.1	0.1	0	0.1	0	0	0	0	0	0	10
3	2	27	70	30	15	0	5	0.1	5	0	0.1	5	0	0	0	0	0	10
3	2	25	85	15	0.1	30	15	0.1	5	0	0.1	0	0	0	0	0.1	0.1	20
3	2	21	55	0.1	0	40	5	0.1	0	0.1	10	0	0	0	0	0.1	0	0
3	2	23	60	0.1	5	15	5	0.1	0	15	20	0.1	0	0	0	0.1	0	0
3	12	26	65	0	5	35	0.1	0.1	0.1	0	0.1	0	0	0	0	10	0	0
3	12	24	75	0	0	50	0.1	0.1	20	0	0.1	0	0	0	0	0	0	5
3	12	28	75	0	5	35	0.1	0	15	0	0.1	5	0	0	0	0	0	10
3	12	22	70	0	0	35	0.1	0.1	15	0	5	0	0	0	0	0	0	5
3	12	27	50	0	20	0	0.1	0.1	0.1	0	0.1	0	0	0	0	0	0	10
3	12	25	70	0	0	55	0.1	0.1	0.1	0	0.1	0	0	0	0	0	0	0.1
3	12	21	70	0	0	55	0.1	0	0.1	0	0	0	0	0	0.1	0	0	15
3	12	23	75	0	0	55	10	0.1	10	0	0.1	0	0.1	0	0	0.1	0.1	0
3	9	26	85	15	5	50	0.1	5	0.1	0	0	0	0	0	0	5	5	0
3	9	24	80	20	0	45	0.1	0.1	10	5	0	0	0	0	0	0	0.1	0
3	9	28	75	10	0.1	45	0.1	0.1	20	0.1	0	0	0	0	0	0	0.1	0.1
3	9	22	55	0	5	35	0.1	0.1	10	0	0.1	0	0	0	0	0	0	5
3	9	27	70	10	50	0	0.1	0.1	10	0	0	0	0	0	0	0	0.1	0.1
3	9	25	80	20	0	35	5	0.1	0.1	0	0	0	0	0	0	0	20	0
3	9	21	70	0	0	50	0.1	0.1	20	0	0	0	0	0	0	0.1	0	0.1
3	9	23	85	5	0.1	50	0.1	0.1	10	10	0	0	0	0	0	5	5	0
3	13	26	80	0	0.1	30	5	5	0	0	0	0	0	0	0	0.1	25	0
3	13	24	80	0	0	50	10	5	0	0	0	0	0	0	0	0	5	0.1
3	13	28	75	0.1	5	50	0.1	0	10	0	0	0	0.1	0	0	10	0.1	0
3	13	22	70	0.1	0.1	45	10	0.1	10	0	0	0	0	0	0	0	5	0
3	13	27	85	0.1	45	0	15	0.1	0.1	0	0	0	0	0	0	0	5	0.1
3	13	25	95	0.1	0	25	40	0.1	0.1	0	0	0	0	0	0	0	20	0
3	13	21	90	0.1	0	20	15	0.1	0	0	0	0	0	0	0	5	50	0
3	13	23	70	0	5	45	5	0.1	0	0.1	0	0	0	0	0	5	5	0
3	8	26	60	5	0.1	45	0.1	0.1	10	0	0	0	0	0	0	0	0	0
3	8	24	65	20	0	35	0.1	5	0.1	0	0	0	0	5	0	0	0.1	0
3	8	28	80	15	0	35	0.1	0.1	25	0	0	0	0	0	0	0	5	0
3	8	22	80	5	0	50	0.1	0.1	20	0	0	0	0	0	0	0	5	0
3	8	27	75	0.1	55	0	10	0.1	0.1	0	0.1	0	0	0	0	0	10	0
3	8	25	75	5	0	30	0.1	0	0	0	0	0	0	0	0	0	40	0
3	8	21	60	25	0	10	5	0.1	5	0	0.1	0	0	0	0.1	0	15	0
3	8	23	70	25	5	5	0.1	0.1	5	5	5	0.1	0	0	0	0	15	0
3	1	26	75	0	0.1	70	0.1	0.1	0.1	0	0	0	0	0	0	5	0.1	0
3	1	24	60	0	0	55	0.1	0.1	0.1	0	0	0	0	0	0	5	0.1	0
3	1	28	80	0	0.1	65	0.1	0.1	10	0	0	0	0	0	0	0	5	0
3	1	22	70	0.1	10	30	0.1	5	25	0	0.1	0	0	0	0	0	0	0
3	1	27	60	5	35	0	0.1	0.1	20	0	0.1	0	0	0	0	0	0	0.1
3	1	25	60	0	0	55	0.1	0.1	5	0	0.1	0	0	0	0	0.1	0	0
3	1	21	60	0	0	30	0.1	0.1	0.1	0	0.1	0	0	0	0	30	0.1	0
3	1	23	55	0	0	25	5	0.1	0.1	0.1	0.1	0	0	0	0	25	0.1	0
3	6	26	70	0	0	40	0.1	5	0.1	0.1	0.1	5	0	0	0	15	0	5
3	6	24	60	0	0	60	0.1	0	0.1	0.1	0	0	0	0	0	0.1	0	0
3	6	28	65	0	5	45	0.1	0.1	15	0	0	0.1	0	0	0	0	0	0.1
3	6	22	65	0	5	30	0.1	0	15	0	0	5	0	0	0	0	0	10
3	6	27	75	0	40	0	0.1	0.1	30	0	0	0	0	0	0	5	0.1	0
3	6	25	75	0	0	70	0.1	0.1	0.1	0	0	0	0	0	0	0	5	0
3	6	21	60	0	0	50	0.1	0.1	0.1	0	0.1	0	0	0	0	10	0.1	0
3	6	23	60	0	0.1	40	0.1	0.1	0.1	5	0	0	0	0	0	5	10	0
3	5	26	65	10	0.1	40		0.1	0.1	0	0.1	0	0	0	0	15	0	0
3	5	24	60	10	0	40	0.1	0.1	10	0.1	0	0	0	0	0	0.1	0	0
3	5	28	55	0	0.1	50	0	0.1	0	0	0.1	0	0	0	0	0.1	0	0
3	5	22	55	0	10	40	0.1	0.1	5	0	0	0	0	0	0	0	0	0
3	5	27	80	0	45	0	5	0.1	20	0	0	0	0	0	0	5	0	0
3	5	25	80	20	0	45	0.1	0.1	5	0	5	0	0	0	0	5	0	0
3	5	21	65	5	0	20	0	0.1	20	0	0.1	0.1	0	0	0	20	0	0
3	5	23	55	0	5	10	0.1	0.1	0.1	15	0.1	0	0	0	0	20	5	0

CG=cheatgrass
Y=yarrow
SB=sandberg
BBG=bulbous bluegrass
Astr or Astrag=astragalus
RB=rabbitbrush
CWG=crested wheatgrass or Nordan
W=Whitmar
RT or Rthistle=Russian thistle
Mus=mustard
pubesc=pubescent wheatgrass
Basin wr=Basin wildrye
skel=Rush skeletonweed
pepperw=pepperweed

T cover= total observed cover percent
Ocover=overstory cover percent
Ucover=understory cover percent

Trace amounts were entered as .1
Cover amounts should total to total cover, except for trace amounts

NATURAL RESOURCES CONSERVATION SERVICE
PLANT MATERIALS CENTER
PULLMAN, WASHINGTON
PMC STUDY PLAN

I. Study Title: Orchardgrass: Comparison of Latar select germplasm to commercial varieties.

Study Number: WAPMC-P-0608-PA

II. Problem: Latar orchardgrass has undergone genetic drift. It is not possible to reconstitute it back to its original phenotypic makeup. The PMC selected wide-leaved phenotypes that had low lignin content and placed these into a breeding program. It is not known if the new selection is superior to commercially available cultivars..

III. Objective: 1) Compare Latar second generation germplasm to commercially available orchardgrass cultivars. Trials located at Pullman, Othello and Prosser WA

IV. Procedure:

plot	1	2	3	4	5
Variety	Pennlate	Potomac	Pizza	Command	OG 001
rep	1	1	1	1	1
plot	6	7	8	9	10
Variety	Bari Dana	Intensive	Sparta	Latar	9080251
rep	1	1	1	1	1
plot	11	12	13	14	15
Variety	Intensive	Pennlate	9080251	Pizza	OG 001
rep	2	2	2	2	2
plot	16	17	18	19	20
Variety	Bari Dana	Latar	Potomac	Command	Sparta
rep	2	2	2	2	2
plot	21	22	23	24	25
Variety	9080251	Bari Dana	Pizza	OG 001	Command
rep	3	3	3	3	3
plot	26	27	28	29	30
Variety	Pennlate	Latar	Intensive	Potomac	Sparta
rep	3	3	3	3	3
plot	31	32	33	34	35
Variety	OG 001	Bari Dana	Intensive	Latar	Potomac
rep	4	4	4	4	4
plot	36	37	38	39	40
Variety	Pennlate	Sparta	Command	9080251	Pizza
rep	4	4	4	4	4
plot	41	42	43	44	45
Variety	Command	Intensive	Potomac	Pizza	Sparta
rep	5	5	5	5	5
plot	46	47	48	49	50
Variety	Pennlate	OG 001	9080251	Bari Dana	Latar
rep	5	5	5	5	5

				othello	othello	othello	prosser	prosser	prosser	pullman
				5/15/2007	8/7/2007	9/28/2007	5/16/2007	8/8/2007	9/27/2007	6/12/2007
Block	**Name**	**Plot**		dry wt (gr/30 sq ft)						
1	Pennlate	1		818	2583	944	2296	3441	1017	2097
1	Potomac	2		973	2402	794	2230	2410	1064	2275
1	Pizza	3		698	2726	898	1450	2810	1178	2775
1	Command	4		1151	3040	1093	1267	2277	1050	2254
1	OG 001	5		1646	3405	1360	1005	1477	645	2441
1	Bari Dana	6		328	2774	1102	1184	2456	802	2915
1	Intensive	7		351	3169	1025	1213	2897	824	2281
1	Sparta	8		317	2928	1102	1113	2225	840	2220
1	Latar	9		174	3255	941	516	2919	821	2404
1	9080251	10		276	3387	1142	137	2486	588	4348
2	Intensive	11		218	3253	1134	1008	3147	908	3378
2	Pennlate	12		669	2794	1189	1641	2821	1232	2704
2	9080251	13		118	3891	1257	337	3536	1115	1839
2	Pizza	14		526	2701	976	1497	2872	1262	2217
2	OG 001	15		943	2940	1262	1352	3487	1355	2016
2	Bari Dana	16		408	3194	1268	1288	2652	952	2319
2	Latar	17		166	3198	952	712	2603	870	1975
2	Potomac	18		667	2565	1227	1811	1510	876	2121
2	Command	19		562	2940	291	1642	2029	979	2203
2	Sparta	20		548	3042	1262	869	2426	1017	2530
3	9080251	21		128	3378	979	269	3664	1012	2690
3	Bari Dana	22		494	3253	1091	819	2739	1142	2853
3	Pizza	23		656	3228	1431	1119	1692	743	2469
3	OG 001	24		982	3637	1292	1375	2494	884	2401
3	Command	25		853	3178	1518	890	2929	1140	2911
3	Pennlate	26		766	3237	1393	1547	2228	979	2527
3	Latar	27		203	3777	1153	338	2513	745	2080
3	Intensive	28		573	4118	1684	961	3449	1186	2561
3	Potomac	29		1166	3144	1102	1183	2214	1240	1726
3	Sparta	30		642	2824	1058	467	2268	892	2268
4	OG 001	31		696	3423	1646	1969	1977	661	1924
4	Bari Dana	32		565	3541	1292	1112	2728	775	2336
4	Intensive	33		622	3852	1540	892	2731	772	2887
4	Latar	34		295	3459	968	232	2720	617	2469
4	Potomac	35		951	2851	1042	1098	1752	691	3412
4	Pennlate	36		880		1376	1304	1980	797	3017
4	Sparta	37		556		1515	777	2113	868	2019
4	Command	38		895		1572	1252	2116	851	2332
4	9080251	39		280		1262	196	1983	522	2635
4	Pizza	40		547		1099	940	1738	609	2509
5	Command	41		672		1480	1318	2540	974	2544
5	Intensive	42		564		1360	1392	3201	1142	3095
5	Potomac	43		1076		1469	1360	2187	917	2724
5	Pizza	44		799		1512	1013	1863	911	2884
5	Sparta	45		373		1297	717	2875	1140	2074
5	Pennlate	46		847		1284	1854	2500	1145	2384
5	OG 001	47		952		846	1835	2807	1061	2612
5	9080251	48		244		851	854	2706	1099	1968
5	Bari Dana	49		769		922	1279	2497	998	2390
5	Latar	50		206		821	350	2263	919	1699

WASHINGTON STATE UNIVERSITY
GRANT/ADAMS COUNTY EXTENSION

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07-10-01

2006 WSU Orchardgrass Variety Trial
2007 Results
Othello, WA

		Forage yield in t/ac Dry matter					
Entry	Maturity	Cut 1 18-May	Cut 2 29-Jun	Cut 3 8-Aug	Cut 4 25-Sep	2007 Total	Color* 25-Sep
Bounty	Early	2.5	1.3	1.9	1.9	7.7	1.7
Benchmark Plus	Early	2.6	1.4	2.0	1.6	7.6	1.5
Ambassador	Early	2.2	1.3	1.9	2.0	7.3	1.6
Century	Early	2.0	1.1	1.8	1.9	6.9	1.2
Mammoth	Early	1.9	1.3	1.9	1.9	6.9	1.2
Endurance	Early	1.8	1.2	1.8	1.9	6.8	1.4
Icon	Medium	3.0	1.5	2.0	1.7	8.3	1.9
OG0204G	Medium	2.8	1.4	2.0	1.9	8.1	1.5
OG0203G	Early-Medium	2.4	1.2	2.1	1.8	7.6	1.6
Checkmate	Late	2.5	1.3	1.9	1.9	7.5	1.9
Baridana	Late	2.1	1.3	2.0	1.9	7.1	1.7
Command	Late	1.9	1.3	2.1	1.7	7.2	1.2
Intensiv	Late	1.8	1.3	2.0	2.0	7.3	1.8
9080251	Late	1.0	1.4	1.9	1.9	6.2	2.8
Helena LG-31	Late	0.7	1.2	2.2	1.8	5.8	1.9
Mean		2.1	1.3	2.0	1.9	7.2	1.6
lsd (.05)		0.4	NS	NS	NS	0.7	0.6
CV%		32	13	15	16	13	35

Planted September 1, 2006
4' x 12' plots, 5 replications
* Color – scored 1-3 with 1= blueish green, 3= yellowish green

Fertilizer applied – Spring and after 2nd and 3rd cuts – 100 lb/ac N, 44 lb/ac P2O5, 44 lb/ac K2O, 33 lb/ac SO4
Herbicide applied, Spring, 2 pt/ac Weedar 64

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

Title	Orchardgrass: Characterization of orchardgrass cultivars and 9080251
Study Number	WAPMC-P-0803-PA
Study Leader	Pamela Scheinost, WAPMC Agron.
Duration	2008 - 2009
Description	Ten cultivars of orchardgrass and accession 9090251 were planted at the Pullman PMC. Traits of these plants have not been adequately documented.
Status of Knowledge	A short blurb here
Experimental Design	Randomized Complete Block (11 treatments, 5 reps)
Materials and methods	Include what cultivars, where it is planted, size of plots, what implemented used to plant. Traits evaluated: Leaf width Leaf margin Leaf rust Stem color Stem collar shape Stem collar color Seedhead length Seedhead colors Glume color Anther length Anther color Anthesis initiated Anthesis complete Other??

Example: Plot area is located on the Rosa Unit of the Prosser Agriculture Experiment Station. It was fallowed in 2005 and 2006. Round up was applied on August 29th, 2007 to control barnyardgrass. The plot area was shallow rototilled on September 5, 2007. It was immediately rolled north to south then rolled diagonally. A drag was pulled north to south to smooth the surface as final seedbed preparation. Forty-five minutes of irrigation was applied to further firm the seedbed.

Plots were laid out on September 5, 2007. Each plot was 8' x 20'.

Seeding occurred on September 6, 2007. A Planet jr was calibrated to seed 14 lb/acre. Six inch row spacings had 13-14 seeds/lineal fee (hole #26). The 12-inch rows had 25 seeds/lineal foot (hole #31).

The entire area was sprinkle irrigated for 4 hours on September 7, 2007 and irrigated weekly there after until October 10, 2007 (4 hr sets)

Year 1:

- Stand (plants per square foot)
- Digital photos from established photo points monthly (1 per entry)
- Biomass production (each plot sampled at 3 different maturity levels). Capture wet and air dry weights.
- Comments (disease, insects, nutrient problems)

Year 2:

- Stand (plants per square foot – 30 days after spring growth onset)
- Biomass production (each plot sampled at 3 different maturity levels)
- Digital photos from established photo points at harvest (1 per entry)
- Comments (disease, insects, nutrient problems)
- Subject to funds -- Forage quality for biofuel application (parameters TBD but may include percent N, silicon, percent ash, ADF and NDF).

Year 3:

- Stand (note any changes from prior year)
- Biomass production (each plot sampled at 3 different maturity levels)
- Comments (disease, insects, nutrient problems)

- Digital photos from established photo points at harvest (1 per entry)
- Subject to funds -- Forage quality for biofuel application (parameters TBD but may include percent N, silicon, percent ash, ADF and NDF(CESU contract?))
-

Technology Transfer Products Tech Note, Release notice documentation packet, current events article, sci soc poster & abstract

PROGRESS

This study is shelved due to 9080251 appears to be still segregating. An additional cycle of recurrent selection is planned before this study is reinitiated.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

STUDY NUMBER: WAPMC-T-0003-RA. Evaluation of native forbs seeded directly into a native grass mix. (2-98D)

PROJECT NUMBER:

STUDY TYPE: Prairie Restoration

LAND USES:

VEGETATIVE PRACTICES: PRIMARY:
SECONDARY:

DESCRIPTION: Broadleaf weeds can be a serious problem when restoring cropland to a prairie. In grass seedings, most of these weeds can be controlled with the use of agricultural chemicals, but including the forb component in the initial seeding severely restricts the available chemicals. Immediately following the seeding of field Q4 to native prairie grasses (See Study 1-97), plots of selected native forbs will be established. The objective is to determine if seeding prairie forbs in combination with grasses is a viable means of establishing a diverse native plant community.

DURATION OF STUDY:

STUDY LEADER: Dave Skinner

LOCATION: Pullman PMC Field Q4

COOPERATORS:

EXPERIMENTAL DESIGN:

PROCEDURE: Plots will consist of a single 30 foot row of each forb replicated 4 times, with approximately 100 seeds per row. Rows will be seeded at a right angle to the grass seeding. Forbs used will be *Achillea millefolium, Agoseris grandiflora, Aster occidentalis, Clarkia pulchella, Collomia grandiflora, Gaillardia aristata, Galium boreale, Heuchera cylindrica, Lupinus sericeus, Penstemon attenuatus, Potentilla arguta, Potentilla gracilis, Sidalcea oregana,* and *Solidago missouriensis.*

PROGRESS: Plots were established in field Q4 on May 22, 2000. See "GPS plot locations" below. Each plot contains 14 randomized species with enough seed to plant 10 seeds per lineal foot (see "2000 Forb Seeding" below). Species with very small seed may

have more seeds/LF because there was no scale available to weigh out amounts less than 0.1 grams. Plant counts were taken on 7/21/01 (see "Plant Counts" below). Due to an abnormally dry late spring and early summer and the late seeding date, many of the species did not germinate. The surrounding grass seeding was sprayed with Buctril ME4 on 6/16/00 and MSMA on 6/26/00. The forb plots were not sprayed or mowed in 2000. Weeds present in all plots included *Amaranthus albus, Lactuca serriola, Chenopodium album, Echinochloa crus-galli, Panicum capillare, Hordeum vulgare, Medicago sativa, Thlapsi arvense,* and *Capsella bursa-pastoris.* Rep l also contained 1 *Avena fatua*. Rep 2 contained 1 *Cirsium arvense*. Rep 3 contained some *Matricaria matricarioides*. Rep 4 had more *Panicum capillare* than the other reps. No plot had a weed population sufficient to affect plant establishment, but all had considerably more than in the surrounding sprayed area. The annuals *Collomia grandiflora* and *Clarkia pulchella* bloomed and set seed later in the season.

The planting around the plots was sprayed with 2 pints/acre of MCPA Amine in April 20, 2001. With the exception of one *Solidago missouriensis* in plot 4, the only plants to establish in the plots were *Collomia grandiflora, Agoseris grandiflora, Achillea millefolium, Clarkia pulchella, and Gaillardia aristata*, which were present in all plots. Plant counts were taken on all species present, including weeds. Weed pressure in the plots was rated moderate, while it was rated light outside the plots. Some of the forbs have moved out of the plots. The Bluebunch wheatgrass in the plots was shorter and less dense than that in the surrounding sprayed area. No plants of Idaho fescue or Prairie junegrass were present in any plot. The forb plots were not mowed. Forb seedhead abundance was recorded on a scale of 0-9, with 9 being most abundant. Averages of the four plots were:

Collomia grandiflora	4.50
Agoseris grandiflora	5.75
Achillea millefolium	5.75
Clarkia pulchella	1.25
Gaillardia aristata	2.00

In 2002, plant counts were taken for all established species and seedhead abundance and percent cover was estimated for all species present in the plots. Data was not collected until September, when it was impossible to find the plants of *Clarkia pulchella*. *Agoseris grandiflora* was not found, either.

Seedhead abundance averages for the 4 plots were:

Collomia grandiflora	3.00
Agoseris grandiflora	NA
Achillea millefolium	3.50
Clarkia pulchella	NA
Gaillardia aristata	2.75

Averages of percent cover across the 4 plots were:

Collomia grandiflora	3.75
Agoseris grandiflora	NA
Achillea millefolium	4.25

Clarkia pulchella NA
Gaillardia aristata 3.25
Collomia grandiflora was scattered throughout all replications. The plants were small and usually bore a single inflorescence. *Achillea millefolium* was scattered widely in replication 4, and some plants were new seedlings from the spring of 2002. New plants were not noted in the other replications.
The surrounding grass planting was sprayed with MCPA amine on 4/19/02, and mowed in late summer. The plots were not sprayed or mowed. Competition in the plots from the weedy native annual *Epilobium paniculatum* was severe. It provided 40-50% cover in all four replications. *Sisymbrium altissimum* was estimated at 30% cover in replication 4, but was not present in the other three replications. Both species were widely scattered in low numbers outside the plots.
Due to time constraints, no data was collected in 2003. Lower concentrations of *Epilobium paniculatum* were observed, however. The surrounding grass planting was not sprayed in 2003, but was mowed on 9/4/03. The plots were not sprayed or mowed.

Because some species have reseeded themselves in the plots, in 2004 it was decided to only rate percent cover for each replication as a whole. This was done on 8/4/04. Data is shown in **Table: Percent Cover, Forb Seeding Trials** below. Some species were found to have reseeded outside the plots in 2004. They include:
Collomia grandiflora and *Achillea millefolium* outside all replications, one *Aster occidentalis* outside replication 1, one *Agoseris grandiflora* outside replication 3, and one *Potentilla gracilis* and one *Aster occidentalis* outside replication 4. Three plants of *Allium acuminatum* were discovered about 18 feet southwest of the southwest corner of replication 1. *Allium acuminatum* was not planted in the field, although some was found in the adjacent field Q3A before the Durar Hard fescue was plowed out. The field was in alfalfa from 1986 to 1994 and in spring grain from 1995-1999. It is possible that these plants survived the cultivation of the field prior to 2000 and only now recovered sufficiently to produce flowers again. It is also possible that they grew from seed incidentally introduced to the field after planting or from seed stored in the seed bank. That they were simply overlooked in the past is also plausible, but unlikely, since they are near the normal route taken when walking into the plots from the road and the plants are quite noticeable in flower.
The surrounding planting was sprayed with 2 pints/acre of 2,4-D amine on May 25, 2004, and mowed on September 14, 2004. The plots were not mowed or sprayed.

The plots were evaluated on 9/9/05. Data is shown in **Table: Percent Cover, Forb Seeding Trials** below. *Pseudoroegneria spicata* cover increased slightly, although most of the plants remained vegetative. *Achillea millefolium* cover increased dramatically, while *Collomia grandiflora* and *Elymus glaucus* nearly disappeared. There was no *Epilobium paniculatum* in the plots, despite the high coverage in 2002. *Ventenata dubia* registered a large coverage increase. *Achillea millefolium* and *Collomia grandiflora* were found outside all plots.
The surrounding planting was sprayed with 2 pints/acre of 2,4-D amine on April 25, 2005, and mowed on September 3, 2005. The plots were not mowed or sprayed.

2000 Forb Seeding: Plots to evaluate direct seeding of Palouse Prairie forbs.

rep 1	rep 2	rep 3	rep 4

↑ **N**

GPS plot locations:

		elevation	field	point
N46.72689	W117.13633	2530	Q4	NE corner
N46.72697	W117.13644	2527	Q4	NW corner
N46.72681	W117.13643	2514	Q4	SE corner
N46.72691	W117.13655	2507	Q4	SW corner

Plots located in the south portion of field Q4. Seeded over the top of grass seeding made 5/16/00. Replications are 30 feet long by 10 feet wide.
From west to east, rows are:
Rep 1. *Potentilla arguta, Collomia grandiflora*, *Clarkia pulchella*, *Gaillardia aristata*, *Sidalcea oregana*, *Agoseris grandiflora*, *Lupinus sericeus*, *Potentilla gracilis*, *Achillea millefolium*, *Galium boreale*, *Solidago missouriensis*, *Heuchera cylindrica*, *Aster occidentalis*, *Penstemon attenuatus*.
Rep 2. *Lupinus sericeus*, *Galium boreale*, *Collomia grandiflora*, *Solidago missouriensis*, *Gaillardia aristata*, *Heuchera cylindrica*, *Aster occidentalis*, *Potentilla arguta*, *Clarkia pulchella*, *Sidalcea oregana*, *Penstemon attenuatus*, *Achillea millefolium*, *Agoseris grandiflora*, *Potentilla arguta*.
Rep 3. *Sidalcea oregana** *Achillea millefolium*, *Aster occidentalis*** *Gaillardia aristata*, *Clarkia pulchella*, *Penstemon attenuatus*, *Potentilla arguta*, *Agoseris grandiflora*, *Heuchera cylindrica*, *Potentilla gracilis*, *Solidago missouriensis*, *Lupinus sericeus*, *Collomia grandiflora*, *Galium boreale*.
Rep 4. *Achillea millefolium*, *Aster occidentalis*, *Potentilla gracilis*, *Agoseris grandiflora*, *Potentilla arguta, Galium boreale*, *Lupinus sericeus*, *Sidalcea oregana*, *Collomia grandiflora*, *Heuchera cylindrica*, *Clarkia pulchella*, *Penstemon attenuatus*, *Gaillardia aristata*, *Solidago missouriensis*.
*Drill didn't trip, seeded w/ *Achillea millefolium* in row 2
**Clod plugged tube, may not have seeded.

Plant Counts: Palouse Prairie Restoration forbs
plants in 30 ft row on 7/21/00

Rep 1	#	**Rep 2**	#	**Rep 3**	#	**Rep 4**	#
Potentilla arguta	0	*Lupinus sericeus*[2]	2	*Sidalcea oregana*	0	*Achillea millefolium*	108
Collomia grandiflora	106	*Galium boreale*	0	*Achillea millefolium*	29	*Aster occidentalis*	0
Clarkia pulchella[1]	34	*Collomia grandiflora*	50	*Aster occidentalis*	0	*Potentilla gracilis*	0
Gaillardia aristata	31	*Solidago missouriensis*	0	*Gaillardia aristata*	31	*Agoseris grandiflora*	42
Sidalcea oregana	0	*Gaillardia aristata*	30	*Clarkia pulchella*[3]	37	*Potentilla arguta*	0
Agoseris grandiflora	54	*Heuchera cylindrica*	0	*Penstemon attenuatus*	0	*Galium boreale*	0
Lupinus sericeus	3	*Aster occidentalis*	0	*Potentilla arguta*	0	*Lupinus sericeus*	0
Potentilla gracilis	2	*Potentilla arguta*	0	*Agoseris grandiflora*	36	*Sidalcea oregana*	0
Achillea millefolium	49	*Clarkia pulchella*	24	*Heuchera cylindrica*	0	*Collomia grandiflora*	24
Galium boreale	0	*Sidalcea oregana*	0	*Potentilla gracilis*	0	*Heuchera cylindrica*	0
Solidago missouriensis	0	*Penstemon attenuatus*	0	*Solidago missouriensis*	0	*Clarkia pulchella*	30
Heuchera cylindrica	0	*Achillea millefolium*	32	*Lupinus sericeus*	2	*Penstemon attenuatus*	0
Aster occidentalis	0	*Agoseris grandiflora*	48	*Collomia grandiflora*	46	*Gaillardia aristata*	12
Penstemon attenuatus	0	*Potentilla gracilis*	0	*Galium boreale*	0	*Solidago missouriensis*	0

[1]all in first 8 feet of row
[2]some seed on ground
[3]2 plants blooming

Table: Percent Cover, Forb Seeding Trials

Species	rep 1			rep 2			rep 3			rep 4		
	2002	2004	2005	2002	2004	2005	2002	2004	2005	2002	2004	2005
Achillea millefolium	5	15	50	5	10	40	2	10	30	5	20	30
Agoseris grandiflora	0	0	0	0	0	0	0	1	0	p	5	0
Amsinckia menziesii	nr	p	p	nr	0	0	nr	0	0	nr	5	5
Aster occidentalis	0	0	p	0	p	p	0	1	p	0	0	0
Bromus marginatus	p	0	0	p	0	0	1	0	0	p	0	0
Clarkia pulchella	p	p	0	p	p	0	p	0	0	p	p	0
Collomia grandiflora	2	30	p	5	20	p	10	15	p	1	10	p
Elymus glaucus	20	5	5	15	5	5	20	5	0	25	5	0
Epilobium paniculatum	50	p	0	40	p	0	40	5	0	40	5	0
Festuca idahoensis	p	0	5	p	0	p	0	0	0	1	0	0
Gaillardia aristata	5	p	p	5	p	0	5	2	p	p	5	p
Galium boreale	0	0	0	0	0	0	0	0	0	0	0	0
Heuchera cylindrica	0	0	0	0	0	0	0	0	0	0	0	0
Lactuca serriola	nr	p	0	nr	p	0	nr	p	0	nr	p	0
Lupinus leucophyllus	0	0	0	0	0	0	0	0	0	0	5	p
Penstemon confertus	0	0	0	0	0	0	0	0	0	0	0	0
Poa secunda	0	0	0	0	0	0	0	0	0	0	0	0
Potentilla arguta	0	0	0	0	0	0	0	0	0	0	0	0
Potentilla gracilis	0	p	p	0	0	0	0	2	p	0	0	0
Pseudoroegneria spicata	20	30	20	15	25	40	50	30	50	50	25	40
Sidalcea oregana	0	p	p	0	p	p	0	1	5	0	0	p
Sisymbrium altissimum	0	0	0	0	0	0	nr	0	0	30	0	p
Solidago missouriensis	0	0	0	0	0	0	0	0	0	0	1	p
Ventenata dubia	nr	5	30	nr	p	20	nr	5	30	nr	5	40
Vulpia myuros	nr	0	0	nr	p	0	nr	5	0	nr	p	0

"nr" indicates the % cover for the species was not rated
"p" indicates the species was present in the plot at very low numbers (cover < 5%)

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

STUDY NUMBER: WAPMC-T-0105-RA. Propagation Requirements for Native Palouse Prairie Species (2-98F).

PROJECT NUMBER:

STUDY TYPE: Palouse Prairie Restoration

LAND USES:

VEGETATIVE PRACTICES: PRIMARY:
SECONDARY:

DESCRIPTION: Seed dormancy is a tactic in the wild which prevents seed from germinating until environmental conditions are conducive to growth and survival of the plant. Little is known about the requirements to break the seed dormancy of native Palouse Prairie forbs. In order to successfully grow plants of these forbs for use in restoration, it is necessary to break the seed dormancy quickly rather than waiting for natural breakdown to occur. Methods to break the dormancy include stratification and scarification. This study will examine methods by which seed dormancy can be broken and plants successfully propagated. Propagation protocols will be developed.

DURATION OF STUDY:

STUDY LEADER: David M. Skinner

LOCATION: Pullman PMC

COOPERATORS:

EXPERIMENTAL DESIGN:

PROCEDURE: Where seed amounts are limited, a screening test will be conducted. Seeds will be planted in the growth chamber without pretreatment and with stratification. They will also be planted with stratification plus cold growing conditions. Stratification can be achieved either by planting seed in pots and placing the pots outdoors during the winter, or by placing moistened seed in a refrigerator. When seed is more plentiful, or when initial screening tests are not highly successful, a more complete set of tests using light, scarification, complex stratification regimes, and other variables will be used.

PROGRESS: Screening trials were conducted in 1998, 1999, and 2000. See "**Propagation Requirements for Some Palouse Prairie Species"** below for a summary. More detailed information can be found in Study "WAPMC-T-0105-RA. Propagation Requirements for Native Palouse Prairie Species (study 2-98F) in previous Annual Technical Reports.

In 2001, more detailed trials were conducted with 11 species for which screening trials had not been conclusive. These trials consisted of 2 pretreatments plus a control (no pretreatment), randomized and replicated 4 times. One pretreatment was 30 days cold moist stratification achieved by placing planted seed outdoors for 30 days, then moving it to the growth chamber. The second was cold, moist stratification plus cool incubation achieved by leaving planted seed outdoors. See "2001 Summary" under WAPMC-T-0105-RA (study 2-98F) in the 2000-2001 Annual Technical Report for details.

In 2002 and 2003, screening trials were conducted with *Iliamna rivularis, Asclepias speciosa, Silene douglasii, Senecio serra,* and *Calochortus nitidus*. Detailed trials were conducted with *Astragalus arrectus, Agastache urticifolia, Perideridia gairdneri, Cirsium brevifolium, Geum macrophyllum, Penstemon deustus, Eriogonum heracleoides, Phacelia heterophylla, Lithospermum ruderale, Wyethia amplexicaulis, Delphinium nuttallianum, and Helianthella uniflora*. Since certain treatments had been applied to some of these species in the past, not all species were subjected to a full range of treatments. See **Table 2002-2003 Propagation Trials** under WAPMC-T-0105-RA (study 2-98F) in the 2002-2003 Annual Technical Report for details. See **Table 2002-2003 Summary** under WAPMC-T-0105-RA (study 2-98F) in the 2002-2003 Annual Technical Report for results and discussion of trials.
During 2002 and 2003 propagation protocols for 28 native species were written and posted on the Native Plant Network website,
http://nativeplants.for.uidaho.edu/network/search.asp . These joined two *Camassia quamash* protocols previously written and posted by Scott Lambert, WA-OR Plant Resource Specialist, in 2000 and 2001. See **Propagation Protocols** below for a list of all protocols from the Pullman PMC. Individual protocols may be accessed at the URL above. Printed copies of protocols written prior to 2004 may be found in Appendix B of the 2002-2003 ATR.

2004 screening trials included *Asclepias speciosa, Lomatium grayi, Ranunculus glaberrimus, Carex microptera,* and *Silene spaldingii*. More complete trials were conducted with *Beckmannia syzigachne, Lomatium macrocarpum, Microseris nutans*, *Spiraea betulifolia,* and *Thermopsis montana*. Some further work was done with *Cirsium brevifolium*. See **Table 2004 Propagation Trials** below for details on species and treatments applied. See **Table 2004 Summary** below for results and discussion of trials. Numbers in the table represent percent of cone-tainers with at least 1 plant.
During 2004 propagation protocols for 23 more native species were written and posted on the Native Plant Network website,
http://nativeplants.for.uidaho.edu/network/search.asp?SearchType=Continental
Individual protocols are printed in the back of this report or they may be accessed at the

URL above. See "Propagation Protocols" below for a complete list of all protocols developed by the Pullman PMC.

2005 screening trials included *Carex athrostachya, Ranunculus uncinatus, Senecio hydrophiloides*, and *Juncus effusus*. Detailed trials were conducted with *Silene douglasii, Arenaria congesta, Montia perfoliata, Deschampsia elongata, Lomatium grayi, Epilobium angustifolium, Polygonum douglasii, Haplopappus carthamoides, Antennaria luzuloides, Orthocarpus tenuifolius,* and *Agoseris heterophylla.* See **Table 2005 Propagation Trials** below for details on species and treatments applied. See **Table 2005 Summary** below for results and discussion of trials. Numbers in the table represent percent of cone-tainers with at least 1 plant.
During 2005 new propagation protocols for 10 native species and updates for 6 species were written and posted on the Native Plant Network website,
http://nativeplants.for.uidaho.edu/network/search.asp?SearchType=Continental
Individual protocols are printed in the back of this report or they may be accessed at the URL above. See "Propagation Protocols" below for a complete list of all protocols developed by the Pullman PMC.

Table: 2004 Propagation Trials

Species	CM+CG	90CM	45CM	30CM	NT	SC	110	180	Boil
Asclepias speciosa	73								
Balsamorhiza sagittata	49								
Besseya rubra	49								
Beckmannia syzigachne									
Carex microptera									
Cirsium brevifolium 01	98								
Cirsium brevifolium 03	42								
Delphinium nuttallianum	98								
Lomatium grayi	39								
Lomatium macrocarpum	4x10	4x10	4x10		4x10				
Microseris nutans	4x10	4x10	4x10		4x10				
Ranunculus glaberrimus	13								
Sisyrinchium inflatum	98								
Silene douglasii	28								
Spiraea betulifolia	4x10				4x10				
Thermopsis montana 1				4x25	4x25	4x25	4x25	4x25	4x25
Thermopsis montana 2				4x25	4x25	4x25	4x25	4x25	4x25

CM = cold, moist stratification
CM+CG = cold, moist stratification plus cool growing conditions
NT = no pretreatment
SC = mechanical scarification
110 = scarified with 110° water
180 = scarified with 180° water
boil = scarified with water heated to a boil, then removed from heat source

Table: 2004 Summary

Species	treatment	total #	rep 1	rep 2	rep 3	rep 4	total	total %
Asclepias speciosa	CG	73	unreplicated				50	68.5
Balsamorhiza sagittata	CG	49	unreplicated				24	49
Besseya rubra	CG	49	unreplicated				46	94
Beckmannia syzigachne	30CM	40	3	0	0	2	5	12.5
Beckmannia syzigachne	ANP	40	9	8	9	8	34	85
Beckmannia syzigachne	AP	40	8	7	7	8	30	75
Beckmannia syzigachne	NT	40	5	7	6	8	26	65
Beckmannia syzigachne	PNT	40	6	7	7	5	25	62.5
Carex microptera	30CM	40	1	2	4	1	8	20
Carex microptera	NT	40	7	6	7	3	23	57.5
Cirsium brevifolium 01*	CG	98	unreplicated				18	45
Cirsium brevifolium 03	CG	42	unreplicated				34	81
Delphinium nuttallianum	CG	98	unreplicated				96	98
Lomatium grayi	CG	39	unreplicated				39	100
Lomatium macrocarpum	45CM	40	1	0	0	0	1	2.5
Lomatium macrocarpum	90CM	40	10	10	10	10	40	100
Lomatium macrocarpum	CG	40	10	10	10	10	40	100
Lomatium macrocarpum	NT	40	0	0	0	0	0	0
Microseris nutans	45CM	40	4	8	7	3	22	55
Microseris nutans	90CM	40	6	8	8	8	30	75
Microseris nutans	CG	40	9	10	10	8	37	92.5
Microseris nutans	NT	40	2	0	3	4	9	22.5
Ranunculus glaberrimus	CG	13	unreplicated				0	0
Sisyrinchium inflatum	CG	98	unreplicated				18	18
Silene spaldingii	CG	28	unreplicated				8	28.5
Spiraea betulifolia	CG	40	0	0	0	0	0	0
Spiraea betulifolia	NT	40	0	0	0	0	0	0
Thermopsis montana 1	110	100	6	3	8	12	29	29
Thermopsis montana 1	180	100	24	25	20	24	93	93
Thermopsis montana 1	30CM	100	6	7	8	5	26	26
Thermopsis montana 1	boil	103	21	22	25	27	95	92
Thermopsis montana 1	NT	100	7	11	9	12	39	39
Thermopsis montana 1	SC	100	15	14	12	15	56	56
Thermopsis montana 2	110	100	8	2	6	3	19	19
Thermopsis montana 2	180	100	18	16	16	16	66	66
Thermopsis montana 2	30CM	100	6	3	5	4	18	18
Thermopsis montana 2	boil	100	24	25	25	24	98	98
Thermopsis montana 2	NT	100	8	4	8	7	27	27
Thermopsis montana 2	SC	100	24	21	20	21	86	86

CM = cold, moist stratification. CM+CG = cold, moist stratification plus cool growing conditions. NT = no pretreatment. SC = mechanical scarification. 110 = scarified with 110° water 180 = scarified with 180° water. boil = scarified with water heated to a boil, then removed from heat source. PNT = prechill 1 week at 35-40 degrees F, then constant day/night temperature. ANP = Alternating day/night temperatures for 2 weeks, no prechill. AP = Prechill 1 week at 35-40 degrees F, then alternating day/night temperatures for 2 weeks.

Discussion of 2004 results:

Asclepias speciosa needs extended cold, moist stratification. These particular plants were not grown in the growth chamber under constant temperatures. However, in the past the few seedlings that germinated have thrived in the greenhouse, so it is unlikely that the cool outdoor temperatures were needed for survival. The seedlings are slow growing and usually not ready to transplant in the spring. They should be outplanted in the fall. Plants overwintered outdoors in containers rarely survive even relatively mild winters.

Balsamorhiza sagittata was grown from seed collected at Farr Cemetery in 1999, and *Besseya rubra* from seed collected on the PMC in 1999. They both have previously been shown to need extended cold stratification and cool growing conditions. *Besseya rubra* still had very high germination after 3 years in controlled storage at 40° F and 40% RH.

Delphinium nuttallianum was grown from seed harvested in the ISI in 2001. They were grown as replacements for the many plants in the ISI which have died.

Beckmannia syzigachne was grown from seed collected in a vernal pool near Tensed, Idaho. Seed collected in Montana and South Dakota did not have complex germination requirements but germination was enhanced by alternating day/night temperatures (Boe and Wynia 1985). They further found that darkness did not inhibit germination A seven day prechill increases seed germination of 'Egan', an Alaska PMC release (Nolan 2004). In view of this information, it was decided not to employ lengthy stratification trials. Instead, treatments used were:

1. No pretreatment. Seed was sown directly into conetainers in the growth chamber. The trays remained in the growth chamber where temperature is maintained at 72-75° F. An initial light cycle of 8 hours on and 16 hours off was used. (NT).
2. Prechill sown and moistened seed 1 week at 35-40° F, then constant temperatures in the growth chamber as in (1) above. Prechill was obtained by placing the seeded tray inside a plastic bag in the walk-in seed storage refrigerator for one week. The plastic bag was utilized to prevent moisture loss from the dehumidifier used for maintaining low humidity in the seed storage room. (PNT).
3. Sow seed in cones and moisten, no prechill, alternating day/night temperatures. Alternating temperatures were achieved by moving the trays to a dark room held at 50° F for 16 hours, then back to the growth chamber under lights at 72° F for 8 hours. This was done for 2 weeks, after which the plants remained in the growth chamber 24 hours a day under the same conditions as (1) above. (ANP).
4. Sow seed in cones and moisten, prechill as in (2) above, alternating day/night temperatures as in (3) above. (AP).
5. 30 days cold, moist stratification followed by constant temperatures in the growth chamber as in (1) above. (30CM).

Seeds in all treatments and replications were covered and watered after sowing. Average germination over all 4 replications for each treatment was:

Treatment 1 (NT)	65%
Treatment 2 (PNT)	62.5%
Treatment 3 (ANP)	85%
Treatment 4 (AP)	75%
Treatment 5 (30CM)	12.5%

Prechilling the seed, even for a short time, decreased germination. Alternating day/night temperatures resulted in the highest germination.

Carex microptera seed planted in cones and covered did not benefit from short stratification of 30 days. Germination was much lower than for seed planted directly in the growth chamber. A small amount of seed was stratified in standing water in a refrigerator for 120 days, then planted into conetainers and covered in late April. The tray was placed in the lath house at that time and germination approached 100%. Further work needs to be done on temperature requirements of this species, but seed is limited at present.

Cirsium brevifolium seed is difficult to obtain because the plant is uncommon. An introduced seed predator, *Rhinocyllus conicus*, released for biological control of introduced *Cirsium* species, has moved over to the native species, further depleting seed production. This is the first time relatively good germination has been achieved with *C. brevifolium* at the PMC. Extended cool, moist stratification seems to be needed. Since 3 seeds germinated in the 2003 trials in the growth chamber, it is probable that the seedlings will grow under constant temperatures. This still remains to be tested, however. That the older seed from 2001 germinated at a lower rate than the 2003 collected seed may indicate the seed does not hold germinability well, but it may also be due to inherent differences in the two lots. Both lots were stored at 40° F and 40% relative humidity after they were cleaned in the winter of the year collected.

Lomatium grayi germinated at a very high rate with extended cool moist stratification and cool growing conditions. All the seed was collected from one plant and not enough was available to run more trials. Maguire and Overland found that the seed would germinate at 15C (1959), but they did not grow plants beyond the germination stage. A more extensive and broader based collection is planned for summer 2004.

Lomatium macrocarpum needs cool, moist stratification to germinate. Since plants propagated in the growth chamber grew as well as those propagated outside, cool growing conditions are not necessary. Shorter stratification times may be sufficient.

Microseris nutans did not germinate without stratification. These results are consistent with work done at Washington State University (Maguire and Overland 1959). Longer stratification resulted in higher germination. The plants given cool growing conditions germinated about 10 days later than those grown inside after stratification. Both treatments reached maximum germination in about 2 weeks. Plants thrived in the growth chamber, so cool growing conditions are likely unnecessary. Increased germination in those seeds left outside is probably due to slightly longer stratification length. Seeds are able to germinate over a wide range of temperatures.

Ranunculus glaberrimus did not germinate despite long stratification and cool spring conditions after being planted on November 26, 2002. Only a very small amount of seed was available. While the plants are conspicuous during flowering, they are quite difficult to locate when seed is mature.

Silene spaldingii is a federally listed threatened species. Only a very small amount of seed was available, so it was decided to attempt to grow it outside. Germination was low, but 8 plants were grown by this method. Since *S. spaldingii* is a late developing plant, it is probable that it does not have complex germination requirements. More work is needed, but seed is not available.

Spiraea betulifolia again failed to germinate. No success has been had with seed of this species. A few plants have been propagated with hardwood cuttings.
Thermopsis montana seed was obtained from 2 sources. Source 1 was from the north fork of the Palouse River near Potlatch, Idaho. It is thought to be an indigenous population. Source 2 is from Brink Park in Moscow, Idaho. Brink Park has undergone extensive restoration work in the past, so the original seed source is not known. Hot water scarification proved the best treatment for both sources of seed. Water is brought to a boil, then removed from the heat source and the seed is dropped into the water and allowed to cool before planting. Water at 180° F was equally effective for the Potlatch source but not for the Brink Park collection. Mechanical scarification was accomplished by rubbing seed between two pieces of sandpaper. Because the seed is rounded, it is difficult to uniformly scratch the seed coat. To assure uniform scarification,100 seeds of each lot were scratched with a dissecting needle and planted in conetainers. The Potlatch source showed an increase in germination over the sandpaper scarified seed (84% vs. 56%), but the Brink Park source showed a decrease (72% vs. 86%). Hot water scarification is more uniform and effective. Germination in most treatments occurred over a period of 1 month, although around 50% occurred within 10 days of planting.

References cited:

Boe, A. and R. Wynia. 1985. Germination, Forage Yield, and Seed Production of American Sloughgrass (*Beckmannia syzigachne*). Journal of Range Management 38:114-116.

Maguire, James D. and Alvin Overland. 1959. Laboratory Germination of Seeds of Weedy and Native Plants. Washington State Agricultural Experiment Station Circular 349, Pullman, WA. 15 p.

Nolan, Andy. Agronomist, Alaska Dept. of Natural Resources, Alaska Plant Materials Center. 2004. Personal communication.

Table: 2005 Propagation Trials

2004 Prop trials									light			CM	
Species	**+CG**	**90CM**	**60CM**	**45CM**	**30CM**	**w/o**	**scar.**	**heat**	**w/oCM**	**45CM**	**90CM**	**+CG**	
AGHE		4X10			4X10	4X10							80/40
ANLU	4X10	4X10	4X10		4X10	4X10							120/40
ARCO5	4X10	4X10		4X10		4x10							120/40
BRDO	tray												
CALU	4X10	4X10											80/0
CLHI	4X10	4X10											80/0
DEEL					4X10	4X10							80/40
EPAN sm	4x10	4x10		4x10		4X10							
EPAN lg	4x10	4x10		4x10		4X10							
ERGR	tray												
FRAL	4X10	4X10				4X10							120/40
HACA				2X10		2X10							80/40
LOGR	4X10	4X10		4x10		4X10							120/40
MOPE		4X10		4x10		4X10							80/40
MORU					4X10	4X10							40/40
ORTE	4X10	4X10		4x10		4X10							120/40
PODO	4X10	6X10		6X10		4X10			4X10	4X10	4X10	4X10	240/80
RAGL	AMAP												
SIDO	2X10	2X10		2X10		2X10			2X10	2X10	2X10	2X10	240/80

Table: 2005 Summary

Species	treatment	# pltd	rep 1	rep 2	rep 3	rep 4	total germ	% germ
Agoseris heterophylla	30CM	40	4	8	6	2	20	50
Agoseris heterophylla	90CM	40	4	4	4	4	16	40
Agoseris heterophylla	NT	40	0	2	3	0	5	12.5
Antennaria luzuloides	30CM	40	0	0	0	0	0	0
Antennaria luzuloides	90CM	40	0	0	0	0	0	0
Antennaria luzuloides	CG	40	4	1	4	0	9	22.5
Antennaria luzuloides	NT	40	0	0	0	0	0	0
Arenaria congesta	45CM	40	3	2	1	3	9	22.5
Arenaria congesta	90CM	40	5	8	6	5	24	60
Arenaria congesta	CG	40	9	6	7	5	27	67.5
Arenaria congesta	NT	40	3	2	4	1	10	25
Castilleja lutescens	90CM	40	0	0	0	0	0	0
Castilleja lutescens	CG	40	0	0	0	0	0	0
Clematis hirsutissima	90CM	40	0	0	0	0	0	0
Clematis hirsutissima	CG	40	0	0	0	0	0	0
Deschampsia elongata	30CM	40	9	10	10	10	39	97.5
Deschampsia elongata	NT	40	10	10	10	10	40	100
Epilobium angustifolium (large)	45CM	40	0	2	0	0	2	5
Epilobium angustifolium (large)	90CM	40	1	0	2	4	7	17.5
Epilobium angustifolium (large)	CG	40	0	0	1	0	1	2.5
Epilobium angustifolium (large)	NT	40	5	5	9	7	26	65
Epilobium angustifolium (small)	45CM	40	1	0	0	1	2	5
Epilobium angustifolium (small)	90CM	40	0	0	1	7	8	20
Epilobium angustifolium (small)	CG	40	3	0	1	0	4	10
Epilobium angustifolium (small)	NT	40	8	6	6	9	29	72.5
Frasera albicaulis	90CM	40	1	1	1	0	3	7.5
Frasera albicaulis	CG	40	0	1	1	0	2	5
Frasera albicaulis	NT	40	0	0	0	x	0	0
Haplopappus carthamoides	45CM	40	0	3	1	0	4	10
Haplopappus carthamoides	NT	40	1	4	3	x	8	20
Lomatium grayi	45CM	40	0	0	0	0	0	0
Lomatium grayi	90CM	40	7	4	7	5	23	57.5
Lomatium grayi	CG	40	7	3	2	5	17	42.5
Lomatium grayi	NT	40	0	0	0	0	0	0
Montia perfoliata	45CM	40	4	4	3	4	15	37.5
Montia perfoliata	90CM	40	5	9	2	8	24	60
Montia perfoliata	NT	40	1	0	1	0	2	5
Orthocarpus tenuifolius	45CM	40	0	0	0	0	0	0
Orthocarpus tenuifolius	90CM	40	0	0	0	0	0	0
Orthocarpus tenuifolius	CG	40	0	0	0	0	0	0
Orthocarpus tenuifolius	NT	40	0	0	0	0	0	0

2005 Summary: continued

Species	treatment	# pltd	rep 1	rep 2	rep 3	rep 4	total germ	% germ
Polygonum douglasii	45CM	40	3	2	1	0	6	15
Polygonum douglasii	90CM	60	5	5	6	7	23	57.5
Polygonum douglasii	CG	60	6	5	7	7	25	62.5
Polygonum douglasii	NT	40	0	0	0	0	0	0
Polygonum douglasii	45CM+L	40	0	0	0	0	0	0
Polygonum douglasii	90CM+L	40	0	3	1	2	6	15
Polygonum douglasii	CG+L	40	2	2	3	0	7	17.5
Polygonum douglasii	NT+L	40	0	0	0	0	0	0
Silene douglasii	45CM	20	1	0	x	x	1	2.5
Silene douglasii	90CM	20	0	1	x	x	1	2.5
Silene douglasii	CG	20	1	1	x	x	2	5
Silene douglasii	NT	20	0	0	x	x	0	0
Silene douglasii	45CM+L	20	0	0	x	x	0	0
Silene douglasii	90CM+L	20	0	0	x	x	0	0
Silene douglasii	CG+L	20	0	0	x	x	0	0
Silene douglasii	NT+L	20	1	0	x	x	1	2.5

CM = cold, moist stratification. CG = cold, moist stratification plus cool growing conditions. NT = no pretreatment. +L = exposed to light by seeding in cone-tainers with no soil covering. (large) = seed which did not pass a 50 mesh screen. (small) = seed which passed a 50 mesh screen.

Discussion of 2005 results:

Agoseris heterophylla was able to germinate at low rates with no pretreatment, but germination was enhanced by stratification. 30 days of cool, moist stratification resulted in the highest germination. Plants were transplanted to the field in May and many did not survive. Those that did survive produced seed. Since *A. heterophylla* is an annual species, it is probably best sown in place in the fall.

Antennaria luzuloides only germinated when left outside under cool, fluctuating spring temperatures. No germination occurred in the other treatments even after they were moved back outside on about March 1, 2005. The seed is very small and it is difficult to determine visually whether or not a seed is sound, but at least some of the seed was viable as evidenced by the germination of the portion given cool growing conditions.

Arenaria congesta had the highest germination when left outside. However, 90 days of cool, moist stratification produced nearly as many seedlings. All seedlings which germinated in the growth chamber grew well, thus cool conditions are not necessary but longer stratification might increase germination rates.

Deschampsia elongata had high germination without pretreatment.

Epilobium angustifolium germinated best without pretreatment. Stratification actually reduced germination considerably. During the cleaning process, the seed was run over a 50 mesh screen. Most of the seed was retained on the screen, but a fraction passed thru it. To determine if the small seed was viable, it was subjected to the same set of pretreatments as the larger seed. The smaller seed germinated at least as well as the larger seed under all conditions of pretreatment.

Frasera albicaulis germinated at very low rates only after very long stratification. From the results it is not possible to discern whether the seed was of low viability or whether germination conditions were not met by the pretreatments applied. No more seed is available from that lot to conduct further trials

Haplopappus carthamoides germinated better without pretreatment, although germination was low. Insect predation usually severely reduces seed production, making collecting sufficient amounts from the wild very time consuming.

Lomatium grayi germinates after long stratification periods. Seedlings thrived when grown in the growth chamber, suggesting that cool growing conditions are not needed, even though the species is active in very early spring and senesces with the arrival of warmer weather.

Montia perfoliata needs an extended cool, moist stratification. Those that germinated did not thrive in the growth chamber, although the bright lighting may have contributed to that as much as the constant warm temperatures. *M. perfoliata* frequently grows in at least partial shade. Ungerminated cone-tainers were moved back outside in early March germinated at a high rate, further suggesting that extended stratification is necessary. Since *M. perfoliata* is an annual species, it is probably best sown in place in the fall.

Polygonum douglasii germinated best with 90 or more days of cool moist stratification. Covered seed germinated at a much higher rate than surface sown seed. Light is not a requirement for germination. Another annual species, it is probably best fall sown in place.

Silene douglasii had very low germination with stratification, but numbers are so low that the data is meaningless. Exposure to light by surface sowing did not aid germination.

No germination occurred in any treatments of *Castilleja lutescens, Clematis hirsutissima*, or *Orthocarpus tenuifolius*. It is not know whether the seed of these three species was nonviable, or the treatments applied were not adequate to induce germination.

Propagation Requirements of Some Palouse Prairie Species

No stratification required

Achillea millefolium
Agoseris grandiflora
Aster jessicae
Aster occidentalis
Beckmannia syzigachne[1]
Bromus marginatus
Clarkia pulchella
Collinsia parviflora[2]
Collomia grandiflora
Collomia linearis
Deschampsia caespitosa
Deschampsia elongata
Elymus glaucus
Epilobium angustifolium
Festuca idahoensis
Gaillardia aristata
Galium boreale[3]
Geum triflorum
Haplopappus liatriformis
Helianthella uniflora
Koeleria macrantha
Linum lewisii
Mimulus guttatus
Phacelia heterophylla
Poa ampla
Poa sandbergii
Pseudoroegneria spicata
Sidalcea oregana[3]
Solidago missouriensis

[1]alternating day/night temperatures increase germination

[2]winter annual, seed in fall

[3]Stratification may increase germination but some will occur without it.

Cold moist stratification required

Agoseris heterophylla
Arenaria congesta
Arnica sororia
Gilia aggregata
Gentiana affinis
Heuchera cylindrica[4]
Lomatium macrocarpum
Lomatium grayi
Microseris nutans
Montia perfoliata
Penstemon confertus
Penstemon deustus
Perideridia gairdneri
Polygonum douglasii
Potentilla arguta
Potentilla gracilis
Wyethia amplexicaulis

Other

Lupinus sericeus,
Lupinus leucophyllus,
Thermopsis montana,
need hot water scarification.
Geranium viscosissimum benefits from scarification
Astragalus arrectus needs mechanical scarification.

[4]light will increase germination

Cold moist stratification plus cool growing conditions

Allium acuminatum
Asclepias speciosa
Balsamorhiza sagittata
Besseya rubra
Brodiaea douglasii
Camassia quamash
Delphinium nuttallianum
Dodecatheon pulchellum
Erythronium grandiflorum
Fritillaria pudica
Heracleum lanatum
Iris missouriensis
Lithophragma parviflora
Lomatium dissectum
Lomatium triternatum
Phlox speciosa
Senecio integerrimus
Sisyrinchium inflatum
Zigadenus venenosus

Stratification Trial Results: compiled from 1998-2005 (for more details, see the discussion under "Progress" above, or the appropriate species propagation protocol).

Species	None	CM	CM	CM+CG	MS	HWS	CG+FS	CM+L	CG+L	yr 2
Achillea millefolium	87									N
Agastache urticifolia	78			84						N
Agoseris grandiflora	98									N
Agoseris heterophylla	12	50	40(90)							
Allium acuminatum		14		high						Y
Antennaria luzuloides	0	0	0(90)	22						
Arenaria congesta	25	22(45)	60(90)	68						
Arnica sororia	34	15		25						N
Asclepias speciosa	5			68						
Aster jessicae	96	86								N
Aster occidentalis	66									
Astragalus arrectus	58				93	78				
Balsamorhiza sagittata				67						N
Besseya rubra	0	0		59						Y
Brodiaea douglasii		0		high						Y
Calochortus nitidus			46(90)	100				61	95	
Cirsium brevifolium	2	0		37						
Clarkia pulchella	88	78								N
Collomia grandiflora	84	20		100						N
Collomia linearis	99									N
Delphinium nuttallianum	0		0 (45)	80						N
Deschampsia elongata	100	98								
Dodecatheon pulchellum	0	0		68						Y
Epilobium angustifolium	69	5(45)	19(90)	6						
Eriogonum heracleoides	0		15 (45)	48						
Frasera albicaulis	0		5(90)	7.5						
Fritillaria pudica	0			medium						Y
Gaillardia aristata	71									N
Galium boreale	75	100		83						
Geranium viscosissimum	30	50		25	58	22				N
Geum macrophyllum	5	48	98 (60)	90						
Geum triflorum	64									N
Haplopappus carthamoides	20	10(45)								
Haplopappus liatriformis	76									N
Helianthella uniflora	39	40								N
Hieracium albertinum	61			38					58	N
Iliamna rivularis	15	25	15 (60)		31	20				Y
Iris missouriensis		0		12			60		0	Y
Lomatium dissectum		0		0						83
Lomatium grayi	0	0(45)	58(90)	71						
Lomatium triternatum		2		76						N
Lupinus leucophyllus	45	45			N*	77				
Lupinus sericeus						78				
Mentzelia laevicaulis	10	48	65 (90)							Y
Microseris nutans	22	55(45)	75(90)	92						
Mimulus guttatus	74									
Montia perfoliata	5	38(45)	60(90)							
Penstemon confertus		19	83 (90)	83					75	Y
Penstemon deustus	0		95(90)	85				18 (45)	83	Y
Perideridia gairdneri		0	90 (90)							Y

Stratification Trial Results: compiled from 1998-2005 (continued)

Species	None	CM	CM	CM+CG	MS	HWS	CG+FS	CM+L	CG+L	yr 2
Phacelia heterophylla	95		95 (45)	98						N
Phlox speciosa	0	3		30						Y
Polygonum douglasii	0	15(45)	58(90)	62				15(90)	18	
Potentilla arguta	0	71								
Potentilla gracilis	0	81								
Senecio integerrimus		5	29(45)	56						
Senecio serra	0		40 (45)	53						
Sidalcea oregana	75	58		48						N
Silene spaldingii				28						
Sisyrinchium inflatum	0			high						Y
Solidago missouriensis	85									N
Thermopsis montana	33	22			71	87				N
Wyethia amplexicaulis	8		79 (90)							N

None = no pretreatment. CM in 3rd column = 30 days cool, moist stratification unless otherwise indicated in parenthesis. CM in 4th column = cool, moist stratification for the number of days indicated in parenthesis. CM+CG = cool, moist stratification plus cool growing conditions (seedlings exposed to outdoor spring temperatures). MS = mechanical scarification. HWS = hot water scarification. CG+FS = fresh seed planted outdoors and exposed to ambient outdoor temperatures. CM+L = cool, moist stratification plus surface sown seed to obtain light exposure. CG+L = outdoor temperatures plus exposure to light. yr 2 = at least some of the seed germinates after a second winter outdoors.

Propagation Protocols: list of Palouse native species for which a propagation protocol has been posted on the Native Plants Network website. See Appendix B for a complete copy of each protocol.

2000
Camassia quamash from seed
(by Scott Lambert)

2001
Camassia quamash vegetatively
(by Scott Lambert)

2002
Achillea millefolium
Agoseris grandiflora
Arnica sororia
Aster jessicae
Aster occidentalis
Balsamorhiza sagittata
Besseya rubra
Brodiaea douglasii
Clarkia pulchella
Collinsia parviflora
Collomia grandiflora
Delphinium nuttallianum
Dodecatheon pulchellum
Festuca idahoensis
Fritillaria pudica
Gaillardia aristata
Galium boreale
Geum triflorum
Haplopappus liatriformis
Koeleria macrantha
Lomatium triternatum

2003
Lupinus leucophyllus
Lupinus sericeus
Mentzelia laevicaulis
Mimulus guttatus
Penstemon confertus
Potentilla arguta
Potentilla gracilis

2004
Allium acuminatum
Bromar seed
Bromus marginatus
Canbar seed
Elymus glaucus
Elymus glaucus seed
Elymus lanceolatus ssp. *lanceolatus*
Elymus trachycaulus
Heuchera cylindrica
Lomatium dissectum

2004 continued
Pascopyrum smithii
Penstemon deustus
Poa ampla
Poa canbyi
Poa sandbergii
Pseudoroegneria spicata ssp. inermis
Pseudoroegneria spicata ssp. spicata
Schwendimar seed
Secar seed
Senecio integerrimus
Sherman seed
Solidago missouriensis
Whitmar seed

2005
Agastache urticifolia
Astragalus arrectus
Aster jessicae update
Aster occidentalis update
Besseya rubra update
Brodiaea douglasii update
Collomia grandiflora update
Collomia linearis
Collinsia parviflora update
Delphinium nuttallianum update
Geum macrophyllum
Iris missouriensis
Leymus cinereus
Thermopsis montana
Wyethia amplexicaulis

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

STUDY NUMBER: WAPMC-T-0106-RA. Evaluation of Palouse Prairie Forb Transplants Into a Hard Fescue Sod. (2-98C. Palouse Prairie Transplant Trials, Field 1A).

PROJECT NUMBER:

STUDY TYPE: Prairie Restoration

LAND USES:

VEGETATIVE PRACTICES: PRIMARY:
SECONDARY:

DESCRIPTION: Some native Palouse Prairie plants have been observed to move into older seedings of Durar Hard fescue over time. Field 1A on the Pullman PMC was seeded to Durar in 1986. The site is a Tucannon silt loam on a south facing slope above the Paradise Creek drainage. Tucannon soils are typically less than 2 feet to bedrock, and some parts of the field have rock at or near the surface. Populations of *Senecio integerrimus, Allium acuminatum, Microsteris gracilis, Collinsia parviflora,* and *Brodiaea douglasii* have moved into the seeded area. *Balsamorhiza sagittata, Lithophragma parviflora, Lomatium dissectum, L. grayi, L .macrocarpum,* and *Wyethia amplexicaulis* exist on the edges of the field.
Plots of selected native species will be planted using both transplants and seed and will be monitored for establishment and spread. Existing populations of native plants will also be monitored.
The objective is to determine if native Palouse Prairie species have the ability to recruit themselves in a Hard fescue sod to promote more species diversity.

DURATION OF STUDY:

STUDY LEADER: Dave Skinner

LOCATION: Pullman PMC Field 1A

COOPERATORS:

EXPERIMENTAL DESIGN: Randomized Complete Block

PROCEDURE: Treatments will consist of rototilled strips, mowed strips, and unmowed strips in 3 replications. Each plot will contain a single species consisting of 6 transplants

on 1x1 foot spacings or 100 seeds scattered evenly across the plot. Plots will be 2 feet by 4 feet. Each species will be represented once in each treatment and replication.

Species to be used are Whitmar, *Pseudoroegneria spicata* ssp. *inermis, Poa secunda, Achillea millefolium, Agoseris grandiflora, Clarkia pulchella, Collomia grandiflora, Gaillardia aristata, Geranium viscosissimum, Geum triflorum, Lomatium dissectum, Lupinus sericeus,* and *Potentilla gracilis*.

12 species x 3 reps
2 methods of planting
A) transplants. 6 plants per plot.
1) mowed ground.
2) tilled ground.
B) seed. 100 seeds per plot.
1) mowed ground.
2) unmowed ground.

Rep 1- mow transplant, mow seed, no mow seed, till transplant
Rep 2- no mow seed, mow seed, till transplant, mow transplant
Rep 3- mow seed, no mow seed, mow transplant, till transplant

Monitor existing populations of *Wyethia amplexicaulis, Lomatium grayi, Allium acuminatum, Balsamorhiza sagittata, Solidago missouriensis, Brodiaea douglasii*, and *Senecio integerrimus*. Establish baseline data for existing populations.

Evaluations:
1st year: early summer plant counts in seeded plots
early fall plant counts/ survival.
2nd year on:
spring plant counts.
vigor ratings.
survival of transplants.
total number of plants.
percent cover of planted species.
percent cover of the 3 most common other species in the plot.
distance dispersed from the plot.

PROGRESS: Spring seeded plots were planted on 4/19/01 by broadcasting seed evenly over each plot. Transplants were put out on 4/26/01 with 6 plants on a 1foot x 1 foot spacing in each plot. Fall seeded plots were broadcast on 11/13/01. *Lomatium dissectum* was seeded at a rate of 75 seeds/plot due to low seed availability. See **2001 Plantings: Field 1A** below for layout.
There was no emergence in the spring seeded plots, not even of the annuals *Clarkia pulchella* and *Collomia grandiflora*. Survival and vigor data was collected on the

transplant trials. As was expected, survival and vigor were much higher in the tilled plots without competition from the Hard fescue. Seedhead abundance was also rated. Not all species produced seed in the initial year, but those that did produced far more in the tilled plots.

Existing populations of native plants were plotted by driving a post near the center of the population and dividing a circle around that post into four quadrants on the compass points. Plants in each quadrant were counted to provide baseline data on each population. Weed populations in both the planted plots and existing native population circles were noted.

2002

In 2002 no seedlings of the perennial species, and only a few seedlings of the annuals *Clarkia pulchella* and *Collomia grandiflora*, were observed in any of the seeded plots. In the spring of 2003, only a few seedlings of *Lomatium dissectum* were found in both the spring and fall seeded plots and a few *Lupinus leucophyllus* and *Geranium viscosissimum* were found in the fall seeded plots. None of the other broadcast perennial plots contained any seedlings. All the *Lupinus leucophyllus* seedlings were found in the unmowed treatments while all the *Geranium viscosissimum* seedlings were found in the mowed plots. Even so, numbers found were so low that broadcasting seed either in fall or spring does not appear at this point to be a viable option except possibly with *Lomatium dissectum*. Since many of the species used are known to have seed dormancy, it is still possible that additional seeds will germinate.

In 2002, no seedlings were found in any of the plots containing spring broadcast seed of perennial forbs. The only perennial species to respond to fall broadcasting was *Lupinus leucophyllus*, which was present in low numbers in 5 of 6 plots. The annual forb *Clarkia pulchella* responded poorly to broadcasting. The maximum number of plants was 3 in fall broadcast plot 602. 7 of 12 plots contained no plants, and only 1 spring broadcast plot contained any plants. *Collomia grandiflora* showed a better response to broadcasting. The maximum number of plants was 16 in both plots 302 and 403. 2 of 12 plots, both spring seeded, contained no plants, and all the fall seeded plots contained at least 4 plants.

All the transplant plots were rated for survival and vigor. Vigor for plants transplanted directly into the Hard fescue cover was generally low. Survival varied by species, with *Achillea millefolium, Agoseris grandiflora* having 100% survival across all plots. *Gaillardia aristata* also had high survival rates. *Lupinus leucophyllus* showed very poor survival, with only 1 plant present in plot 301. Vigor and survival were much higher in the tilled plots. Only *Poa secunda* had a rate of under 60%, however it was difficult to determine as the plants were dormant on July 1st when final ratings were completed. *Lupinus leucophyllus* and *Potentilla gracilis* were the only other species to show less than 100% survival.

Transplanted plots were also measured for distance spread. *Collomia grandiflora* plants were found as far as 19 feet from the original plot. A few *Clarkia pulchella* were found as far as 18 feet from the original plot, although most tended to be within 3-4 feet. *Agoseris grandiflora* and *Achillea millefolium* were the only perennial species found to be spreading after the first year, and only from the plants in the tilled strips. Some new plants of the windborne *Agoseris grandiflora* were found as far as 32 feet from the parent

plants. *Achillea millefolium* seedlings were generally found within a few feet of the original plot, since the seed is not windborne, and not all plots were found to have new seedlings outside the plot. None of the other species were noted to have generated new plants in the first year following transplanting. No new plants of any of the perennial species were found to have spread by seed from the transplants placed directly into the Hard fescue.

All introduced species were removed from the tilled plots by hoeing or hand pulling. All plots were rated for percent cover of the 4 most common species, either native or introduced.

2003

In 2003, survival, vigor and seed production continued to be high for most species transplanted into the tilled strips, with the exception of *Poa secunda*. *Agoseris grandiflora, Clarkia pulchella,* and *Collomia grandiflora* were observed to be spreading at distances exceeding 15 feet from the original planting site and *Achillea millefolium* was found as far as 10 feet from the original plots. Seed spread of the other species was low to nonexistent. By 2003, weed populations in the tilled plots were lower than in previous years and generally did not threaten the planted species. No weed control was carried out in 2003.

Over the same period, survival, vigor, and seed production declined for most species transplanted directly into existing fescue sod and in some cases no plants survived in any replication. Seed spread of *Clarkia pulchella*, *Collomia grandiflora* and *Agoseris grandiflora* was measured in these plots as well but the numbers of plants were fewer. Interestingly, only 2 of 18 of the original transplanted *Agoseris grandiflora* survived in 2003. Most had been killed by rodents. Some *Lupinus leucophyllus* were found outside the plot in replication 301 (mow/transplant). It was the only case of seed spread of *Lupinus leucophyllus* in the planting. Some of the transplanted *Lomatium dissectum* in the tilled plots flowered for the first time in 2003, but none in the mowed plots did.

In 2002 and 2003, existing populations of native species in field 1A were monitored and data collected on number of plants and percent coverage. No plants of *Allium acuminatum* plot 1 flowered in 2003. There were 51 in 2001 and 29 in 2002. No *Phacelia heterophylla* was found in the field in 2002 or 2003, but the population on the road bank to the west remained intact. Other populations of native species in the field remained intact and some increased slightly.

2004

All the plots were evaluated for survival, vigor, number of plants, percent cover of the 4 most prevalent species and distance of spread beyond the plots in 2004. Plant counts and cover of all species present were also estimated for the existing native species plots in the field. Precipitation totals for 2003 were normal, but a dry June may have impacted the plantings going into the normally dry months of July and August 2003 and affected their performance in 2004.

Survival and vigor continued to be high for most of the species transplanted into tilled strips. More *Lomatium dissectum* flowered in the tilled plots, but none flowered in the mowed plots. None of the *Poa secunda* transplants survived, however, nor were any plants found established from seed. *Agoseris grandiflora* and *Achillea millefolium* survival overall was down, but the plants have been observed to be short-lived. Plants

either transplanted or seeded into existing Hard fescue sod generally had low survival and/or low vigor. *Collomia grandiflora* and *Lomatium dissectum* were the only species to establish when spring broadcast, and *L. dissectum* did not germinate until the second year. Those 2 species, along with *Clarkia pulchella* and *Lupinus leucophyllus* were able to establish at low rates from fall broadcast seed. See **Table: Plant Counts, Table: Survival of Transplants, Table: Percent Cover of Transplants, Table: Vigor ratings, Table: Total number of plants,** and **Table: Field 1A by species** below for details.
Near the till/transplant plots *Collomia grandiflora, Agoseris grandiflora*, and *Clarkia pulchella* demonstrated the ability to colonize the Hard fescue outside the plots. Lower numbers of *Gaillardia aristata, Lupinus leucophyllus* and *Achillea millefolium* were also able to establish at shorter distances from some of those plots.
The existing populations of native plants were monitored again in 2004 and data was collected on number of plants and percent canopy coverage estimated for all species present in the plots. Most of the *Allium acuminatum* plots had fewer flowers than in 2003, although plot ALAC1 had a few flowers where none had bloomed in 2003. The *Achillea millefolium* population below the west edge of the field had not spread into the field. The 3 *Lomatium grayi* plants present in 2003 could not be found in 2004, although they may have senesced by the time evaluations were done. The plants of *Senecio integerrimus* and *S. serra* also could not be found. The *S. integerrimus* was absent in 2003 as well. No new seedlings of *Wyethia amplexicaulis* were noted.

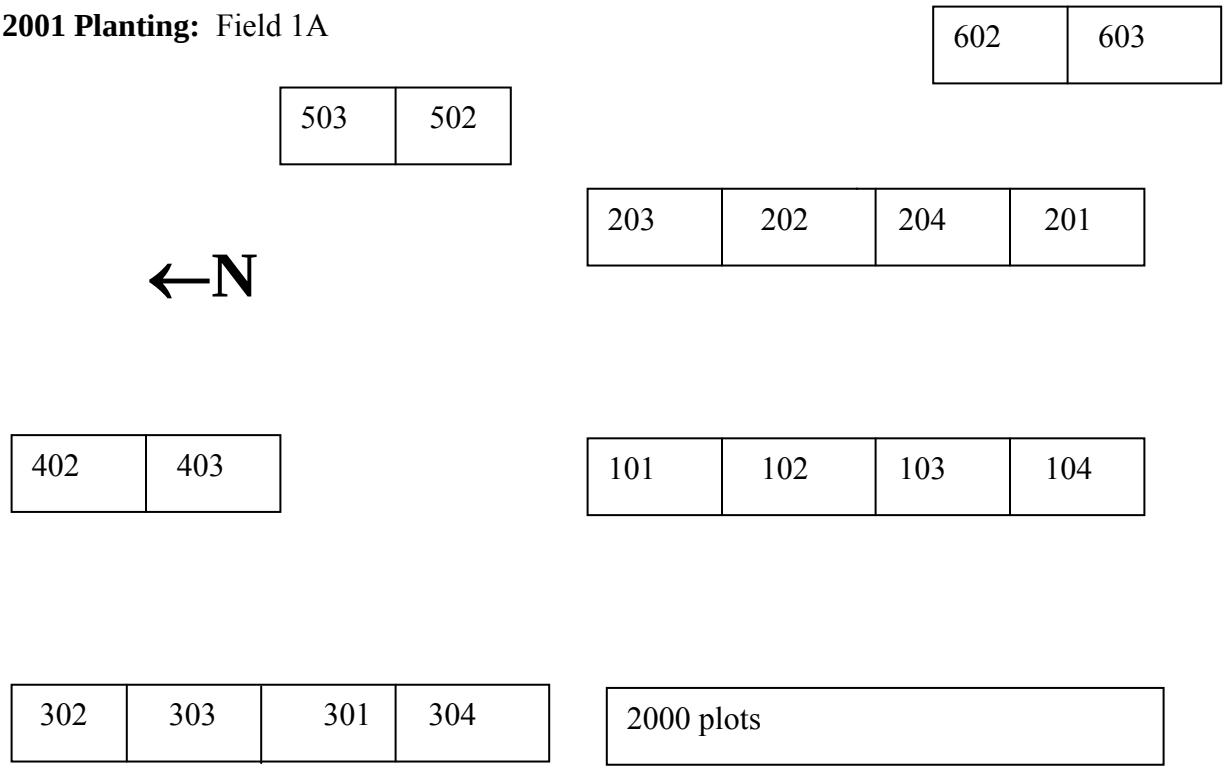
2005

All the plots were again evaluated for survival, vigor, number of plants, percent cover of the 4 most prevalent species and distance of spread beyond the plots in 2005. Plants were counted and canopy cover of all the existing native species in the field was estimated. The winter of 2004-2005 was generally dry, and very little precipitation was received in February and the first half of March. The dry conditions likely impeded seed germination.
For the transplanted plots overall, the downward trend in vigor, cover, and survival continued for most species, with many at or near zero, especially for those species transplanted directly into the Hard fescue sod. *Lomatium dissectum* was the only species to remain constant or increase across all the plots. *Potentilla gracilis, Geum triflorum, and Geranium viscosissimum* were at or above previous year levels in the tilled plots. The seeded plots all had very low establishment, vigor, and cover.
Seed reproduction of the annuals *Clarkia pulchella* and *Collomia grandiflora* was very low, despite high numbers in 2003 and 2004. See **Table: Plant Counts, Table: Survival of Transplants, Table: Percent Cover of Transplants, Table: Vigor ratings, Table: Total number of plants,** and **Table: Field 1A by species** below for details.
Generally only *Collomia grandiflora* and *Agoseris grandiflora* had established at any distance from the original plots, although occasionally *Gaillardia aristata, Lupinus leucophyllus,* and *Achillea millefolium* were found close to particularly vigorous plots.

The existing populations of native plants were monitored again in 2005 and data was collected on number of plants and percent canopy coverage estimates for all species in the plots.

The existing *Allium acuminatum* plots produced no flowers in 2005. There were no new seedlings of *Wyethia amplexicaulis* found. *Brodiaea douglasii* in plot BRDO3 had fewer flowers than in 2004. All the seed was harvested from this plot and the bulbs were dug out because it lies within the right-of-way for the State Route 270 highway construction and will likely be destroyed. The bulbs were planted in field G3. No spread from either *Achillea millefolium* existing population was noted. The *Senecio serra* population had 3 flowering and 29 vegetative stems. The original *Lomatium grayi* plants in plot LOGR1 were not found, but 5 seedlings were present. No *Phacelia heterophylla* was found in the field, although the population on the road bank below remains intact.

2001 Planting: Field 1A



Not to scale

Note: Treatments are not square with each other. 300, 400, and 500 run slightly northeast to southwest. 100, 200 and 600 treatments run slightly northwest to southeast. See below for individual plot layout within each replication. All replication corners are marked with a 4 foot fiberglass fence post and plot corners are marker with a 2 foot post.

Spring Planted Replications. Plot #1 is located on the north end of each treatment.

REP 1	**treat 101**	**treat 102**	**treat 103**	**treat 104**
plot #	m/tp	m/s	nm/s	t/tp
1	PSSP	CLPU	GETR	LUSE
2	POSE	GETR	POSE	COGR
3	ACMI	ACMI	POGR	POSE
4	AGGR	LODI	AGGR	GEVI
5	CLPU	PSSP	LUSE	POGR
6	COGR	POSE	PSSP	AGGR
7	GAAR	LUSE	GAAR	LODI
8	GEVI	GEVI	COGR	GETR
9	GETR	POGR	CLPU	GAAR
10	POGR	GAAR	LODI	CLPU
11	LODI	COGR	ACMI	PSSP
12	LUSE	AGGR	GEVI	ACMI

REP 3	treat 203	treat 202	treat 204	treat 201
	nm/s	m/s	t/tp	m/tp
1	AGGR	PSSP	LODI	POGR
2	LODI	ACMI	AGGR	GAAR
3	GAAR	POSE	GEVI	COGR
4	CLPU	LODI	GETR	ACMI
5	GEVI	AGGR	CLPU	GEVI
6	POSE	LUSE	ACMI	LODI
7	POGR	POGR	PSSP	LUSE
8	ACMI	CLPU	COGR	POSE
9	PSSP	GETR	LUSE	GETR
10	COGR	GAAR	POGR	CLPU
11	GETR	GEVI	GAAR	PSSP
12	LUSE	COGR	POSE	AGGR

REP 3	treat 302	treat 303	treat 301	treat 304
	m/s	nm/s	m/tp	t/tp
1	PSSP	PSSP	ACMI	LODI
2	GETR	POGR	AGGR	POGR
3	CLPU	LUSE	CLPU	COGR
4	POSE	LODI	PSSP	POSE
5	ACMI	CLPU	GEVI	CLPU
6	LUSE	GETR	LODI	PSSP
7	GAAR	ACMI	POGR	GAAR
8	COGR	GEVI	GETR	GEVI
9	AGGR	POSE	POSE	AGGR
10	GEVI	COGR	GAAR	LUSE
11	LODI	AGGR	LUSE	ACMI
12	POGR	GAAR	COGR	GETR

01 = m/tp = mowed/transplanted
02 = m/s = mow/seeded
03 = nm/s = not mowed/seeded
04 = nm/tp = not moved/transplanted

ACMI = *Achillea millefolium*
AGGR = *Agoseris grandiflora*
CLPU = *Clarkia pulchella*
COGR = *Collomia grandiflora*
GAAR = *Gaillardia aristata*
GETR = *Geum triflorum*
GEVI = *Geranium viscosissimum*
LODI = *Lomatium dissectum*
LUSE = *Lupinus sericeus*
POGR = *Potentilla gracilis*
POSE = *Poa secunda*
PSSP = *Pseudoroegneria spicata inermis* cv. “Whitmar”

Fall Seeded Replications

treat 402	**treat 403**	**treat 403**	**treat 502**	**treat 602**	**treat 603**
m/s	nm/s	nm/s	m/s	m/s	nm/s
GAAR	AGGR	LODI	POGR	CLPU	GETR
COGR	GEVI	COGR	GAAR	GEVI	POSE
GEVI	POSE	AGGR	PSSP	GETR	ACMI
CLPU	COGR	GAAR	GEVI	POSE	LUSE
GETR	LUSE	PSSP	GETR	LODI	GAAR
AGGR	POGR	LUSE	ACMI	POGR	COGR
POGR	GETR	GEVI	POSE	PSSP	LODI
ACMI	PSSP	ACMI	AGGR	ACMI	AGGR
LODI	GAAR	CLPU	LUSE	GAAR	PSSP
POSE	LODI	POSE	CLPU	LUSE	GEVI
LUSE	ACMI	POGR	COGR	AGGR	CLPU
PSSP	CLPU	GETR	LODI	COGR	POGR

02 = m/s = mowed/seeded
03 = nm/s = not mowed/seeded

ACMI = *Achillea millefolium*
AGGR = *Agoseris grandiflora*
CLPU = *Clarkia pulchella*
COGR = *Collomia grandiflora*
GAAR = *Gaillardia aristata*
GETR = *Geum triflorum*
GEVI = *Geranium viscosissimum*
LODI = *Lomatium dissectum*
LUSE = *Lupinus sericeus*
POGR = *Potentilla gracilis*
POSE = *Poa secunda*
PSSP = *Pseudoroegneria spicata inermis* cv. “Whitmar”

Table: Plant counts, Field 1A Seeded Plots

mowed and spring broadcast seeded plots

	rep 102			rep 202			rep 302		
species	2003	2004	2005	2003	2004	2005	2003	2004	2005
Achillea millefolium	0	0	0	0	0	0	0	0	0
Agoseris grandiflora	0	0	0	0	0	0	0	0	0
Clarkia pulchella	0	0	0	0	0	0	0	0	0
Collomia grandiflora	0	0	0	1	0	0	0	6	0
Gaillardia aristata	0	0	0	0	0	0	0	0	0
Geranium viscosissimum	0	0	0	0	0	0	0	0	0
Geum triflorum	0	0	0	0	0	0	0	0	0
Lomatium dissectum	1	0	1	0	0	0	6	5	4
Lupinus leucophyllus	0	0	0	0	0	0	0	0	0
Poa secunda	0	0	0	0	0	0	0	0	0
Potentilla gracilis	0	0	0	0	0	0	0	0	0
Pseudoroegneria spicata	0	0	0	0	0	0	0	0	0

unmowed and spring broadcast seeded plots

	rep 103			rep 203			rep 303		
species	2003	2004	2005	2003	2004	2005	2003	2004	2005
Achillea millefolium	0	0	0	0	0	0	0	0	0
Agoseris grandiflora	0	0	0	1	0	0	0	0	0
Clarkia pulchella	0	0	0	0	0	0	0	0	0
Collomia grandiflora	0	11	0	1	5	0	4	1	0
Gaillardia aristata	0	0	0	0	0	0	0	0	0
Geranium viscosissimum	0	0	0	0	0	0	0	0	0
Geum triflorum	0	0	0	0	0	0	0	0	0
Lomatium dissectum	0	0	0	6	3	2	2	4	3
Lupinus leucophyllus	0	0	0	0	0	0	0	0	0
Poa secunda	0	0	0	0	0	0	0	0	0
Potentilla gracilis	0	0	0	0	0	0	0	0	0
Pseudoroegneria spicata	0	0	0	0	0	0	0	0	0

Table: Plant counts, Field 1A Seeded Plots (continued)

mowed and fall broadcast seeded plots

	rep 402			rep 502			rep 602		
species	2003	2004	2005	2003	2004	2005	2003	2004	2005
Achillea millefolium	0	0	0	0	0	0	0	0	0
Agoseris grandiflora	0	0	0	0	0	0	0	0	0
Clarkia pulchella	0	0	0	0	0	0	7	12	0
Collomia grandiflora	0	25	1	2	14	0	3	16	1
Gaillardia aristata	0	0	0	0	0	0	0	0	0
Geranium viscosissimum	1	0	0	0	0	0	0	0	0
Geum triflorum	0	0	0	0	0	0	0	0	0
Lomatium dissectum	2	0	0	1	0	2	6	0	0
Lupinus leucophyllus	0	1	1	1	0	0	3	1	1
Poa secunda	0	0	0	0	0	0	0	0	0
Potentilla gracilis	0	0	0	0	0	0	0	0	0
Pseudoroegneria spicata	0	0	0	0	0	0	0	0	0

unmowed and fall broadcast seeded plots

	rep 403			rep 503			rep 603		
species	2003	2004	2005	2003	2004	2005	2003	2004	2005
Achillea millefolium	0	0	0	0	0	0	0	0	0
Agoseris grandiflora	0	0	0	0	0	0	0	0	0
Clarkia pulchella	1	0	0	0	0	0	0	0	0
Collomia grandiflora	0	7	0	1	0	3	1	1	0
Gaillardia aristata	0	0	0	0	0	0	0	0	0
Geranium viscosissimum	0	0	0	1	0	0	0	0	0
Geum triflorum	0	0	0	0	0	0	0	0	0
Lomatium dissectum	6	0	4	3	0	2	1	0	0
Lupinus leucophyllus	2	2	2	0	0	0	4	1	1
Poa secunda	0	0	0	0	0	0	0	0	0
Potentilla gracilis	0	0	0	0	0	0	0	0	0
Pseudoroegneria spicata	0	0	0	0	0	0	0	0	0

No seedlings were found in any plots in 2002, thus that data is not included here.

Table: Survival of transplants

Transplanted in mowed strips

	rep 101				rep 201				rep 301			
species	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2005
Achillea millefolium	6	5	5	4	6	3	1	0	6	5	3	0
Agoseris grandiflora	6	1	0	1	6	0	0	0	6	2	0	0
Clarkia pulchella	annual	annual	annual	annual	annual	annual	annual	annual	annual	annual	annual	annual
Collomia grandiflora	annual	annual	annual	annual	annual	annual	annual	annual	annual	annual	annual	annual
Gaillardia aristata	5	1	3	2	2	1	3	0	3	6	6	6
Geranium viscosissimum	2	2	2	2	0	0	0	0	1	1	1	1
Geum triflorum	2	1	0	0	0	0	0	0	0	0	0	0
Lomatium dissectum	5	4	3	3	4	4	4	3	5	6	6	4
Lupinus leucophyllus	0	0	0	0	0	0	0	0	1	1	1+4	1
Poa secunda	3	0	0	0	4	0	0	0	2	1	0	0
Potentilla gracilis	3	1	0	1	0	0	0	0	3	0	1	0
Pseudoroegneria spicata	4	4	1	0	4	3	2	2	6	3	2	0

Transplanted in tilled strips

	rep 104				rep 204				rep 304			
species	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2005
Achillea millefolium	6	3	1	0	6	6	5	0	6	6	2	1
Agoseris grandiflora	6	2	0+	0	6	0	0+1	0	6	0	0	0
Clarkia pulchella	annual	annual	annual	annual	annual	annual	annual	annual	annual	annual	annual	annual
Collomia grandiflora	annual	annual	annual	annual	annual	annual	annual	annual	annual	annual	annual	annual
Gaillardia aristata	6	6	5	1	6	6	5	0	6	6	6	6
Geranium viscosissimum	5	5	5	5	6	6	5	6	6	6	6	6
Geum triflorum	6	6	3	4	6	6	6	6	6	6	6	6
Lomatium dissectum	6	6	6	5	6	6	6	5	6	6	5	4
Lupinus leucophyllus	1	1	1	1	6	6	6	2	4	6	6	3
Poa secunda	2	0	0	0	4	0	0	0	4	2	0	0
Potentilla gracilis	5	5	5	5	6	6	6	5	6	6	6	6
Pseudoroegneria spicata	6	4	4	3	5	4	3	1	6	6	5	3

+ indicates new plants from seed

Table: % Cover of transplants, Field 1A Plots

Transplanted in mowed strips

	rep 101				rep 201				rep 301			
species	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2005
Achillea millefolium	10	15	30	30	20	2	5	0	30	25	15	0
Agoseris grandiflora	10	5	1	10	25	0	0	0	30	5	0	0
Clarkia pulchella	1	2	15	0	1	10	10	0	10	10	25	0
Collomia grandiflora	5	2	40	5	1	1	20	0	10	5	20	10
Gaillardia aristata	5	5	20	20	20	10	20	0	25	45	60	80
Geranium viscosissimum	1	5	20	20	0	0	0	0	1	3	5	10
Geum triflorum	1	0	0	0	0	0	0	0	1	0	0	0
Lomatium dissectum	5	0	40	30	5	15	30	50	5	15	50	60
Lupinus leucophyllus	0	0	0	0	0	0	0	0	15	60	60	50
Poa secunda	1	0	0	0	0	0	0	0	0	0	0	0
Potentilla gracilis	1	1	5	10	0	0	0	0	1	5	0	0
Pseudoroegneria spicata	5	1	5	0	1	5	10	20	15	0	5	0

Transplanted in tilled strips

	rep 104				rep 204				rep 304			
species	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2005
Achillea millefolium	90	1	10	0	100	60	35	0	100	30	5	p
Agoseris grandiflora	50	1	5	0	30	0	1	5	60	1	0	0
Clarkia pulchella	70	10	25	0	40	15	40	0	60	50	20	p
Collomia grandiflora	20	5	15	0	15	5	40	0	60	5	30	p
Gaillardia aristata	90	75	30	10	100	60	50	0	100	60	60	70
Geranium viscosissimum	30	60	80	90	50	80	60	80	50	90	70	100
Geum triflorum	50	60	60	60	30	50	70	90	60	80	80	90
Lomatium dissectum	25	40	70	80	10	40	60	70	10	20	60	70
Lupinus leucophyllus	5	10	20	20	50	70	70	30	70	100	80	40
Poa secunda	5	0	0	0	10	0	0	0	0	0	0	0
Potentilla gracilis	40	70	90	70	50	65	70	30	50	75	90	90
Pseudoroegneria spicata	50	60	20	20	40	40	25	5	40	30	30	20

"p" denotes present at less than 5% cover

Table: Vigor ratings, Field 1A Plots

transplanted in mowed strips

	rep 101				rep 201				rep 301			
species	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2005
Achillea millefolium	4	4	5	5	4	3	0	0	6	4	2	0
Agoseris grandiflora	5	3	0	4	6	0	0	0	6	4	0	0
Clarkia pulchella	4	4	3	0	2	4	2	0	5	5	3	0
Collomia grandiflora	4	3	4	4	3	2	4	0	5	3	4	4
Gaillardia aristata	5	3	3	6	3	2	3	0	4	6	6	8
Geranium viscosissimum	2	1	3	5	0	0	0	0	2	3	2	3
Geum triflorum	1	0	0	0	0	0	0	0	2	0	0	0
Lomatium dissectum	d	0	4	d	d	0	3	6	d	d	4	7
Lupinus leucophyllus	0	0	0	0	0	0	0	0	7	8	9	9
Poa secunda	d	0	0	0	d	0	0	0	d	0	0	0
Potentilla gracilis	2	1	1	4	0	0	0	0	2	3	0	0
Pseudoroegneria spicata	2	2	3	0	3	3	2	3	4	0	2	0

Transplanted in tilled strips

	rep 104				rep 204				rep 304			
species	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2005
Achillea millefolium	9	1	4	0	9	5	3	0	9	1	2	1
Agoseris grandiflora	8	1	0	0	5	0	2	3	7	2	0	0
Clarkia pulchella	8	6	3	0	7	5	5	0	7	5	3	2
Collomia grandiflora	5	3	5	0	4	2	4	0	7	3	2	3
Gaillardia aristata	8	7	4	4	9	6	4	0	9	7	7	6
Geranium viscosissimum	6	4	7	8	7	6	4	7	5	7	7	7
Geum triflorum	6	6	4	6	5	4	3	6	7	6	4	7
Lomatium dissectum	4	5	5	8	d	5	6	7	d	d	5	8
Lupinus leucophyllus	5	6	5	7	5	6	6	6	6	8	9	5
Poa secunda	d	0	0	0	d	0	0	0	d	0	0	0
Potentilla gracilis	6	5	7	6	7	5	5	5	6	7	8	8
Pseudoroegneria spicata	6	3	4	4	6	5	4	2	5	5	3	5

rated 0-9 with 9 highest d denotes dormant at time of evaluation

Table: Total number of plants (transplants + seedlings)

Transplanted in mowed strips

	rep 101				rep 201				rep 301			
species	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2005
Achillea millefolium	6	5	5	4	6	2	1	0	6	12	4	0
Agoseris grandiflora	6	1	1	1	6	0	0	0	6	4	0	0
Clarkia pulchella	m	5	16	0	m	11	7	0	m	21	18	0
Collomia grandiflora	m	7	65	2	m	3	16	0	m	8	30	4
Gaillardia aristata	5	3	3	2	2	3	1	0	3	16	6	12
Geranium viscosissimum	2	2	2	2	0	0	0	0	1	1	1	1
Geum triflorum	2	0	0	0	0	0	0	0	0	0	0	0
Lomatium dissectum	5	0	3	0	4	1	2	3	5	3	5	6
Lupinus leucophyllus	0	0	0	0	0	0	0	0	1	2	4	6
Poa secunda	3	0	0	0	4	0	0	0	2	0	0	0
Potentilla gracilis	3	1	1	1	0	0	0	0	3	1	0	0
Pseudoroegneria spicata	4	1	1	3	4	2	2	2	6	0	2	0

Transplanted in tilled strips

	rep 104				rep 204				rep 304			
species	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2005
Achillea millefolium	6	2	10	0	6	6	8	0	6	14	2	1
Agoseris grandiflora	6	1	1	0	6	0	2	1	6	1	0	0
Clarkia pulchella	m	20	14	0	m	TNTC	37	0	m	TNTC	17	2
Collomia grandiflora	m	22	25	0	m	12	42	0	m	11	46	3
Gaillardia aristata	6	6	4	2	6	6	5	0	6	29	13	11
Geranium viscosissimum	5	5	5	5	6	6	5	6	6	6	6	6
Geum triflorum	6	6	3	4	6	6	6	6	6	6	6	7
Lomatium dissectum	6	4	5	5	6	6	6	5	6	6	5	4
Lupinus leucophyllus	1	1	1	1	6	6	6	2	4	6	6	4
Poa secunda	2	0	0	0	4	0	0	0	4	0	0	0
Potentilla gracilis	5	5	5	5	6	6	6	5	6	6	6	6
Pseudoroegneria spicata	6	4	4	3	5	5	3	1	6	6	5	3

m indicates data missing

TNTC = too numerous to count

Table: Field 1A by Species

treatment 01 is transplanted in mowed strips
treatment 04 is transplanted in tilled strips

			Rep 1				Rep 2				Rep 3			
Species	**treat**	**Parameter**	**2002**	**2003**	**2004**	**2005**	**2002**	**2003**	**2004**	**2005**	**2002**	**2003**	**2004**	**2005**
Achillea millefolium	01	% cover	10	15	30	30	20	2	5	0	30	25	15	0
Achillea millefolium	01	survival	6	5	5	4	6	3	1	0	6	5	3	0
Achillea millefolium	01	total plants	6	5	5	4	6	2	1	0	6	12	4	0
Achillea millefolium	01	vigor	4	4	5	5	4	3	0	0	6	4	2	0
Achillea millefolium	04	% cover	90	1	10	0	100	60	35	0	100	30	5	p
Achillea millefolium	04	survival	6	3	1	0	6	6	5	0	6	6	2	1
Achillea millefolium	04	total plants	6	2	10	0	6	6	8	0	6	14	2	1
Achillea millefolium	04	vigor	9	1	4	0	9	5	3	0	9	1	2	1
Agoseris grandiflora	01	% cover	10	5	1	10	25	0	0	0	30	5	0	0
Agoseris grandiflora	01	survival	6	1	0	1	6	0	0	0	6	2	0	0
Agoseris grandiflora	01	total plants	6	1	1	1	6	0	0	0	6	4	0	0
Agoseris grandiflora	01	vigor	5	3	0	4	6	0	0	0	6	4	0	0
Agoseris grandiflora	04	% cover	50	1	5	0	30	0	1	5	60	1	0	0
Agoseris grandiflora	04	survival	6	2	0+	0	6	0	0+1	0	6	0	0	0
Agoseris grandiflora	04	total plants	6	1	1	0	6	0	2	1	6	1	0	0
Agoseris grandiflora	04	vigor	8	1	0	0	5	0	2	3	7	2	0	0
Clarkia pulchella	01	% cover	1	2	15	0	1	10	10	0	10	10	25	0
Clarkia pulchella	01	survival	annual	annual	annual	annual	annual	annual	annual	annual	annual	annual	annual	annual
Clarkia pulchella	01	total plants	m	5	16	0	m	11	7	0	m	21	18	0
Clarkia pulchella	01	vigor	4	4	3	0	2	4	2	0	5	5	3	0
Clarkia pulchella	04	% cover	70	10	25	0	40	15	40	0	60	50	20	p
Clarkia pulchella	04	survival	annual	annual	annual	annual	annual	annual	annual	annual	annual	annual	annual	annual
Clarkia pulchella	04	total plants	m	20	14	0	m	TNTC	37	0	m	TNTC	17	2
Clarkia pulchella	04	vigor	8	6	3	0	7	5	5	0	7	5	3	2

m = missing data
+ indicates new seedling
TNTC = too numerous to count
d = dormant at time of evaluation

Table: Field 1A by Species (continued)

			Rep 1				Rep 2				Rep 3			
Species	**treat**	**Parameter**	**2002**	**2003**	**2004**	**2005**	**2002**	**2003**	**2004**	**2005**	**2002**	**2003**	**2004**	**2005**
Collomia grandiflora	01	% cover	5	2	40	5	1	1	20	0	10	5	20	10
Collomia grandiflora	01	survival	annual	annual	annual	annual	annual	annual	annual	annual	annual	annual	annual	annual
Collomia grandiflora	01	total plants	m	7	65	2	m	3	16	0	m	8	30	4
Collomia grandiflora	01	vigor	4	3	4	4	3	2	4	0	5	3	4	4
Collomia grandiflora	04	% cover	20	5	15	0	15	5	40	0	60	5	30	p
Collomia grandiflora	04	survival	annual	annual	annual	annual	annual	annual	annual	annual	annual	annual	annual	annual
Collomia grandiflora	04	total plants	m	22	25	0	m	12	42	0	m	11	46	3
Collomia grandiflora	04	vigor	5	3	5	0	4	2	4	0	7	3	2	3
Gaillardia aristata	01	% cover	5	5	20	20	20	10	20	0	25	45	60	80
Gaillardia aristata	01	survival	5	1	3	2	2	1	3	0	3	6	6	6
Gaillardia aristata	01	total plants	5	3	3	2	2	3	1	0	3	16	6	12
Gaillardia aristata	01	vigor	5	3	3	6	3	2	3	0	4	6	6	8
Gaillardia aristata	04	% cover	90	75	30	10	100	60	50	0	100	60	60	70
Gaillardia aristata	04	survival	6	6	5	1	6	6	5	0	6	6	6	6
Gaillardia aristata	04	total plants	6	6	4	2	6	6	5	0	6	29	13	11
Gaillardia aristata	04	vigor	8	7	4	4	9	6	4	0	9	7	7	6
Geranium viscosissimum	01	% cover	1	5	20	20	0	0	0	0	1	3	5	10
Geranium viscosissimum	01	survival	2	2	2	2	0	0	0	0	1	1	1	1
Geranium viscosissimum	01	total plants	2	2	2	2	0	0	0	0	1	1	1	1
Geranium viscosissimum	01	vigor	2	1	3	5	0	0	0	0	2	3	2	3
Geranium viscosissimum	04	% cover	30	60	80	90	50	80	60	80	50	90	70	100
Geranium viscosissimum	04	survival	5	5	5	5	6	6	5	6	6	6	6	6
Geranium viscosissimum	04	total plants	5	5	5	5	6	6	5	6	6	6	6	6
Geranium viscosissimum	04	vigor	6	4	7	8	7	6	4	7	5	7	7	7

m = missing data
+ indicates new seedling
d = dormant at time of evaluation

Table: Field 1A by Species (continued)

			Rep 1				Rep 2				Rep 3			
Species	**treat**	**Parameter**	**2002**	**2003**	**2004**	**2005**	**2002**	**2003**	**2004**	**2005**	**2002**	**2003**	**2004**	**2005**
Geum triflorum	01	% cover	1	0	0	0	0	0	0	0	1	0	0	0
Geum triflorum	01	survival	2	1	0	0	0	0	0	0	0	0	0	0
Geum triflorum	01	total plants	2	0	0	0	0	0	0	0	0	0	0	0
Geum triflorum	01	vigor	1	0	0	0	0	0	0	0	2	0	0	0
Geum triflorum	04	% cover	50	60	60	60	30	50	70	90	60	80	80	90
Geum triflorum	04	survival	6	6	3	4	6	6	6	6	6	6	6	6
Geum triflorum	04	total plants	6	6	3	4	6	6	6	6	6	6	6	7
Geum triflorum	04	vigor	6	6	4	6	5	4	3	6	7	6	4	7
Lomatium dissectum	01	% cover	5	0	40	30	5	15	30	50	5	15	50	60
Lomatium dissectum	01	survival	5	4	3	3	4	4	4	3	5	6	6	4
Lomatium dissectum	01	total plants	5	0	3	0	4	1	2	3	5	3	5	6
Lomatium dissectum	01	vigor	d	0	4	d	d	0	3	6	d	d	4	7
Lomatium dissectum	04	% cover	25	40	70	80	10	40	60	70	10	20	60	70
Lomatium dissectum	04	survival	6	6	6	5	6	6	6	5	6	6	5	4
Lomatium dissectum	04	total plants	6	4	5	5	6	6	6	5	6	6	5	4
Lomatium dissectum	04	vigor	4	5	5	8	d	5	6	7	d	d	5	8
Lupinus leucophyllus	01	% cover	0	0	0	0	0	0	0	0	15	60	60	50
Lupinus leucophyllus	01	survival	0	0	0	0	0	0	0	0	1	1	1+4	1
Lupinus leucophyllus	01	total plants	0	0	0	0	0	0	0	0	1	2	4	6
Lupinus leucophyllus	01	vigor	0	0	0	0	0	0	0	0	7	8	9	9
Lupinus leucophyllus	04	% cover	5	10	20	20	50	70	70	30	70	100	80	40
Lupinus leucophyllus	04	survival	1	1	1	1	6	6	6	2	4	6	6	3
Lupinus leucophyllus	04	total plants	1	1	1	1	6	6	6	2	4	6	6	4
Lupinus leucophyllus	04	vigor	5	6	5	7	5	6	6	6	6	8	9	5

m = missing data
+ indicates new seedling
d = dormant at time of evaluation

Table: Field 1A by Species (continued)

			Rep 1				Rep 2				Rep 3			
Species	**treat**	**Parameter**	**2002**	**2003**	**2004**	**2005**	**2002**	**2003**	**2004**	**2005**	**2002**	**2003**	**2004**	**2005**
Poa secunda	01	% cover	1	0	0	0	0	0	0	0	0	0	0	0
Poa secunda	01	survival	3	0	0	0	4	0	0	0	2	1	0	0
Poa secunda	01	total plants	3	0	0	0	4	0	0	0	2	0	0	0
Poa secunda	01	vigor	d	0	0	0	d	0	0	0	d	0	0	0
Poa secunda	04	% cover	5	0	0	0	10	0	0	0	0	0	0	0
Poa secunda	04	survival	2	0	0	0	4	0	0	0	4	2	0	0
Poa secunda	04	total plants	2	0	0	0	4	0	0	0	4	0	0	0
Poa secunda	04	vigor	d	0	0	0	d	0	0	0	d	0	0	0
Potentilla gracilis	01	% cover	1	1	5	10	0	0	0	0	1	5	0	0
Potentilla gracilis	01	survival	3	1	0	1	0	0	0	0	3	0	1	0
Potentilla gracilis	01	total plants	3	1	1	1	0	0	0	0	3	1	0	0
Potentilla gracilis	01	vigor	2	1	1	4	0	0	0	0	2	3	0	0
Potentilla gracilis	04	% cover	40	70	90	70	50	65	70	30	50	75	90	90
Potentilla gracilis	04	survival	5	5	5	5	6	6	6	5	6	6	6	6
Potentilla gracilis	04	total plants	5	5	5	5	6	6	6	5	6	6	6	6
Potentilla gracilis	04	vigor	6	5	7	6	7	5	5	5	6	7	8	8
Pseudoroegneria spicata	01	% cover	5	1	5	0	1	5	10	20	15	0	5	0
Pseudoroegneria spicata	01	survival	4	4	1	0	4	3	2	2	6	3	2	0
Pseudoroegneria spicata	01	total plants	4	1	1	3	4	2	2	2	6	0	2	0
Pseudoroegneria spicata	01	vigor	2	2	3	0	3	3	2	3	4	0	2	0
Pseudoroegneria spicata	04	% cover	50	60	20	20	40	40	25	5	40	30	30	20
Pseudoroegneria spicata	04	survival	6	4	4	3	5	4	3	1	6	6	5	3
Pseudoroegneria spicata	04	total plants	6	4	4	3	5	5	3	1	6	6	5	3
Pseudoroegneria spicata	04	vigor	6	3	4	4	6	5	4	2	5	5	3	5

m = missing data
+ indicates new seedling
d = dormant at time of evaluation

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

STUDY NUMBER: WAPMC-T-9908-RA. Initial Seed Increase of Palouse Prairie Native Species

PROJECT NUMBER:

STUDY TYPE: Prairie Restoration

LAND USES:

VEGETATIVE PRACTICES: PRIMARY:
SECONDARY:

DESCRIPTION: Seed availability of Palouse Prairie native species is limited and it is preferred to use local seed sources for restoration projects. Little information exists on the cultural requirements for Palouse Prairie native plants. Methods of growing, harvesting, cleaning, and storage of Palouse Prairie natives also need characterization. This study will examine these issues and also provide seed to be used in the restoration of field Q3 and Q4 on the PMC. The objective is to characterize seed production of species native to the Palouse Prairie and provide seed for restoration.

DURATION OF STUDY:

STUDY LEADER: David M. Skinner

LOCATION: Pullman PMC fields Q4, Q6, G3.

COOPERATORS:

EXPERIMENTAL DESIGN:

PROCEDURE: Seed of native Palouse Prairie plants will be collected from local sources. Plants will be grown and transplanted out to a seed increase block. Seed will be used to develop harvesting and cleaning techniques, propagation protocols, and restoration techniques.

PROGRESS: Seed collections began in 1997. See list **Seed Collection 1997-2005** below for species information. Seed was cleaned, then planted in the PMC Growth Chamber during the winter of 1997-98. Plants were transplanted to field Q4 in rows 6 feet apart and 1 foot between plants in the row on May 20, 1998. Additional plants which germinated later in the spring were planted in field Q4 in the fall of 1998. See **Seed Increase Plantings** below for layout. Some of these plants produced seed and were

harvested during the summer. Trays of ungerminated seeds were kept in the lath house until the following spring. Seeds and plants of some of the smaller statured native forbs were planted in the plant beds behind the growth chamber on October 21, 1998. All remaining plants were transferred from the plant bed to field Q4 in 2003. Plants of the annuals, *Clarkia pulchella* and *Collomia grandiflora*, were transplanted to field F1 on May 21, 1998. They were harvested for seed.

Seed was harvested from most of the plants in the Initial Seed Increase in 1999. Annuals were again grown in field F1 and harvested for seed. See **Seed Yields** below for details.

The seed increase planting in field Q4 was expanded in May, 2000 with additional species from plants propagated in the Growth Chamber. See **2000 Increase Planting** below. Plants grown from a 1999 collection of *Festuca idahoensis* were transplanted to an increase block in field G3 on May 18, 2000. Seed was harvested from the increase planting in Q4. See **Seed Yields** below for details.

Plants of *Lomatium triternatum* and *Geranium viscosissimum* were added to the increase planting in field G3 on May 21, 2001. Other plants were transplanted to the increase planting in field Q4 to replace those which had died. 21 *Besseya rubra* were transplanted to Field Q4 to replace the *Linum lewisii*. Since the initial seed increase planting in field Q4 did not contain sufficient grass plants to produce the seed needed when the rest of Field Q3 is ready to be restored to Palouse Prairie, seed increase plantings of Beardless bluebunch wheatgrass and Idaho fescue were made on May 10, 2001 in field Q6. The Idaho fescue failed to establish from spring seeding in both 2001 and 2002. See **Field Q6 Increase Planting** below. Seed was harvested from the increase plantings in Q4 and G3 in 2001. See **Seed Yield** below for species and amounts harvested. Data was compiled on harvesting and cleaning techniques. A portable generator and a shop vac were used to harvest many of the Asteraceae species which ripen indeterminately. It has the advantage of only harvesting mature seed without an excess of stems and leaves. It is especially effective on those species which disseminate by a windborne pappus**. See Seed Cleaning of Palouse Species** below**.**

Seed was harvested from the increase plantings in 2002 and 2003. See **Seed Yield** below for details. *Clarkia pulchella, Collomia grandiflora* and *Collinsia parviflora* seed was harvested from the plants which were direct seeded in the fall of 2002 as part of Study WAPMC-T-0307-RA in field G3. Plants of *Penstemon deustus, Eriogonum heracleoides, Phlox speciosa, Besseya rubra, Phacelia heterophylla, Lomatium dissectum, Castilleja lutescens, Hieracium albertinum, Lomatium triternatum* and *Sidalcea oregana* were added to the increase planting in G3 in 2002 and 2003. See **Initial Seed Increase Planting Field G3** below for layout. *Calochortus nitidus* was seeded directly into about 8 feet of row 5 in the field Q4 increase planting where lupines had died. It was seeded in December and 74 seedlings were counted in the spring of 2003. 52 plants were counted in 2004. The *Festuca idahoensis* seeding in field Q6 failed to establish in 2001 or 2002. The planting was made in 2003 using plants propagated in the growth chamber and transplanted to the field on May 20. See **Field Q6 Increase**

Planting below for layout. All plants were removed from the Plant Bed in the fall of 2003 and planted in rototilled strips in field Q4. See "**STUDY NUMBER:** 1-97 Palouse Prairie restoration on PMC site: reintroducing native plants into former cropland (1997)" for details

Seed was harvested from the field Q4 and field G3 increase plantings in 2004 and 2005. See **Seed Yield** below for details. *Clarkia pulchella, Collomia grandiflora* and *Collinsia parviflora* seed was harvested from the plants which were direct seeded in the fall of 2003 and spring 2004 and again in the fall of 2004 and spring 2005 as part of Study WAPMC-T-0307-RA in field F1. While no quantitative data has been gathered, it appears that fall sown seed of all three annuals produces larger, more vigorous plants and more seed. *Collinsia parviflora* is considered a winter annual and germination often does not occur from spring seedings. The spring of 2004, however, was marked by a protracted cool and wet period and many of the spring sown *C. parviflora* seeds germinated. The plants were shorter and less vigorous than those arising from fall sown seed. Plants of *Penstemon deustus, Helianthella uniflora, Deschampsia caespitosa, Thermopsis montana, Astragalus arrectus, Dodecatheon pulchellum, Linum lewisii, Iris missouriensis,* and *Perideridia gairdneri* were added to the increase planting in G3 in 2004. Much of the *L. lewisii* did not survive. The few that did were moved up with the others in the 10th row. *Cirsium brevifolium* and *Microseris nutans* were planted in their place in the 11th row. Corms of *Brodiaea douglasii* salvaged from the new SR 270 highway right-of-way in field 1A were planted in October 2005 to fill out the east end of the 11th (southern most) row. See **Initial Seed Increase Planting Field G3: Palouse Prairie 2004** and **Initial Seed Increase Planting Field G3: Palouse Prairie 2005** below for layout. By 2005, approximately half of the original *Haplopappus liatriformis* plants had died. The survivors continue to produce abundant seed crops. *Elymus glaucus* and *Poa secunda* (Big bluegrass) seed yields were very low. Both were removed in fall 2005. The space will be used for other forb plantings. *Galium boreale* produced no seed, even though the plants remain vigorous. While *Geum triflorum* plants exhibited strong vegetative growth, seed production was down. Most of the original *Lupinus sericeus* and *L. leucophyllus* plants have died. New ones have established from seed scattered around the planting. *Aster jessicae* is highly rhizomatous and has spread into the adjoining row, outcompeting the *Heuchera cylindrica* and *Potentilla arguta* planted there and seriously reducing seed yields of both species. *Penstemon confertus* plants lacked vigor and produced little seed. Most of the original *Senecio integerrimus* and *Delphinium nuttallianum* plants have died. Some new seedlings of *D. nuttallianum* were noted early in the season. *Achillea millefolium* is also short-lived. The original plants have all died and been replaced by new ones from volunteer seed.

Vegetative proliferation in *Festuca idahoensis*:
Vivipary and vegetative proliferation are sometimes used interchangeably, whereas the term vivipary may be used more strictly to refer to seeds which germinate in the inflorescence and vegetative proliferation to refer to the replacement of the seed with a vegetative propagule, or plantlet (Beetle 1980). Probably the most well known case of this phenomenon is in *Poa bulbosa*, which reproduces entirely by plantlets instead of seed

produced in the inflorescence. Production of plantlets instead of seed has been reported in *Poa, Deschampsia, Festuca,* and *Phleum* (Beetle 1980; Harmer 1984). *Agropyron spicatum* was observed to produce plantlets in the inflorescence, especially in the autumn, in British Columbia (Marchand and McLean 1965). Vegetative proliferation or vivipary is more common in parts of the British Isles which receive extremely high precipitation. High humidity prevents the plantlets from drying out before they produce roots (Wycherley 1953). It is also more common in arctic and alpine species (Beetle 1980, Harmer 1984). The Montana PMC observed vivipary or vegetative proliferation at varying levels in 5 accessions of *Festuca idahoensis*, including "Joseph" and P6435 over 3 successive years (USDA 2004). Vegetative proliferation may have a genetic cause or it may be a response to unusual environmental conditions (Beetle 1984, Wycherley 1953). In 2004, during the process of hand harvesting the *Festuca idahoensis* seed increase planting in field Q6, varying degrees of vegetative proliferation were noticed, particularly in the 3 western-most (down slope) rows. At the Pullman PMC, this condition has not been noted in *Festuca idahoensis* in the past. It is certainly possible that the phenomenon has simply been overlooked. An unusual extended warm and dry period for most of March coupled with a very wet and cool period in the second half of May might have contributed to the expression of this characteristic. Bridger, Montana has a summer rainfall pattern, which may account for the more frequent expression of vegetative proliferation at that location.

Those plants in the lower three rows displaying plantlets were not harvested with the rest of the field. Each plant was marked with an orange flag on the south side of the plant. Observations will be made to determine whether these same plants have a tendency for vegetative reproduction. No vegetative proliferation was detected in any of the marked plants in 2005. In 2004, the inflorescence from viviparous plants was harvested separately from the rest of the planting. 100 plantlets were planted in a tray of 98 Ray Leach conetainers. The tray was placed in the lath house and watered regularly. By fall, only 3 plants had developed from the plantlets. The tray was left in the lath house over winter for further observation. No further germination of plantlets occurred in 2005. Plants developing from these plantlets will be outplanted for observation. Plantlets are much larger than normal seed and relatively easy to remove with seed cleaning equipment.

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Marchand, L.S. and A. McLean. 1965. Observations on Vegetative Proliferation in *Agropyron spicatum*. Canadian Journal of Botany 43:1533-1537.

USDA, Natural Resources Conservation Service. 2004. 2002-2003 Annual Technical Report, Bridger, Montana Plant Materials Center. Vol 1: Herbaceous. p. 36.

Wycherley, P.R. 1953. The Distribution of Viviparous Grasses in Great Britain. Journal of Ecology 41:275-288.

Field Q4 Increase Planting
Palouse Prairie Restoration 1998

N ↑

4 SIOR, 21 HECY, 5 POAR, 1 POGR, 2 PEDE, 5 GEVI, 21 ASOC, (cont below)

2 POGR, 31 POGR, 22 POAR, 30 SOMI, 42 BASA, 44 WYAM, 16 FEID?

98 9033816, 44 AGGR, 6 HECY, 49 LUSE

90 ELGL, 29 ACMI, 21 BERU, 11 LUSE, 8 SIOR, 14 ASOC, 16 GETR

94 ELGL, 51 FEID, 13 GETR, 23 HALI, 14 GAAR

137 BB, 13 KOMA, 27 GAAR, 10 GABO, 7 PEDE

142 POSE, 8 EPAN, 18 HEUN, 10 HIAL, 6 GEVI, 2 Silene, 1 Arnica?, 4 FEID?

Continuation of first row: 8 HALI, 1 EPAN, 2 HIAL, 1 HECY, 1 GETR, 5 GEAF, 1 IRMI

Rows are 6 ft apart. Plants 1 ft apart within row. Plot is immediately south of seeding plots made in 1998. Number before species represents number of plants transplanted.

2000 Increase Plantings. Planting is an extension to the east of 1998 increase block above. Northernmost 2 rows extend into 1998 block.

26PEAT, 2 HIAL, 18 GEAF

33 DENU, 7 CLHI, 6 HECY, 29 SEIN

8 HECY, 42 GABO

7 CIBR, 43 GABO

11 LIRU, 37 GETR

2 VAED, 3 CRAT, 21 HEUN, 10 ARSO, 4 CALU

6 HELA, 42 LUSE

9033816 = *Poa secunda (P. ampla*)
ACMI = *Achillea millefolium*
Arnica? = seed identified as *Arnica* sp., but is *Helianthella uniflora*
ARSO = *Arnica sororia*
ASOC = *Aster occidentalis*
BASA = *Balsamorhiza sagittata*
BB = *Pseudoroegneria spicata ssp inerme*
BERU = *Besseya rubra*
AGGR = *Agoseris grandiflora*
CALU = *Castilleja lutescens*
CIBR = *Cirsium brevifolium*
CLHI = *Clematis hirsutissima*
CRAT = *Crepis atrabarba*
DENU = *Delphinium nuttallianum*
ELGL = *Elymus glaucus*
EPAN = *Epilobium angustifolia*
FEID = *Festuca idahoensis*
FEID? = seed identified as *Festuca idahoensis*, but appears to be bluegrass
GAAR = *Gaillardia aristata*
GABO = *Galium boreale*
GEAF = *Gentiana affinis*
GETR = *Geum triflorum*
GEVI = *Geranium viscosissimum*
HALI = *Haplopappus liatriformis*

HECY = *Heuchera cylindrica*
HEUN = *Helianthella uniflora*
HIAL = *Hieracium albertinum*
IRMI = *Iris missouriensis*
KOMA = *Koeleria macrantha*
LIPE = *Linum perenne*
LIRU = *Lithospermum ruderale*
LUSE = *Lupinus sericeus*
PEAT = *Penstemon attenuatus*
POAR = *Potentilla arguta.*
POGR = *Potentilla gracilis*. Few of these are *P. gracilis*. Most are *P. arguta.*
POSE = *Poa secunda*. Blend of 9033830, 9033869, and 9033877
SIOR = *Sidalcea oregana*
SEIN = *Senecio integerrimus*
SOMI = *Solidago missouriensis*
VAED = *Valeriana edulis*
WYAM = *Wyethia amplexicaulis*

Field Q6 Increase Planting:

<table>
<tr><th>78 feet</th><th>24 feet</th><th>112 feet</th></tr>
<tr><td rowspan="2">SYN-1 Drought Tolerant
Alfalfa Seed Increase
36” rows</td><td rowspan="2">Durar

border</td><td>PPR Idaho fescue seed Increase 36” rows
from transplants in 2003</td></tr>
<tr><td>PPR Bluebunch wheatgrass Seed Increase
36” rows in 2001
from seed lot PPR00-1</td></tr>
</table>

Alfalfa rows are 66 feet long with 6 foot clean tilled border around the planting. Idaho fescue and Beardless bluebunch rows are 100 feet long with 6 foot clean tilled border around the planting.

→ NE

Initial Seed Increase Planting Field G3: Palouse Prairie 2004 ↑ **NE**

80 *Deschampsia caespitosa*						**/ 44 *Dodecatheon pulchellum***	
17 *D. caespitosa* /	**64 *Thermopsis montana***					**/ 21 *Astragalus arrectus***	
95 *Penstemon deustus*				**/10 *E. heracleoides***	**/8 *P. deustus***	**/8 *H. uniflora***	
10 *P. deustus* /	**26 *P. speciosa***	**/ 6 *E. heracleoides* /**		**40 *P. heterophylla***		**/ 9 *E. heracleoides***	**ROAD**
28 *Penstemon deustus*/			**73 *Phacelia heterophylla***				
		Festuca idahoensis					
Festuca idahoensis				**/3 *Valeriana edulis***	**/19 *L. triternatum***	**/7 *G. viscosissimum***	
7 *L. dissectum*/	**10 *Castilleja lutescens*/**		**35 *Hieracium albertinum***		**/47 *Geranium viscosissimum***		
42 *Lomatium triternatum*			**/30 *Sidalcea oregana***		**/25 *Phlox speciosa***		
13 *Linum lewisii* /			**90 *Iris missouriensis***				
	58 *Linum lewisii*			**/ 34 *Perideridia gairdneri***		**/ OPEN**	

D. pulchellum and *P. gairdneri* planted 11/8/04. *D. pulchellum* on 6" spacing.

Initial Seed Increase Planting Field G3: Palouse Prairie 2005 ↑ **NE**

	80 ***Deschampsia caespitosa***					**/ 44** ***Dodecatheon pulchellum***	
17 ***D. caespitosa /***		**64** ***Thermopsis montana***				**/ 21** ***Astragalus arrectus***	
	95 ***Penstemon deustus***			**/ 10** ***E. heracleoides***	**/ 8** ***P. deustus***	**/ 8** ***H. uniflora***	
10 ***P. deustus /***	**26** ***P. speciosa***	**/ 6** ***E. heracleoides /***		**40** ***P. heterophylla***		**/ 9** ***E. heracleoides***	**ROAD**
	28 ***Penstemon deustus/***		**73** ***Phacelia heterophylla***				
		Festuca idahoensis					
Festuca idahoensis				**/3** ***Valeriana edulis*** **/ 19** ***L. triternatum*** **/ 7** ***G. viscosissimum***			
7 ***L. dissectum/*** **10** ***Castilleja lutescens/***			**35** ***Hieracium albertinum***		**/47** ***Geranium viscosissimum***		
	42 ***Lomatium triternatum***		**/30** ***Sidalcea oregana***		**/25** ***Phlox speciosa***		
13 ***Linum lewisii /***			**90** ***Iris missouriensis***				
10 ***Cirsium brevifolium*** **(05) /** **47** ***Microseris nutans*** **(05)**				**/ 34** ***Perideridia gairdneri***		***/Brodiaea douglasii***	

B. douglasii planted fall 2005 from corms salvaged from SR 270 ROW in field 1A.

Seed Yields: Palouse Prairie Seed Increase
all weights in grams unless otherwise noted

species	2004	2005
Achillea millefolium	20.7	141.1
Agoseris grandiflora	0.0	0.0
Agoseris heterophylla		3.1
Allium acuminatum	2.3	0.0
Arabis sp.	0.0	0.0
Arnica sororia	23.1	11.4
Aster jessicae	0.0	0.0
Aster occidentalis	120.7	7.4
Balsamorhiza sagittata	4.7	0.6
Besseya rubra	3.3	16.2
Clarkia pulchella	98.7	75.2
Cirsium brevifolium	0.0	5.0
Clematis hirsutissima	0.9	0.0
Collinsia parviflora	28.5	17.2
Collomia grandiflora	720.2	172.5
Delphinium nuttallianum	0.0	0.1
Deschampsia caespitosa		371.7
Deschampsia elongata		32.6
Elymus glaucus	4.1 lbs	3.0 lbs
Epilobium angustifolium	?	0.5
Eriogonum heracleoides	17.4	56.6
Festuca idahoensis	1180.4	7082.4
Gaillardia aristata	74.0	154.5
Galium boreale	214.0	0.0
Gentiana affinis	19.4	10.0
Geranium viscosissimum	66.9	9.2
Geum triflorum	62.1	32.3
Gilia aggregata	63.4	12.9
Haplopappus liatriformis	44.0	20.5
Helianthella uniflora	135.4	215.0
Heracleum lanatum	296.0	152.3
Heuchera cylindrica	140.5	43.0
Hieracium albertinum	32.6	34.3
Iris missouriensis	22.6	336.8
Koeleria macrantha	35.1	0.0
Linum lewisii	0.0	0.0
Lithophragma parviflora	0.4	0.0
Lomatium triternatum	410.1	691.6
Lupinus leucophyllus	38.9	0.0
Lupinus sericeus	52.3	0.0
Microseris nutans	5.6	0.5
Microsteris gracilis	0.0	0.0

Seed Yields: Palouse Prairie Seed Increase (continued)
all weights in grams unless otherwise noted

species	**2004**	**2005**
Penstemon confertus	30.5	1.2
Penstemon deustus	531.0	2039.2
Perideridia gairdneri		21.8
Phacelia heterophylla	146.6	23.6
Phlox speciosa	0.3	2.0
Poa secunda	66.1	45.0
Poa secunda (*P. ampla*)	160.0	168.8
Polygonum douglasii		0.5
Potentilla arguta	416.7	25.4
Potentilla gracilis	193.0	419.4
Pseudoroegneria spicata	3.3 lbs	7.5 lbs
Senecio integerrimus	2.7	3.0
Sidalcea oregana	55.0	11.0
Silene douglasii	1.2	1.8
Silene spaldingii		0.1
Solidago missouriensis	187.0	25.2
Thermopsis montana		88.2
Wyethia amplexicaulis	452.0	239.1

Collections, Palouse Prairie Seed Increase

all weights in grams unless otherwise noted

species	2004	2005
Agoseris heterophylla	0.6	
Antennaria luzuloides	0.3	
Arenaria congesta	0.7	
Brodiaea douglasii	0.5	2.5
Castilleja lutescens	0.2	
Clematis hirsutissima	1.2	
Crepis atrabarba		0.6
Eriophyllum lanatum		4.0
Erythronium grandiflorum	4.2	
Frasera albicaulis	0.7	
Gaillardia aristata		2.2
Haplopappus carthamoides	0.8	
Helianthella uniflora		0.1
Heracleum lanatum		1861.0
Hydrophyllum capitatum		0.2
Iris missouriensis		18.4
Linum lewisii		0.9
Lithospermum ruderale		6.4
Lomatium dissectum	103.4	684.5
Lomatium gormanii		0.7
Lomatium grayi	16.5	44.3
Lupinus sericeus	8.1	
Montia perfoliata	18.7	
Montia rubra	0.2	
Orthocarpus tenuifolius	1.0	0.9
Penstemon attenuatus	1.5	0.0
Polygonum douglasii	1.8	
Potentilla gracilis		1.2
Ranunculus glaberrimus	few	
Rosa woodsii		26.5
Sanguisorba occidentalis		4.9
Wyethia amplexicaulis		166.7
Zigadenus venenosus	1.5	

Seed Cleaning of Palouse Prairie Species: small amounts

Species	Rub board problems	coarse screen	fine screen	Oregon Blower	notes
Achillea millefolium	not used	4/64		6-7	
Agoseris grandiflora	pappus			12	
Allium acuminatum	none	5/64		15-19	
Arabis spp.	not used			7	
Arnica sororia	pappus		10 mesh	10	
Aster jessicae	pappus		10 mesh	10	4)
Aster occidentalis	pappus			6	4)
Balsamorhiza sagittata	none	12/64		12	
Besseya rubra	none	10 mesh	20 mesh	11	
Camassia quamash	none	12/64	20 mesh	10	
Castilleja lutescens	none	10 mesh	20 mesh	10	1)
Clarkia pulchella	none	20 mesh		8	
Clematis hirsutissima	style			11	
Collinsia parviflora	none	5/64	1/16	16	
Collomia grandiflora	none			16	
Crepis atrabarba	none			13	
Delphinium nuttallianum	not used	1/18		6	
Elymus glaucus	awns			10-12	
Epilobium angustifolium	down				
Festuca idahoensis	none	4/64		6-7	
Fritillaria pudica	not used				
Gaillardia aristata	pappus			8	2)
Galium boreale	none			10	
Gentiana affinis	none	1/22		3-5	
Geranium viscosissimum	none			25-30	
Geum triflorum	style			8	
Haplopappus carthamoides	none				
Haplopappus liatriformis	pappus			12	4)
Helianthella uniflora	none	14/64	8/64	8-10	
Heuchera cylindrica	none	20 mesh		6	
Hieracium albertinum	none			10	
Hydrophyllum capitatum	none			25	
Iris missouriensis	not used			35	
Koeleria macrantha	none			4-5	
Linum lewisii	none			10	

Seed Cleaning of Palouse Prairie Species: small amounts (continued)

Species	Rub board problems	coarse screen	fine screen	Oregon Blower	
Lithophragma parviflora	none	40 mesh	50 mesh		
Lithospermum ruderale	none			23	
Lomatium dissectum	none	14/64	5/64	11	
Lomatium grayi				8	
Lomatium triternatum	none	5/64		7-8	
Lupinus leucophyllus	not used			35	
Microsteris gracilis	not used	5/64		11	
Mimulus guttatus	not used			4	
Penstemon attenuatus	not used	20 mesh	30 mesh	9	
Perideridia gairdneri	none	8/64		12	
Phlox speciosa	not used	8/64		18	
Potentilla arguta	not used			5	
Potentilla gracilis	not used			6	
Prunella vulgaris	none	10 mesh	30 mesh	no record	
Pseudoroegneria spicata	none	12/64		10-11	
Senecio integerrimus	none	5/64		12	
Sidalcea oregana	none	8/64	5/64	15	
Silene sp.	none	5/64		9-11	
Sisyrinchium inflatum	none	8/64		15	
Solidago missouriensis	pappus			5	3)
Spiraea betulifolia	not used	4/64	30 mesh	6	
Valeriana edulis	use lightly			15	
Wyethia amplexicaulis	none			11-13	

Seed Cleaning of Palouse Prairie Species: Air screen equipment

Species	harvest method	hammermill screen	scalp top	scalp bottom	wind	clean top	clean bottom	clean wind	runs	notes
Achillea millefolium	heads	9/64	1/16	blank	1 w/ tape	1/21	blank	1 w/ tape	1	1)
Agoseris grandiflora	heads	6/64	1/20x1/2	blank	1	3/4x5/16	6-30	2	2	2)
Allium acuminatum	heads	9/64	Oregon Blower only							
Arabis sp.	plants	not used				1/18	blank	1 w/ tape		OB #7 final
Aster jessicae	vacuum	6/64	7	blank	1 w/ tape	1/12	blank	1		
Aster occidentalis	vacuum	6/64 w/hulls				1/16	blank		1	
Clarkia pulchella	plants	9/64	1/14	blank	1	1/22	blank	1	1	
Clematis hirsutissima	heads	not cleaned								
Collinsia parviflora	plants	6/64	not cleaned							
Collomia grandiflora	plants	not used				7	1/16	2.5	1	3)
Elymus glaucus	plants	9/64				10	1/18	both open	1	M2B
Epilobium angustifolium	not harvested									
Festuca idahoensis	plants	6/64				8	blank	top open	2	M2B
Gaillardia aristata	vacuum	9/64				12	1/20	1		4)
Galium boreale	heads	6/64	1/12	blank		1/13	blank	1	2	
Geranium viscosissimum	plants	1/4	12	blank	2	8	blank	3.5	2	OB 30 (3)
Geum triflorum	heads	9/64 w/hulls	7	blank	1	1/12	blank	1		
Haplopappus liatriformis	vacuum	6/64	8	blank	1	3/64x5/16	1/16	2.5		OB 15
Heuchera cylindrica	heads	6/64	1/20	blank	1 w/tape	1/25	blank	1 w/tape		5)
Hieracium albertinum	plants	6/64	1/16x1/4	blank	1	6x20	blank	1		6)
Koeleria macrantha	plants	12/64	3/64x5/16	blank	1 w/tape	3/64x5/16	blank	1	3	7)
Lupinus leucophyllus	heads	1/4	15	blank	3	13	1/14	3.5		OB 35 (8)
Microsteris gracilis	plants	6/64								9)
Penstemon attenuatus	heads	6/64	1/18	blank	1 w/tape	1/24	blank	1 w/tape	2	
Poa secunda	plants	6/64	7	blank	1	1/14	blank	1		
Potentilla arguta	plants	1/4	1/14	blank	1 w/tape	1/25	blank	1 w/tape	3	10)
Potentilla gracilis	plants	6/64	1/18	blank	1 w/tape	1/21	blank	1 w/tape		
Pseudoroegneria spicata	plants	9/64				12	1/24	both open	2	M2B
Sidalcea oregana	heads	12/64	8	1/20	2	7	1/20	2.5		
Solidago missouriensis	heads	6/64	1/18	blank	1 w/tape	1/24	blank	1	2	

Seed Collections 1997-2005

Achillea millefolium
Agastache urticifolia
Agoseris heterophylla
Agoseris grandiflora
Allium acuminatum
Antennaria luzuloides
Arenaria congesta
Arnica sororia
Asclepias speciosa
Aster jessicae
Aster occidentalis
Astragalus arrectus
Balsamorhiza sagittata
Besseya rubra
Brodiaea douglasii
Camassia quamash
Carex microptera
Castilleja lutescens
Cirsium brevifolium
Clarkia pulchella
Clematis hirsutissima
Collinsia parviflora
Collomia grandiflora
Delphinium nuttallianum
Deschampsia caespitosa
Deschampsia elongata
Dodecatheon pulchellum
Elymus glaucus
Epilobium angustifolium
Erigeron corymbosus
Eriogonum heracleoides
Eriophyllum lanatum
Erythronium grandiflora
Festuca idahoensis
Frasera albicaulis
Fritillaria pudica
Gaillardia aristata
Galium boreale
Gentiana affinis
Geranium viscosissimum
Geum macrophyllum
Geum triflorum
Gilia aggregata
Haplopappus carthamoides
Haplopappus liatriformis
Helianthella uniflora
Heracleum lanatum
Heuchera cylindrica
Hieracium albertinum
Hydrophyllum capitatum
Hydrophyllum fendleri
Iris missouriensis
Koeleria macrantha
Leymus cinereus
Linum lewisii
Lithophragma parviflora
Lithospermum ruderale
Lomatium dissectum
Lomatium gormanii
Lomatium grayi
Lomatium macrocarpum
Lomatium triternatum
Lupinus leucophyllus
Lupinus sericeus
Microseris nutans
Microsteris gracilis
Montia perfoliata
Orthocarpus tenuifolius
Penstemon attenuatus
Penstemon confertus
Penstemon deustus
Perideridia gairdneri
Phacelia heterophylla
Phlox speciosa
Poa secunda (Big bluegrass)
Poa secunda (Sandberg bluegrass)
Polygonum douglasii
Potentilla arguta
Potentilla gracilis
Pseudoroegneria spicata ssp. *inermis*
Ranunculus glaberrimus
Rosa woodsii
Sanguisorba occidentalis
Senecio integerrimus
Senecio serra
Sidalcea oregana
Silene douglasii

Seed Collections 1997-2005
(continued)
Silene spaldingii
Sisyrinchium inflatum
Solidago missouriensis
Spiraea betulifolia
Valeriana edulis
Wyethia amplexicaulis
Zigadenus venenosus

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

STUDY NUMBER:: WAPMC-T-9909-RA. Palouse Prairie Grass Establishment (2-98B).

PROJECT NUMBER:

STUDY TYPE: Prairie Restoration.

LAND USES:

VEGETATIVE PRACTICES: PRIMARY:
SECONDARY:

DESCRIPTION: Using early seral grasses in a mix with late seral or climax grass species may aid in the establishment of a prairie restoration planting. Beardless bluebunch wheatgrass, *Pseudoroegneria spicata* ssp *inermis* and Idaho fescue, *Festuca idahoensis* are the late seral grasses typical of most habitat types of the Palouse Prairie. Mountain bromegrass, *Bromus carinatus*, Sandberg bluegrass, *Poa secunda*, Prairie junegrass, *Koeleria macrantha* and Blue wildrye, *Elymus glaucus* are all minor components of the prairie. These minor components may serve to aid establishment of the late seral grasses by occupying gaps until the slower developing late seral species can establish themselves.. A permanent belt transect will be established in each plot and data on species distribution collected along that transect.
The objective is to determine if inclusion of early seral species will aid in establishment of a stable late seral grass community.

DURATION OF STUDY:

STUDY LEADER: Dave Skinner

LOCATION:

COOPERATORS:

EXPERIMENTAL DESIGN: Randomized Complete Block

PROCEDURE: Five mixes of perennial prairie grasses, with three replications, 12 ft. X 50 ft. per replication, will be seeded using a Hege 1000 plot drill. Whitmar, *Pseudoroegneria spicata ssp inerme*, and Joseph, *Festuca idahoensis*, will be seeded in all plots.

Treatments are;

Whitmar and Joseph alone,
Whitmar and Joseph with *Elymus glaucus*,
Whitmar and Joseph with *Poa secunda*,
Whitmar and Joseph with Bromar, *Bromus carinatus*,
Whitmar and Joseph with *Koeleria macrantha*.

Observations will be taken on plant survival, species composition, plant cover, seed head production; weed competition and plant vigor.

PROGRESS: Five mixes of perennial prairie grasses, with three replications, 12 ft. X 50 ft. per replication, were seeded on April 23, 1998 using a Hege 1000 plot drill.
See "Palouse Prairie Mixture Seedings" for layout. Seed of *Koeleria macrantha* was not available on April 23, and those plots were seeded on May 6, 1998. Drill problems on plots 101, 202, 301 and 302 resulted in only half the plot being seeded initially and these plots were also reseeded on May 6. Plots were mowed and sprayed as needed throughout the summer.

A single permanent 10 foot by 1 foot belt transect was established in each mixture plot and plant counts were collected on 6/28/99. Competition from Prickly lettuce, *Lactuca serriola*, was severe. In order to reduce the competition, plots were sprayed with MCPA in May and mowed after the grasses had set seed.

The same data from the same belt transect was collected in 2000. See "**Plant Counts**" below for data. Photos of each plot were taken. The plots were sprayed with MCPA in April, 2000. They were not mowed.
Concern developed about the aggressive reseeding of Bromar. It has invaded the west end of all the 100 series plots and numerous seedlings were noted in all plots where Bromar was planted. It was included in the study because it is a short-lived species, but it may dominate a site through its abundant reseeding capabilities. Head smut, *Ustilago bullata*, has largely been eliminated by the use of seed treatments, but may be a biological factor in limiting the aggressiveness of Mountain bromegrass in restoration planting.

The winter of 2000-2001 was characterized by a near record duration of snow cover. Snow fell in early November and remained on the ground well into February. This contributed to abnormally high rodent activity under the snowpack. Coupled with the thick mat of vegetative material from the season's growth, Meadow voles were particularly active. They caused serious damage to the planting, leaving many voids. The voids were filled by weeds, primarily Prickly lettuce, *Lactuca serriola*. Time constraints prevented spraying the plots while the weeds were at a susceptible stage. No data was collected on the planting during the 2001 season. The planting recovered sufficiently through the growing season that it is expected to provide meaningful data in the future. The plots were mowed after the grasses produced seed to reduce weed seed production. Mowing may reduce rodent predation in stands where the grasses produce considerable

biomass in the form of reproductive tillers. Rodent activity was not as severe in the planting surrounding the plots, which was mowed in late summer of 2001.
Plant counts were taken along the permanent belt transects in 2002 and 2003. See table **Plant Counts** below for data. In 2003, estimates of percent cover for each species present in a plot were made visually. See table **Grass plots: Species coverage 2003** below for data. Bromar Mountain brome has invaded the west end of the 100 series plots and nearly eliminated the seeded species. The coverage numbers for those plots was split between the portion containing Bromar and the portion not affected by Bromar as of yet. Suppression of the seeded species by Bromar, either where it was seeded or has invaded, is quite obvious visually and from the coverage data. It is not as apparent in the plant count data because that data simply notes the presence of the species and not its condition. Also, none of the transects are located in the area being invaded. Sandberg bluegrass, *Poa secunda*, was not present in any transect after 2000.

Plant counts were taken along the permanent belt transects in 2004. See table **Plant Counts** below for data. In 2004, estimates of percent cover for each species present in a plot were made visually. See table **Grass plots: Species coverage 2004** below for data. The summer of 2003 was marked by a prolonged dry period which may have impacted the planting in 2004. The number of plants in most transects declined significantly, but that was not reflected in coverage estimates for the two major species, Bluebunch wheatgrass, *Pseudoroegneria spicata*, and Idaho fescue, *Festuca idahoensis*, as well as Mountain brome, *Bromus marginatus*. *Koeleria macrantha* was not found in any plots. *Tragopogon dubius* was a minor constituent of most plots in 2004, but *Sisyrinchium altissimum* replaced it as a serious weed competitor. The coverage estimates for *S. altissimum* are included with the seeded species in the column marked "SIAL." No herbicides were applied to the plots in 2004. They were mowed on September 14, 2004.

Plant counts were taken along the permanent belt transects in 2005. See table **Plant Counts** below for data. Due to time constraints, data was not taken until 9/2/05 and it was not possible to make accurate percent cover estimates due to the senescence of most species by that time. Thus, no coverage data is available for 2005. It was noted, however, that *Ventenata dubia, Apera interrupta, Vulpia myuros,* and *Tragopogon dubius* were common in all plots. *Sisymbrium altissimum* and *Lactuca serriola* were common in some plots but not others. Small amounts of *Poa pratensis* were found in plots 101, 102, and 202 where none had been noticed in the past. *Bromus marginatus* is no longer the dominant species in the planting, but the numbers of other seeded species are generally much lower in the plots where it was seeded, suggesting that it crowded the other species out or prevented their establishment. However, the check plots, where 'Whitmar' and *Festuca idahoensis* were seeded alone, has lower numbers of both species than most other plots except the *Bromus marginatus* plots. *Koeleria macrantha* and *Poa secunda* have disappeared from the planting. The *Koeleria macrantha* was purchased as "eastern Washington origin" seed, but the true source of the seed is not known. "Origin" on the seed label refers only to where the seed was grown, not the original source of the ecotype. It may have been a diploid ecotype. Diploid *K. macrantha* is not well adapted to low elevations in the western US (Robertson 1974). *Poa secunda* is very short statured and

probably could not compete with the taller species, although it might still be present but escaped notice due to its habit of senescing early coupled with the late dates of evaluation. *Elymus glaucus* is still present in all plots in which it was seeded.
GPS locations of both points on the belt transects are show in the table "**Grass Plots:** GPS locations of belt transects" below. Since some of the waypoints have the same value as other waypoints for different transects, they should not be relied upon for accurate locations. A piece of rebar is driven in the ground at the exact location of each end of the transect and that should be relied upon for exact locations.

No data was collected from this study in 2006.

References cited:

Robertson, Philip A. 1974. Morphological Variation and Chromosome Numbers of North American Populations of *Koeleria cristata*. Bulletin of the Torrey Botanical Club 101:124-129.

Palouse Prairie Mixture seeding plots.

1998

↑N

101 w/ ELGL	205 w/ KOMA	301 w/ ELGL
Alone 102	w/ Bromar 204	w/ Bromar 304
103 w/ Sandberg	203 w/ Sandberg	303 w/ Sandberg
104 w/ Bromar	202 Alone	305 w/ KOMA
w/ KOMA 105	w/ ELGL 201	Alone 302

Plots are 12 x 50 ft. Seeded w/ Hege planter on 8 inch spacing. This plot lies immediately east of plots seeded 1997. All plots contain Whitmar Bluebunch wheatgrass and Joseph Idaho fescue.

Plant Counts: grass mixture plots in field Q4 1999-2005**.**

plot	99 Whit	00 Whit	02 Whit	03 Whit	04 Whit	05 Whit	99 feid	00 feid	02 feid	03 feid	04 feid	05 feid	99 other	00 other	02 other	03 other	04 other	05 other	
101	12	16	18	8	7	6	10	24	4	8	5	13	3	3	2	8	11	4	*Elymus glaucus*
102	16	10	13	15	5	0	10	17	3	8	3	4	0	0	0	0	0	0	check
103	9	10	24	21	4	8	11	9	4	5	4	6	9	5	0	0	0	0	*Poa secunda*
104	8	4	5	13	3	2	1	1	2	1	1	0	10	13	11	12	2	0	*Bromus marginatus*
105	10	9	13	17	3	5	13	11	4	8	2	1	4	2	1	0	0	0	*Koeleria macrantha*
201	12	10	13	8	1	5	19	10	10	17	15	5	2	5	10	7	3	4	*Elymus glaucus*
202	12	7	2	6	4	1	12	10	3	11	5	3	0	0	0	0	0	0	check
203	14	8	15	13	6	10	8	5	3	14	6	6	7	4	0	0	0	0	*Poa secunda*
204	8	7	5	6	4	1	9	12	4	8	4	0	12	6	17	20	8	2	*Bromus marginatus*
205	9	12	9	19	3	5	8	7	6	9	7	7	3	1	0	0	0	0	*Koeleria macrantha*
301	7	7	9	10	6	10	15	7	10	12	5	0	3	5	8	14	4	3	*Elymus glaucus*
302	14	10	14	9	5	7	14	12	10	11	7	4	0	0	0	0	0	0	check
303	7	11	10	14	8	11	8	7	5	4	3	3	2	3	0	0	0	0	*Poa secunda*
304	7	7	3	14	8	4	9	10	7	5	6	4	5	6	20	6	2	0	*Bromus marginatus*
305	10	11	13	20	5	9	13	12	7	13	7	1	4	7	1	0	0	0	*Koeleria macrantha*

104 2000 contains many Bromar seedlings
204 2000 contains many Bromar seedlings
304 2000 contains many Bromar seedlings
205 2000 contains Whitmar seedlings
305 2000 some are new KOMA seedlings
101 2002 has 2 Bromar
102 2002 has 1 Bromar

104 2002 has numerous Bromar seedlings
105 2002 has 3 Bromar
205 2002 has 1 ELGL
203 2002 has 8 Bromar
202 2002 is dominated by *Sisymbrium altissimum* and *Descurainia sophia*
301 2003 Whitmar and Bromar are mostly small plants probably 1 year old
101, 102, 202, 2005 have Poa pratensis present in plot

Grass plots: Species coverage 2003 rep 1

plot	PSSP	FEID	other	BRMA	TRDU
105	5/50	5	0 KOMA	50/+	40
104	< 5	< 5		60	10
103	0/35	< 5	0 POSE	40/+	10
102	+/30	5	check	30/+	10
101	0/50	12	5 ELGL	35/0	< 5

other species present

105 *Descurainia sophia, Sisymbrium altissimum, Galium aparine, Vulpia myuros*

104 *D. sophia, S. altissimum, G. aparine, V. myuros, Lactuca serriola, Amsinckia* sp.

103 *D. sophia, S. altissimum, G. aparine, V. myuros, L. serriola, Amsinckia* spp.

102 *S. altissimum, G. aparine, L. serriola, Amsinckia* sp. *Ventenata dubia, Agropyron repens, Cirsium arvense*

101 *S. altissimum, L. serriola, Amsinckia* sp., *Cirsium arvense, V. myuros*

plot 105 BRMA invaded west half. Split numbers reflect W/E portion of plot

plot 103 BRMA invaded 15 feet of west end. Split numbers reflect W/E portions of plot

plot 102 same as 103

plot 101 BRMA invaded west 10 feet. Split numbers reflect W/E portions of plot

Other species without percent signs are present at < 1% cover.

TRDU = *Tragopogon dubius*

Grass plots: Species coverage 2003 rep 2

plot	PSSP	FEID	other	BRMA	TRDU
201	35	25	5 ELGL	0	25
202	10	20	check	< 5	20
203	40	15	0 POSE	< 5	35
204	10	5	30 BRMA		5
205	60	20	1 KOMA	<5	5

other species present

201 *V. dubia, D. sophia, L. serriola, V. myuros. Bromus tectorum*

202 *D. sophia, S. altissimum, Amsinckia* spp., *V. dubia, L. serriola, B. tectorum*

203 *C. arvense, V. myuros, D. sophia, L. serriola, B. tectorum, G. aparine, S. altissimum*

204 *C. arvense, V. myuros, L. serriola, B. tectorum, G. aparine, S. altissimum, Verbascum thapsus, V. dubia, Amsinckia* sp.

205 *C. arvense, V. dubia, V. myuros, L. serriola, G. aparine, Epilobium paniculatum*

Other species without percent signs are present at < 1% cover.
TRDU = *Tragopogon dubius*

Grass plots: Species coverage 2003 rep 3

plot	PSSP	FEID	other	BRMA	TRDU
301	30	20	40 ELGL	< 5	5
304	10	7	25 BRMA		15
303	70	25	0	< 5	20
305	75	30	KOMA1	0	10
302	75	25	check	0	10

other species present

301 *V. dubia* 15%, *V, myuros, L. serriola, G. aparine*

304 *V. myuros* 5%, *C. arvense, G. aparine, V. dubia, V. thapsus, S. altissimum, D. sophia*

303 *B. tectorum, S. altissimum, V. myuros, L. serriola, G. aparine*

305 *V. dubia* 1%, *V. myuros, L. serriola, B. tectorum, G. aparine*

302 *D. sophia, S. altissimum, Amsinckia* sp., *V. myuros, L. serriola, Agoseris grandiflora, B. tectorum, Achillea millefolium, V. dubia, G. aparine*

Other species without percent signs are present at < 1% cover.
TRDU = *Tragopogon dubius*

Grass plots: Species coverage 2004 rep 1

plot	PSSP	FEID	other	BRMA	SIAL
105	20/50	0/20	0 KOMA	20/0	40
104	40	10	BRMA	50	30
103	30/60	10	0 POSE	20/0	30
102	40	30	check	10/0	5
101	30	20	20 ELGL	0	20

other species present

105 *Lactuca serriola* 30%, *Tragopogon dubius* 5%, *Descurainia sophia*, *Epilobium paniculatum*, *Bromus tectorum*, *Amsinckia menziesii*, *Galium aparine*

104 *Lactuca serriola* 10%, *Vulpia myuros* 10%, *Galium aparine* 5%, *Tragopogon dubius*, *Epilobium paniculatum*, *Cirsium arvense*

103 *Lactuca serriola* 15%, *Tragopogon dubius* 5%, *Vulpia myuros* 5%, *Ventenata dubia* 5%, *Epilobium paniculatum*

102 *Lactuca serriola* 10%, *Vulpia myuros* 10%, *Tragopogon dubius* 5%, *Galium aparine* 5%, *Ventenata dubia* 5%, *Epilobium paniculatum*

101 *Lactuca serriola* 10%, *Ventenata dubia* 5%, *Vulpia myuros*, *Cirsium arvense*

plot 105 BRMA invaded west half. Split numbers reflect W/E portion of plot.
plot 103 BRMA invaded 15 feet of west end. Split numbers reflect W/E portions of plot.
plot 102 same as 103.
plot 101 BRMA invaded west 10 feet. Split numbers reflect W/E portions of plot.
Other species without percent signs are present at < 1% cover.
SIAL = *Sisymbrium altissimum.*

Grass plots: Species coverage 2004 rep 2

plot	PSSP	FEID	other	BRMA	SIAL
201	40	20	5 ELGL	<5	10
202	20	10	check	0	50
203	30	20	0 POSE	0	20
204	30	10	BRMA	5	40
205	50	40	0 KOMA	0	5

other species present

201 *Lactuca serriola* 5%, *Tragopogon dubius* 5%, *Lupinus leucophyllus*, *Epilobium paniculatum*, *Galium aparine*, *Descurainia sophia*, *Vulpia myuros*

202 *Lactuca serriola* 20%, *Vulpia myuros* 5%, *Bromus tectorum* 5%, *Tragopogon dubius*

203 *Lactuca serriola* 15%, *Vulpia myuros* 10%, *Descurainia sophia* 5%, *T. dubius* 5%, *Epilobium paniculatum*, *Bromus tectorum*, *Cirsium arvense*

204 *Vulpia myuros* 10%, *Lactuca serriola* 5%, *Ventenata dubia* 5%, *Tragopogon dubius*, *Elymus glaucus*

205 *Lactuca serriola* 10%, *Ventenata dubia* 5%, *Vulpia myuros*, *Cirsium arvense*, *Epilobium paniculatum*

Other species without percent signs are present at < 1% cover.
SIAL = *Sisymbrium altissimum*

Grass plots: Species coverage 2004 rep 3

plot	PSSP	FEID	other	BRMA	SIAL
301	30	10	20 ELGL	0	0
304	30	20	BRMA	10	5
303	50	20	0 POSE	0	0
305	60	15	0 KOMA	0	0
302	60	20	check	0	0

	other species present
301	*Ventenata dubia* 30%, *Vulpia myuros* 10%, *Lactuca serriola* 5%, *Tragopogon dubius* 5%, *Epilobium paniculatum*
304	*Ventenata dubia* 10%, *Vulpia myuros* 10%, *Lactuca serriola* 10 %, *Tragopogon dubius* 5%, *Epilobium paniculatum*
303	*Lactuca serriola* 10%, *Tragopogon dubius* 5%, *Ventenata dubia* 5%, *Epilobium paniculatum, Galium aparine, Vulpia myuros*
305	*Lactuca serriola* 5%, *Tragopogon dubius* 5%, *Ventenata dubia* 5%, *Bromus tectorum, Epilobium paniculatum, Vulpia myuros, Cirsium arvense*
302	*Ventenata dubia* 10%, *L. serriola* 5%, *T. dubius* 5%, *Descurainia sophia, Agoseris grandiflora, Achillea millefolium, Lupinus leucophyllus, E. paniculatum*

Other species without percent signs are present at < 1% cover.

SIAL = *Sisymbrium altissimum*

Grass Plots: GPS locations of outside trial corners, field Q4

SE	N46.72722	W117.13370	2568	southeast corner of trials
NE	N46.72736	W117.13360	2574	northeast corner of trials
NW	N46.72751	W117.13416	2563	northwest corner of trials
SW	N46.72736	W117.13427	2560	southwest corner of trials

Grass Plots: GPS locations of belt transects, field Q4

plot	north	west	elevation	point
101	N46.72749	W117.13410	2561	north end of transect
	N46.72747	W117.13407	2562	south end of transect
102	N46.72744	W117.13406	2565	north end of transect
	N46.72742	W117.13403	2565	south end of transect
103	N46.72742	W117.13403	2565	north end of transect
	N46.72742	W117.13412	2560	south end of transect
104	N46.72739	W117.13412	2559	north end of transect
	N46.72736	W117.13412	2562	south end of transect
105	N46.72736	W117.13412	2562	north end of transect
	N46.72734	W117.13411	2557	south end of transect
205	N46.72734	W117.13411	2557	north end of transect
	N46.72742	W117.13388	2562	south end of transect
204	N46.72742	W117.13393	2561	north end of transect
	N46.72740	W117.13390	2562	south end of transect
203	N46.72738	W117.13393	2558	north end of transect
	N46.72736	W117.13387	2557	south end of transect
202	N46.72733	W117.13391	2553	north end of transect
	N46.72731	W117.13392	2552	south end of transect
201	N46.72731	W117.13395	2550	north end of transect
	N46.72728	W117.13396	2546	south end of transect
301	N46.72737	W117.13373	2558	north end of transect
	N46.72733	W117.13376	2553	south end of transect
304	N46.72734	W117.13379	2554	north end of transect
	N46.72733	W117.13377	2553	south end of transect
303	N46.72732	W117.13381	2552	north end of transect
	N46.72729	W117.13380	2551	south end of transect
305	N46.72728	W117.13380	2552	north end of transect
	N46.72726	W117.13378	2553	south end of transect
302	N46.72726	W117.13380	2557	north end of transect
	N46.72724	W117.13379	2562	south end of transect

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

STUDY NUMBER: WAPMC-T-0208-RA. Evaluation of scarification techniques to improve germination of *Geranium viscosissimum.*

PROJECT NUMBER:

STUDY TYPE: Prairie Restoration

LAND USES:

VEGETATIVE PRACTICES: PRIMARY:
SECONDARY:

DESCRIPTION: *Geranium viscosissimum* is a common forb of the Intermountain West as well as the Palouse Prairie. Seed germination does not respond well to stratification. The seed possesses a thick seed coat which may present a physical barrier to water imbibition. The seed is rounded and is therefore difficult to mechanically scarify in a uniform matter. Hot water scarification has been effective in rupturing the impervious seed coat of Lupines. This study will examine the effects of hot water and mechanical scarification on seed germination of *Geranium viscosissimum*.

DURATION OF STUDY:

STUDY LEADER: Dave Skinner

LOCATION: Pullman PMC

COOPERATORS:

EXPERIMENTAL DESIGN: Randomized Complete Block

PROCEDURE: Seed of several lots of *Geranium viscosissimum* will be subjected to hot water treatment and mechanical scarification. Treatment 01 will be the control, no treatment will be applied. Treatment 02 is mechanical scarification administered by rubbing the seed between sheets of 150 grit sandpaper. Treatment 03 is hot water scarification accomplished by boiling water and removing it from the heat source, then dropping the seed in and allowing the water to cool before planting. Four replications of 25 seeds of each treatment will be planted in flats and the number of emerging seedlings counted.

PROGRESS: To test whether imbibition of water actually occurred without treatment, 25 plump seeds of PPR00-1 and PPR01-1 placed on wet filter paper in Petri dishes at

room temperature. Each lot was replicated twice. Plump seeds were selected since they should be the most mature. One group of 25 shriveled seeds from lot PPR01-1 was also observed in the same manner. Seed was placed in the dishes on 2/25/02. Counts of imbibed seed were taken after 2 days, then periodically until 16 days. See table "**GEVI Imbibition Data"** below for results.

GEVI Imbibition Data

	date 2/27	date 3/1	date 3/4	date 3/6	date 3/8	rad 3/8	date 3/11	rad 3/11	date 3/13	rad 3/13
PPR00-1 (1)	12	13	16	17	17	3	18	3	18	3
PPR00-1 (2)	13	17	18	18	19	2	19	2	19	2
PPR01-1 (1)	4	7	8	9	9	2	10	2	10	2
PPR01-1 (2)	4	9	11	12	15	4	15	7	15	9
PPR01-1 (S)	1	2	2	2	2	0	2	0	3	0

rad = number of seeds with the radicle emerging from the seed coat

Few shriveled seeds imbibed water and none showed signs of germinating after 16 days. Cleaning equipment should be adjusted to remove this portion of the seed. Over 70% of the PPR00-1 seeds imbibed water, yet few germinated, suggesting there may be a physiological dormancy associated with the seed. PPR01-1 seed showed lower imbibition rates but one replication had much higher germination rates than any of the others. This was the only replication to suggest that dormancy is low.

Seed of lots PPR00-1 and PPR01-1 were treated as above under "Procedure" and planted in randomized rows in flats containing Redi-Earth™ seed starting mix. See table "***Geranium viscosissimum* germination trials:** Summary" below for data. One trial was run starting in March (first run) and a second trial was started in late April (second run). A third trial was conducted in 2004 using the same 2 seed lots, plus lots PPR02-1 and PPR03-1. The hot water scarification treatment was omitted from the 2004 trial since 2002 results indicated that it caused seed damage and reduced germination. Data and results are included in the table below.

Seed lot PPR01-1 had less germinability than lot PPR00-1. This is borne out by the imbibition trials also. This may be due to seasonal climate variation, or to harvest timing and technique, or to an extended dormancy not overcome in these trials. Mechanical scarification increased germination. Hot water scarification reduced germination, in some cases by a considerable amount. This may be due to excessively high water temperatures. Some of the emerging cotyledons were chlorotic and failed to sustain the embryo until the plant could establish. Those that did survive were much less vigorous than their untreated or mechanically scarified counterparts. Further trials should be conducted to determine if a lower water temperature is beneficial.
Most seeds germinated in the 13-18 days range, but a few germinated much later. Since all seeds tested were well filled and plump, germination rates ultimately should be quite high. Failure of a relatively high percentage of the seed to germinate or to germinate later

in the trials suggests that the scarification technique was less than optimal. Seeds are rounded and roll easily and thus some may not be properly scarified by hand. Use of seed scarification machinery might produce better results on larger volumes of seed.

The low germination rates might also indicate that more than one dormancy factor is involved in seed germination. Since the 2000 seed and the 2001 scarified seed germinated at lower or similar rates in 2002 and 2004, a morphological dormancy seems unlikely. Seed should be tested for physiological dormancy.

It is also possible that a portion of the seed is non-viable. Tetrazolium tests should be made to determine total viability of the seed.

***Geranium viscosissimum* germination trials:** Summary

lot/ treatment	2002 run 1					2002 run 2					2004					total germ	# seeds used	% germ
	1	2	3	4	%	1	2	3	4	%	1	2	3	4	%			
00/NT	8	10	12	9	39	15	19	15	17	66	5	9	8	6	28	133	300	44
00/SC	9	10	12	11	42	19	19	20	16	74	5	9	9	11	34	150	300	50
00/HW	2	3	4	2	11	6	4	9	8	27	--	--	--	--		38	200	19
01/NT	10	14	7	5	36	11	9	9	10	39	4	14	16	18	52	127	300	42
01/SC	9	18	15	11	53	16	18	15	13	62	12	11	16	18	57	172	300	57
01/HW	8	7	11	11	37	5	7	8	1	21	--	--	--	--		58	200	29
02/NT	--	--	--	--	--	--	--	--	--	--	4	12	7	12	35	35	100	35
02/SC	--	--	--	--	--	--	--	--	--	--	10	12	15	17	54	54	100	54
03/NT	--	--	--	--	--	--	--	--	--	--	6	7	16	7	36	36	100	36
03/SC	--	--	--	--	--	--	--	--	--	--	6	8	14	11	39	39	100	39

NT = no pretreatment
SC = scarified by hand rubbing between 2 pieces of 150 grit garnet sandpaper
HW = hot water scarification by plunging seed into boiled water removed from heat source
lot number before the treatment corresponds to the year in which the seed was harvested.

Overall germination:

without pretreatment 41.4%
scarified 51.9%

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

STUDY NUMBER: WAPMC-T-0306-RA. Palouse Prairie Restoration: Evaluation of seed weights of native seeds following cleaning.

PROJECT NUMBER:

STUDY TYPE:

LAND USES:

VEGETATIVE PRACTICES: PRIMARY:
SECONDARY:

DESCRIPTION:
Definitive data on the number of seeds per pound for many native Palouse Prairie species is not available. Some of the data which is available does not appear to be accurate. This data is needed to determine seeding rates and amounts.

DURATION OF STUDY:

STUDY LEADER:
David M. Skinner

LOCATION:
Pullman PMC

COOPERATORS:

EXPERIMENTAL DESIGN:

PROCEDURE:
Two replications of 500 seeds each for each species will be weighed and the number of seeds per pound calculated. At this time there is sufficient seed available of the following species; *Achillea millefolium, Agoseris grandiflora, Allium acuminatum, Arabis* spp., *Arnica sororia, Aster jessicae, Aster occidentalis, Balsamorhiza sagittata, Clarkia pulchella, Collinsia parviflora, Collomia grandiflora, Delphinium nuttallianum, Gaillardia aristata, Galium boreale, Geranium viscosissimum, Geum triflorum, Haplopappus liatriformis, Helianthella uniflora, Heuchera cylindrica, Iris missouriensis, Lomatium dissectum, Microsteris gracilis, Penstemon confertus, Potentilla arguta, Potentilla gracilis, Sidalcea oregana, Solidago missouriensis,* and *Wyethia amplexicaulis.* Other species will be determined as seed becomes available.

PROGRESS:

Seeds of the above species were counted and weighed in grams on 2/7/03. See table "**Seeds Per Pound of Native Species"** below for results. Seeds per pound were calculated using a conversion factor of 453.6 grams per pound. 4 replications were counted of *Agoseris grandiflora*, all from the same lot. 2 replications each of 2 lots of *Aster occidentalis* and *Haplopappus liatriformis* were sampled. All four replications were included in the final calculations. This data was sent to the PLANTS Database (http://plants.usda.gov/) where it was used in their "Conservation Plant Characteristics" tables.

In 2005, determinations were made for *Camassia quamash, Collomia linearis, Eriogonum heracleoides, Fritillaria pudica, Gentiana affinis, Gilia aggregata, Heracleum lanatum, Hieracium albertinum, Lomatium grayi, Lomatium triternatum, Microseris nutans, Montia perfoliata, Penstemon deustus, Phacelia heterophylla,* and *Sisyrinchium inflatum.* Data is included in the table "**Seed Weights of Some Palouse Native Species**" below. The table was also published on the Pullman PMC website at http://www.wsu.edu/~pmc_nrcs/Docs/Seed_Weights_Palouse_Native_Species.pdf

It is noted that seed weight can vary from lot to lot according to weather conditions, harvesting techniques and cleaning techniques. Including more samples from multiple lots would reduce the variability, however these figures will allow calculations of seeding rates with reasonable accuracy.

Seed Weights of Some Palouse Native Species:

determined by the Pullman Plant Materials Center, Pullman, Washington

Current Species Name[1]	Former Species Name[2]	Seeds/gm	Seeds/lb
Achillea millefolium	*Achillea millefolium*	6,250	2,835,000
Agoseris grandiflora	*Agoseris grandiflora*	603	273,665
Allium acuminatum	*Allium acuminatum*	559	253,691
Arnica sororia	*Arnica sororia*	894	405,725
Balsamorhiza sagittata	*Balsamorhiza sagittata*	136	61,630
Camassia quamash	*Camassia quamash*	229	104,027
Clarkia pulchella	*Clarkia pulchella*	4,608	2,090,323
Claytonia perfoliata	*Montia perfoliata*	2,425	1,099,903
Collinsia parviflora	*Collinsia parviflora*	772	350,000
Collomia grandiflora	*Collomia grandiflora*	324	146,986
Collomia linearis	*Collomia linearis*	680	308,529
Delphinium nuttallianum	*Delphinium nuttallianum*	1,361	617,143
Eriogonum heracleoides	*Eriogonum heracleoides*	321	145,721
Fritillaria pudica	*Fritillaria pudica*	366	165,996
Gaillardia aristata	*Gaillardia aristata*	411	186,436
Galium boreale	*Galium boreale*	1,600	725,760
Gentiana affinis	*Gentiana affinis*	10,684	4,846,154
Geranium viscosissimum	*Geranium viscosissimum*	121	54,809
Geum triflorum	*Geum triflorum*	991	449,554
Helianthella uniflora	*Helianthella uniflora*	91	41,087
Heracleum maximum	*Heracleum lanatum*	81	36,621
Heuchera cylindrica	*Heuchera cylindrica*	16,667	7,560,000
Hieracium cynoglossoides	*Hieracium albertinum*	1,603	727,156
Ipomopsis aggregata	*Gilia aggregata*	799	362,416
Iris missouriensis	*Iris missouriensis*	51	23,349
Lomatium dissectum	*Lomatium dissectum*	99	45,031
Lomatium grayi	*Lomatium grayi*	176	79,882
Lomatium triternatum	*Lomatium triternatum*	141	63,812
Microseris nutans	*Microseris nutans*	476	215,692
Olsynium douglasii var. inflatum	*Sisyrinchium inflatum*	273	123,928
Penstemon confertus	*Penstemon confertus*	10,204	4,628,571
Penstemon deustus	*Penstemon deustus*	6,098	2,765,854
Phacelia heterophylla	*Phacelia heterophylla*	1,233	559,172
Phlox gracilis	*Microsteris gracilis*	644	292,080
Potentilla arguta	*Potentilla arguta*	9,709	4,403,883
Potentilla gracilis	*Potentilla gracilis*	3,774	1,711,698
Pyrrocoma liatriformis	*Haplopappus liatriformis*	357	161,740
Sidalcea oregana	*Sidalcea oregana*	349	158,325
Solidago missouriensis	*Solidago missouriensis*	4,405	1,998,238
Symphyotrichum jessicae	*Aster jessicae*	1,196	542,584
Symphyotrichum spathulatum	*Aster occidentalis*	2,849	1,292,308
Wyethia amplexicaulis	*Wyethia amplexicaulis*	62	28,221

[1] USDA, NRCS. 2005. The PLANTS Database, Version 3.5 (http://plants.usda.gov). Data compiled from various sources by Mark W. Skinner. National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

[2] Hitchcock, C. Leo, and Arthur Cronquist. 1973. Flora of the Pacific Northwest. Univ. of Washington Press. Seattle, WA.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

STUDY NUMBER: WAPMC-T-0307-RA. Evaluation of Seeding Time on Establishment of Palouse Prairie Forbs for Seed Increase.

PROJECT NUMBER:

STUDY TYPE: Prairie Restoration

LAND USES:

VEGETATIVE PRACTICES: PRIMARY:
SECONDARY:

DESCRIPTION: Seed availability is a major impediment to restoring Palouse Prairie. Seed growers will need cultural information on seeding practices in order to successfully increase the seed supply, yet little is know about how to grow most of the native Palouse Prairie forbs in a seed production setting. Seeding rate, seeding time, and seeding depth are a few of the parameters which need to be established. This study will examine the effect of seeding time on establishment of seed increase plantings.

DURATION OF STUDY:

STUDY LEADER: Dave Skinner

LOCATION: Pullman PMC

COOPERATORS:

EXPERIMENTAL DESIGN: Randomized Complete Block

PROCEDURE: Species to be studied will be determined by availability of sufficient seed to complete each plot. Each species will be seeded in a single plot in each treatment using a Hege 1000 plot seeder. Each plot will contain four 20 foot long rows. Treatments will consist of an early fall seeding (T1, mid September), a late fall seeding (T2, late October) and an early spring seeding (T3, mid to late April). Plots will be randomized within and between treatments. Space, time and seed supply constraints prevent replicating the plots in each treatment, however data will be collected on each of the 4 rows separately. Small seeded species will be planted at a rate of 40 seeds per linear foot, and large seeded species at 20 seeds per linear foot. All species will be seeded no more than ¼ inch deep. If there are indications that this rate and depth should be increased or decreased for certain species, addition trials can be conducted at a later date.

Plant counts will be taken at intervals of 4, 8, 12, and 16 feet along each row in the spring following seeding. Estimates of percent stand will be made for each row in the fall or early spring following seeding. The plots may be observed in future seasons for carryover germination. The plots may also be used for other cultural trials such as weed control methods after establishment data collection is completed. The entire seeding will be made in at least 3 separate years in order to minimize effects of annual climate variation.

PROGRESS: 2002-2003 plots were established in field I1. Existing spring barley stubble was chiseled then disked. Each treatment was cultivated with a Glencoe cultivator and packed with a Brillion roller immediately before seeding. Spring seeded plots were worked with a cultivator before rod weeding. T1 (early fall) plots were seeded on 9/30/02. T2 Plots (late fall) were seeded on 10/28/02, and T3 (spring) plots were seeded 4/21/03. See "**Forb Seeding Time Trials plot layout:**" below for layout. The T1 seeding was delayed several weeks in hope of receiving some precipitation. It was made in dry soil. Little precipitation fell before November, effectively meaning that there was little difference between the early and late fall seedings.
The annuals *Clarkia pulchella, Collomia grandiflora* and *Collinsia parviflora* were seeded in field G3 in single rows with the push Hege planter on the same dates as the perennial species. The spring seeding was made in Field F. None of the annuals emerged from the spring seeding. This was expected of the *C. parviflora*, since it is a winter annual. The other 2 annuals, however, have been grown easily from unstratified seed in the Growth Chamber. Plant counts were taken on 5/8/03 for all fall seedings and on 6/12/03 for all spring seeding. Percent stand of each row was estimated on 11/19/03 and again on 5/12/05. *Lupinus leucophyllus* emerged during the winter but many seedlings did not survive to be counted in May.

2003-2004 plots were established in a similar manner as 2002-2003 except the stubble was not chiseled. Chiseling resulted in large clods, making seedbed preparation and seeding difficult. Instead the field was disked twice, then cultivated and rolled just before seeding. T1 plots were seeded on 9/17/03, T2 on 10/29/03, and T3 on 4/13/04. Plots of P6435 *Festuca idahoensis* and 'Whitmar' *Pseudoroegneria spicata* ssp. *inermis* were added to the planting. *Heuchera cylindrica* was surface sown. All other species were seeded about 1/8 inch deep. Annuals were seeded in a single row per species and treatment in field F1 on the same dates as the perennial species. Plant counts were taken on all plots on June 14 & 15, 2004. Estimates were made of percent stand in all perennial species on 5/12/05. Plant establishment of fall seeded species was generally much lower than in 2002/2003 due to an extended early spring dry spell which left a thick and hard soil crust thru which the seedlings could not penetrate. Spring seedings generally emerged better than fall seedings for those species without prolonged seed dormancy. Even the winter annual *Collinsia parviflora* was able to germinate in the spring and produced better stands, although seed production was low.

2004-2005 plots were established in the same manner as 2003-2004. T1 plots were seeded on 9/21/04, T2 on 10/26/04, and T3 on 4/26/05. Plant counts were taken on 6/9/05. Due to dry conditions, most of the plants were dormant in the fall. Percent stand

data will be taken in spring 2006. Emergence was low for most species due to a very dry period from February 1 thru March 16, during which only 0.11 inches of precipitation was received.

2005-2006 plots were established in the same manner. T1 plots were seeded on 9/20/05 and T2 plots on 10/25/05. T3 plots were sown on 5/3/06. Plant count data was collected on T1 & T2 on 5/30/06 and on T3 on 7/6/06. Due to dry conditions thru the summer and fall, most of the plants were dormant and percent stand data was not collected. Overall, *Agoseris grandiflora, Aster occidentalis, Gaillardia aristata, Lupinus sericeus, Potentilla gracilis, Solidago missouriensis, Clarkia pulchella,* and *Collomia grandiflora* did best from early fall seedings. *Penstemon confertus, Potentilla arguta, Clarkia pulchella, Collomia grandiflora, Collomia linearis,* and *Collinsia parviflora* all emerged best from late fall seedings. *Galium boreale* also emerged best in late fall seedings, but all treatments had very low emergence. *Festuca idahoensis, Geum triflorum, Helianthella uniflora,* and *Lomatium dissectum* had slightly higher early fall emergence but all treatments were low. *Achillea millefolium, Haplopappus liatriformis, Heuchera cylindrica, Pseudoroegneria spicata,* and *Sidalcea oregana* responded poorly to all treatments. The forb seed has not been tested for germination, but germination of the bluebunch wheatgrass and the Idaho fescue was 92% and 77%, respectively, in January 2006.

For the perennial species, seedlings per foot and percent stand data were averaged over each plot. The results are presented in the table "**Perennial Forb Seeding Time Trials Data**" Herbicide trials were conducted on the 02/03 and 03/04 plantings in 2005. Part of the data collection included cover class estimates of the seeded species. The midpoints of each cover class were averaged for each plot and that data was included in the table. See "% cover July 05" in table below. See study "WAPMC-T-0605-R: Evaluation of herbicides for weed control in seed production of native forbs" elsewhere in this report for details of the herbicide study. Similar data on the annual species is presented in the table "**Annual Forb Seeding Time Trials Data**" below.

Forb Seeding Time Trials plot layout: field I1

N↑

02/03

T1	ACMI	GAAR	GETR	HEUN	LULE	POAR	SIOR	LODI	blank
	AGGR	ASOC	GABO	HALI	HECY	PECO	POGR	SOMI	blank
T2	LODI	HECY	GETR	GABO	POAR	POGR	PECO	ACMI	blank
	GAAR	LULE	SIOR	HEUN	ASOC	HALI	AGGR	SOMI	blank
T3	HALI	GAAR	POGR	ACMI	HEUN	ASOC	LODI	LULE	blank
	SOMI	POAR	PECO	GETR	SIOR	AGGR	HECY	GABO	blank

03/04

T1	HECY	POAR	GABO	HALI	ACMI	SOMI	PECO	POGR	GAAR
	AGGR	GETR	LODI	PSSP	SIOR	LULE	HEUN	FEID	ASOC
T2	HALI	AGGR	ACMI	LULE	GETR	POGR	ASOC	HECY	HEUN
	GAAR	GABO	LODI	SOMI	POAR	PSSP	SIOR	PECO	FEID
T3	LODI	GAAR	SOMI	HEUN	HECY	FEID	GABO	HALI	POGR
	ACMI	LULE	POAR	SIOR	PSSP	GETR	PECO	ASOC	AGGR

04/05

T1	GAAR	AGGR	GABO	POGR	SIOR	FEID	ACMI	HECY	POAR
	GETR	SOMI	LODI	LULE	PECO	HEUN	HALI	PSSP	ASOC
T2	HEUN	SOMI	SIOR	HALI	LODI	ACMI	POGR	POAR	AGGR
	GABO	GAAR	ASOC	PSSP	GETR	PECO	HECY	LULE	FEID
T3	PECO	POGR	POAR	GAAR	FEID	PSSP	SOMI	ASOC	AGGR
	LULE	HEUN	HALI	LODI	GETR	ACMI	GABO	SIOR	HECY

05/06

T1	ACMI	HECY	FEID	POGR	ASOC	SIOR	LODI	GAAR	GABO
	PSSP	PECO	AGGR	HALI	POAR	HEUN	LULE	SOME	GETR
T2	ASOC	HEUN	PSSP	PECO	HALI	GABO	GETR	AGGR	ACMI
	POAR	SOMI	HECY	SIOR	FEID	LODI	POGR	LULE	GAAR
T3	HECY	POGR	GAAR	PECO	GETR	FEID	HEUN	PSSP	ASOC
	SOMI	HALI	SIOR	ACMI	LODI	LULE	GABO	POAR	AGGR

Not to scale.

There is a 6 ft clean till between each treatment and between each pair of species in a treatment.

Forb Seeding Time Trials plot layout: field I1 (continued) **N↑**

06/07

T1a	POAR	HECY	GETR	ASOC	LULE	SIOR	POGR	FEID	HALI
	HEUN	LODI	PECO	ACMI	GAAR	SOMI	AGGR	PSSP	GABO
T2a	SOMI	AGGR	LULE	GETR	POAR	PSSP	GABO	HEUN	ACMI
	ASOC	LODI	GAAR	HALI	PECO	POGR	FEID	SIOR	HECY
T2b	SIOR	POGR	HECY	AGGR	POAR	HEUN	PSSP	LODI	FEID
	ACMI	HALI	LULE	GABO	PECO	GETR	GAAR	ASOC	SOMI
T3a	PECO	ACMI	ASOC	SOMI	HECY	GETR	POGR	PSSP	FEID
	HEUN	LODI	HALI	AGGR	SIOR	POAR	LULE	GAAR	GABO
T3b	SIOR	AGGR	HALI	HECY	LULE	LODI	SOMI	POAR	PECO
	POGR	FEID	ACMI	PSSP	GABO	ASOC	GARR	HEUN	GETR

Not to scale.
There is a 6 ft clean till between each treatment and between each pair of species in a treatment.
a = plots seeded with the original seed lots used in all previous trials.
b = plots seeded with newer seed lots.

Perennial Forb Seeding Time Trials Data:

Species	year	treatment	average seed/L.F.	% stand fall 03	% stand May 05	% cover July 05
Achillea millefolium	02/03	T1	4	33.8	35	61.9
	02/03	T2	1.5	40	32.5	73.8
	02/03	T3	4.9375	45	57.5	82.5
	03/04	T1	2.25	NA	57.5	55.6
	03/04	T2	2.375	NA	60	85.6
	03/04	T3	2.625	NA	60	91.3
	04/05	T1	2.6875			
	04/05	T2	1.25			
	04/05	T3	5.9375			
Agoseris grandiflora	02/03	T1	9.3125	93.2	12.5	8.8
	02/03	T2	11	97.2	0	0
	02/03	T3	21	46.8	<1	<1
	03/04	T1	0.125	NA	<1	1.9
	03/04	T2	2.9375	NA	37.5	26.2
	03/04	T3	5.125	NA	53.75	32.5
	04/05	T1	5.5625			
	04/05	T2	10.9375			
	04/05	T3	8.3125			
Aster occidentalis	02/03	T1	4.75	81.25	60	68.1
	02/03	T2	9.375	77.5	71.25	73.8
	02/03	T3	4.75	13.75	30	40.6
	03/04	T1	0.5625	NA	<1	17.5
	03/04	T2	0.375	NA	1.75	8.8
	03/04	T3	0.25	NA	4.25	20.6
	04/05	T1	4.1875			
	04/05	T2	0.125			
	04/05	T3	2.1875			
Festuca idahoensis	02/03	T1	not			
	02/03	T2	planted			
	02/03	T3	in 02/03			
	03/04	T1	1.8125	NA	3.25	15
	03/04	T2	2.25	NA	50	32.5
	03/04	T3	1.6875	NA	31.25	20.6
	04/05	T1	1.5			
	04/05	T2	1.375			
	04/05	T3	1.125			
Gaillardia aristata	02/03	T1	10.6875	67.5	71.25	85.6
	02/03	T2	10.9375	90	90	91.3
	02/03	T3	3.5	23.75	52.5	62.5
	03/04	T1	1	NA	5	26.2
	03/04	T2	0.375	NA	8.75	31.9
	03/04	T3	10.8125	NA	66.25	73.8
	04/05	T1	4.1875			
	04/05	T2	2.5625			
	04/05	T3	9.1875			

Perennial Forb Seeding Time Trials Data: continued

Species	year	treatment	average seed/L.F.	% stand fall 03	% stand May 05	% cover July 05
Galium boreale	02/03	T1	0	23.75	6.25	2.5
	02/03	T2	1	NA	7.5	11.9
	02/03	T3	0	0	0	<1
	03/04	T1	0	NA	0	<1
	03/04	T2	0	NA	0	<1
	03/04	T3	0	NA	0	<1
	04/05	T1	0			
	04/05	T2	0			
	04/05	T3	0.0625			
Geum triflorum	02/03	T1	0.0625	0.5	1.25	<1
	02/03	T2	0.1875	2.5	2.5	<1
	02/03	T3	1.0625	0	<1	2.5
	03/04	T1	0.3125	NA	<1	1.2
	03/04	T2	0.3125	NA	<1	1.9
	03/04	T3	4.6875	NA	4.25	20.6
	04/05	T1	0.4375			
	04/05	T2	0			
	04/05	T3	1.5625			
Haplopappus liatriformis	02/03	T1	1.75	30	37.5	20.6
	02/03	T2	1.125	23.75	38.75	50
	02/03	T3	0.1875	2.5	3.125	11.2
	03/04	T1	0.375	NA	<1	1.9
	03/04	T2	0.8125	NA	12.5	15
	03/04	T3	0.0625	NA	<1	1.9
	04/05	T1	0.1875			
	04/05	T2	0.5			
	04/05	T3	0.125			
Heuchera cylindrica	02/03	T1	0	0	0	0
	02/03	T2	0.5	0	0	0
	02/03	T3	0	0	0	0
	03/04	T1	0	NA	0	0
	03/04	T2	0	NA	0	0
	03/04	T3	0	NA	0	0
	04/05	T1	0			
	04/05	T2	0			
	04/05	T3	0			
Helianthella uniflora	02/03	T1	3.125	42.5	50	
	02/03	T2	3.75	31.25	45	26.2
	02/03	T3	0	0	5	2.5
	03/04	T1	2	NA	0	15
	03/04	T2	1.5	NA	30	11.9
	03/04	T3	0.25	NA	<1	1.9
	04/05	T1	1.125			
	04/05	T2	0.3125			
	04/05	T3	0.4375			

Perennial Forb Seeding Time Trials Data: continued

Species	year	treatment	average seed/L.F.	% stand fall 03	% stand May 05	% cover July 05
Lomatium dissectum	02/03	T1	0.9375	NA	12.5	8.8
	02/03	T2	1.875	NA	40	11.9
	02/03	T3	0	0	45	1.9
	03/04	T1	0.0625	NA	<1	0
	03/04	T2	0	NA	0	0
	03/04	T3	0	NA	<1	0
	04/05	T1	0.1875			
	04/05	T2	0.0625			
	04/05	T3	0			
Lupinus leucophyllus	02/03	T1	2.4375	NA	55.6	79.4
	02/03	T2	3.25	55	78.75	79.4
	02/03	T3	0.5	0	15	15
	03/04	T1	1.1875	NA	18.75	11.9
	03/04	T2	1.375	NA	3.25	31.9
	03/04	T3	3.6875	NA	15	20.6
	04/05	T1	0.25			
	04/05	T2	1.5			
	04/05	T3	1.5			
Penstemon confertus	02/03	T1	0.75	50	27.5	31.9
	02/03	T2	3.6875	25	22.5	50
	02/03	T3	0	0	<1	4.4
	03/04	T1	0.1875	NA	<1	1.9
	03/04	T2	1.0625	NA	8.75	31.9
	03/04	T3	0	NA	<1	<1
	04/05	T1	3.8125			
	04/05	T2	0.4375			
	04/05	T3	0			
Potentilla arguta	02/03	T1	0.375	31.25	30	26.6
	02/03	T2	1.625	27.5	27.5	31.9
	02/03	T3	0	0	1.25	1.9
	03/04	T1	0.0625	NA	<1	<1
	03/04	T2	0.3125	NA	2	3.8
	03/04	T3	0.3125	NA	<1	8.8
	04/05	T1	0.625			
	04/05	T2	0.75			
	04/05	T3	7.0625			
Potentilla gracilis	02/03	T1	1.6875	21.25	47.5	44.4
	02/03	T2	1.75	20	48.75	38.1
	02/03	T3	0	0	<1	2.5
	03/04	T1	0.1875	NA	<1	11.2
	03/04	T2	0.5625	NA	<1	7.5
	03/04	T3	0.1875	NA	<1	1.9
	04/05	T1	0.5			
	04/05	T2	0.8125			
	04/05	T3	3.125			

Perennial Forb Seeding Time Trials Data: continued

Species	year	treatment	average seed/L.F.	% stand fall 03	% stand May 05	% cover July 05
Pseudoroegneria spicata	02/03	T1	not planted in 02/03			
	02/03	T2				
	02/03	T3				
	03/04	T1	0.8125	NA	<1	11.9
	03/04	T2	1.75	NA	40	31.9
	03/04	T3	2.3125	NA	71.25	43.8
	04/05	T1	0.625			
	04/05	T2	0.125			
	04/05	T3	2			
Sidalcea oregana	02/03	T1	0.5625	NA	12.5	8.8
	02/03	T2	0.3125	3.75	16.25	21.2
	02/03	T3	0	0	1.5	11.9
	03/04	T1	0.625	NA	1.5	8.8
	03/04	T2	0	NA	<1	<1
	03/04	T3	0	NA	<1	1.2
	04/05	T1	0.3125			
	04/05	T2	0.0625			
	04/05	T3	0			
Solidago missouriensis	02/03	T1	7.5625	65	62.5	85.6
	02/03	T2	6.4375	75	70	67.5
	02/03	T3	2.5625	50	71.25	73.7
	03/04	T1	0.1875	NA	<1	1.9
	03/04	T2	1.375	NA	45	56.2
	03/04	T3	1.6875	NA	35.25	20.6
	04/05	T1	1.125			
	04/05	T2	0.625			
	04/05	T3	2.652			

Annual Forb Seeding Time Trials Data:

02-03 Annuals		4 ft	8 ft	12 ft	16 ft	total	% stand
Clarkia	T1	no data					
pulchella	T2	31	11	25	29	96	100
	T3	0	0	0	0	0	0
		4 ft	8 ft	12 ft	16 ft		
Collomia	T1	35	59	40	69	203	100
grandiflora	T2	42	74	69	37	222	100
	T3	4	2	1	0	7	30
		4 ft	8 ft	12 ft	16 ft		
Collinsia	T1	5	20	15	15	55	80
parviflora	T2	5	14	13	19	51	80
	T3	0	0	0	0	0	0

03-04 Annuals		4 ft	8 ft	12 ft	16 ft		% stand
Clarkia	T1	15	6	1	12	34	60
pulchella	T2	3	4	8	11	26	90
	T3	2	5	0	3	10	40
		4 ft	8 ft	12 ft	16 ft		
Collomia	T1	10	7	8	8	33	70
grandiflora	T2	3	7	6	8	24	90
	T3	5	11	10	8	34	90
		4 ft	8 ft	12 ft	16 ft		
Collinsia	T1	no data					
parviflora	T2	4	6	4	5	19	30
	T3	13	10	8	2	33	70

04-05 Annuals		4 ft	8 ft	12 ft	16 ft		
Clarkia	T1	7	1	4	0	12	50
pulchella	T2	1	0	2	1	4	20
	T3	0	0	4	2	6	10
		4 ft	8 ft	12 ft	16 ft		
Collomia	T1	1	4	3	1	9	30
grandiflora	T2	1	6	2	7	16	50
	T3	18	20	35	32	105	100
		4 ft	8 ft	12 ft	16 ft		
Collinsia	T1	2	3	2	2	9	20
parviflora	T2	1	7	2	2	12	30
	T3	8	29	42	2	81	90

05 T3 *Collinsia parviflora* grew very little and produced no seed, despite excellent emergence.
05 T3 *Collomia grandiflora* was killed by mildew and produced no seed

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

STUDY NUMBER: WAPMC-T-0214-RA. Evaluation of Snowberry Growth Habit With and Without Competition.

PROJECT NUMBER:

STUDY TYPE: Prairie Restoration

LAND USES:

VEGETATIVE PRACTICES: PRIMARY:
SECONDARY:

DESCRIPTION: Common snowberry, *Symphoricarpos albus*, is a major component of the Palouse Prairie. It occurred in the Palouse Prairie in two forms, a single stemmed, dwarfed, and often sterile form found intermixed with the grasses and forbs, and a taller, branched and more shrub-like form which tended to develop thickets within the matrix of the grasses and forbs (Daubenmire 1970). It is not know whether these two forms are genetically different or if the difference is attributable to environmental factors. This study will examine whether or not cuttings from a known shrubby growth form of the plant can be used to introduce the dwarfed form into a prairie restoration planting or if material will need to be collected from known dwarf forms to maintain that characteristic. The dwarf form rarely produces seed, and so cannot be effectively propagated by that method. Additionally, a cutting taken from the dwarf form would need to be of a length that would likely include several years of woody growth and thus be more difficult to root.

DURATION OF STUDY:

STUDY LEADER: Dave Skinner

LOCATION: Pullman PMC

COOPERATORS:

EXPERIMENTAL DESIGN:

PROCEDURE: The Okanogan Selection of *Symphoricarpos albus* was released by the Pullman PMC in 1997 and is known to be thicket forming type of the species. Cuttings will be taken from the breeder planting of the Okanogan Selection and propagated in the growth chamber. They will then be planted out into an established grass stand and into a cultivated area and the differences in growth observed and measured.

PROGRESS: 38 hardwood cuttings were taken on 2/13/02. They were treated with 0.3% IBA and placed in the growth chamber entry room to initiate rooting under cooler temperatures. They were moved to the growth chamber on 3/1/02. 28 plants rooted. They were moved to the cold frame on 4/11/02. Since the Palouse Prairie grass planting in field Q4 is still undergoing herbicide treatments for broadleaf weeds, the snowberry were planted out in field H1. 3 replications of 4 plants were planted into the west end of the uppermost clean tilled strip in H1. 3 replications of 4 plants each were planted into the existing stand of Durar hard fescue immediately below the lower strip in field H1 by scalping off a small area of Durar roughly 20 centimeters (8 inches) in diameter. Both treatments of plants were watered throughout the summer to assure survival and establishment and the plants in to clean tilled strip were hand weeded as necessary. See "Snowberry growth forms plot layouts" and "GPS locations of plots" below. No evaluations were performed during the establishment year.

On May 7, 2003 measurements were taken on plant height, number of stems, number of suckers, and plant width. See table **Snowberry Growth Data** below for details. Plants growing without competition were taller and wider than those competing with Durar Hard fescue. In September, the plants growing in clean tilled ground were measured again. Many of the plants in the clean tilled ground produced prodigious amounts of fruit. The stems of many plants were bent to the ground with the weight of the fruit. Fruit production was rated 0-9 with 9 highest. No data was taken on those plants in the Durar. They had neither leaves nor fruit and had grown very little since the spring measurement. At this point it is not known whether they are dormant or deceased.
On June 2, 2004, data was again taken on plant height, number of stems, number of suckers, and plant width. The same parameters, plus fruit abundance, were measured again on September 9, 2004. See table **Snowberry Growth Data** below for details. Growth of the transplants in the existing Hard fescue remained poor, and survival declined even further from 2003. Those which survived produced no fruit. The planting is on a south facing slope. The exposure, combined with the competitiveness of the Durar, may make the site inhospitable for snowberry. The native vegetation on the site was likely an *Agropyron spicatum – Festuca idahoensis* habitat type (Daubenmire 1970). Snowberry was absent from that habitat type, probably because of its xeric nature. Overall, the plants in the tilled ground grew significantly from 2003 to 2004. Fruit set, however, declined.

In the winter of 2005, more cuttings of the Okanogan selection were taken and treated with 0.3% IBA and placed in the growth chamber entry room to initiate rooting under cooler temperatures. They were moved to the growth chamber. On May 24,2005 they were planted into the Durar hard fescue stand in field J, using the same layout as the plantings in field H1. Field J has a west aspect, which should be somewhat more hospitable to snowberry. See "Snowberry growth forms plot layouts" below. They were watered as needed thru the summer of 2005, but no data was collected.
On 6/20/05 data on the plants in field H1 was taken. Data included plant height, number of stems, number of suckers, and plant width. See table "Snowberry Growth Data" below

for details. Plants growing without competition were taller and wider than those competing with Durar Hard fescue. Fall data was not collected in 2005. In the existing grass planting, plants surviving in 2004 were still alive in 2005, but they were much smaller and much less vigorous than those in the tilled ground. No vegetative reproduction occurred and the plants did not set fruit, while the plants in the tilled ground are beginning to spread vegetatively and have produced abundant fruit. While some of the transplants are able to survive with the existing grass competition, it does not appear that they will be able to reproduce.

Data was not collected in spring 2006. Fall data was taken on 9/12/06. Only one plant was obviously still alive in the field H grass planting and only 6 in the 2005 field J planting. The plants in tilled ground were robust and produced fruit.

References:

Daubenmire, R.F. 1970. Steppe vegetation of Washington. Tech. Bull. 62. Washington Ag. Exp. Station, Washington State Univ., Pullman, WA.

GPS locations of plots:

		elevation	field	location
N46.72336	W117.13811	2539	H1	SYAL in grass east end
N46.72338	W117.13826	2541	H1	SYAL in grass west end
N46.72362	W117.13810	2547	H1	SYAL in till east end
N46.72367	W117.13828	2546	H1	SYAL in till west end
N46.72504	W117.13947	2559	J	SYAL in grass 2005 N
N46.72496	W117.13960	2557	J	SYAL in grass 2005 S

Snowberry growth forms plot layouts:

Planted in existing grass 2002, field H1 south of strip 4. **N↑**

rep 3				rep 2				rep 1			
4	3	2	1	4	3	2	1	4	3	2	1

Planted in tilled ground 2002, west end of strip 1 **N↑**

rep 3				rep 2				rep 1			
4	3	2	1	4	3	2	1	4	3	2	1

Planted in existing grass west of field J1. **N→**

rep 3				rep 2				rep 1			
4	3	2	1	4	3	2	1	4	3	2	1

Snowberry Growth Data: 2003-2005

Planted in existing grass – spring data

	plt #	2003 ht cm	2004 ht cm	2005 ht cm	2003 # stems	2004 # stems	2005 # stems	2003 # suckers	2004 # suckers	2005 # suckers	2003 width cm	2004 width cm	2005 width cm
rep 1	1	6	7	8	3	1	1	1	0	0	9	4	5
	2	11	7	9	2	1	1	0	0	0	7	3	3
	3	11	11	13	1	1	1	0	0	0	13	7	8
	4	dead	7	dead	x	0	x	x	0	x	x	0	x
rep 2	1	8	4	dead	3	1	x	0	0	x	6	0	x
	2	10	3	dead	1	1	x	0	0	x	9	0	x
	3	8	8	dead	2	1	x	0	0	x	12	0	x
	4	8	5	1	1	1	1	1	0	0	12	5	1.5
rep 3	1	8	0	dead	3	0	x	0	0	x	4	0	x
	2	dead	3	dead	x	1	x	x	0	x	x	0	x
	3	10	6	1	3	1	1	0	0	0	8	4	3
	4	3	2	dead	1	1	x	0	0	x	5	0	x

Planted in tilled ground – spring data

	plt #	2003 ht cm	2004 ht cm	2005 ht cm	2003 # stems	2004 # stems	2005 # stems	2003 # suckers	2004 # suckers	2005 # suckers	2003 width cm	2004 width cm	2005 width cm
rep 1	1	15	50	58	1	1	1	0	0	3	15	30	75
	2	14	39	69	2	6	5	0	0	2	16	37	57
	3	dead	0	x	x	0	x	x	0	x	x	0	x
	4	18	39	78	5	2	4	0	0	3	13	20	60
rep 2	1	19	54	81	1	1	4	0	1	7	17	29	61
	2	17	41	86	1	1	4	0	1	2	18	32	53
	3	16	52	75	1	1	5	0	1	1	20	21	65
	4	20	38	64	5	2	1	0	0	0	18	13	40
rep 3	1	18	36	66	1	1	1	0	0	1	16	37	69
	2	11	55	81	3	2	3	0	2	2	8	39	74
	3	14	54	89	1	3	1	0	1	5	18	36	59
	4	17	45	95	4	4	4	0	0	4	17	36	62

Planted in existing grass – fall data

	plt #	2003 ht cm	2004 ht cm	2005 ht cm	2003 # stems	2004 # stems	2005 # stems	2003 # suckers	2004 # suckers	2005 # suckers	2003 width cm	2004 width cm	2005 width cm	2004 fruit[1]	2005 fruit
rep 1	1	no	7	no	no	1	no	no	0	no	no	1	no	0	0
	2	data	11	data	data	2	data	data	1	data	data	5	data	0	0
	3	taken	12	taken	taken	1	taken	taken	0	taken	taken	6	taken	0	0
	4		7			1			0			0		0	0
rep 2	1	no	4	no	no	1	no	no	0	no	no	0	no	0	0
	2	data	3	data	data	1	data	data	0	data	data	0	data	0	0
	3	taken	8	taken	taken	1	taken	taken	0	taken	taken	0	taken	0	0
	4		5			1			0			1		0	0
rep 3	1	no	0	no	no	0	no	no	0	no	no	0	no	0	0
	2	data	3	data	data	1	data	data	0	data	data	0	data	0	0
	3	taken	6	taken	taken	1	taken	taken	0	taken	taken	2	taken	0	0
	4		2			1			0			0		0	0

Planted in tilled ground – fall data

	plt #	2003 ht cm	2004 ht cm	2005 ht cm	2003 # stems	2004 # stems	2005 # stems	2003 # suckers	2004 # suckers	2005 # suckers	2003 width cm	2004 width cm	2005 width cm	2004 fruit[1]	2005 fruit
rep 1	1	53	45	no	1	1	no	0	0	no	22	50	9	4	no
	2	48	40	data	3	4	data	0	1	data	19	47	8	5	data
	3	dead	0	taken		0	taken		0	taken		0		0	taken
	4	39	58		3	3		0	1		16	29	5	2	
rep 2	1	36	60	no	1	3	no	0	2	no	22	35	6	4	no
	2	65	75	data	2	2	data	0	1	data	26	50	7	1	data
	3	48	61	taken	2	2	taken	1	3	taken	36	48	5	4	taken
	4	33	45		3	2		1	0		19	32	4	3	
rep 3	1	34	65	no	1	1	no	0	0	no	31	48	6	3	no
	2	44	68	data	3	2	data	0	1	data	33	49	7	5	data
	3	47	65	taken	1	3	taken	0	1	taken	23	40	8	4	taken
	4	59	80		4	7		0	0		22	55	9	3	

Height in cm is from ground level to the tallest part of the plant.
stems are counted as those stems apparently arising from the crown.
suckers are counted as those stems apparently arising from rhizomes away from the root crown.
Width in cm is measured at the widest part of the plant.
Fruit rated 0-9 with 9 being most abundant. 0 = no fruit.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

STUDY NUMBER: WAPMC-T-0408-RA. Methods of Restoring Palouse Prairie Grasses and Forbs in an Agricultural Field.

PROJECT NUMBER:

STUDY TYPE: Prairie Restoration

LAND USES:

VEGETATIVE PRACTICES: PRIMARY:
SECONDARY:

DESCRIPTION: The Palouse Prairie was a complex ecosystem with over 100 species of grasses, forbs, and shrubs. Frequently 30 or 40 species are found growing in close association in areas as small as 4 square meters. Total forb coverage often exceeds 150% (Daubenmire 1970). The plant community was dominated by species which were active in the spring and early summer, then avoided the deepening drought of mid summer by becoming dormant.

When all the native vegetation has been removed, as in an agricultural situation, little is know about the best procedure to begin restoration of a Palouse native plant community. Midwestern prairie restoration has been more closely studied. Most recommendations for tallgrass prairie restoration involve seeding a large number of grasses and forbs at the same time (Packard & Mutel 1997). Indeed, restored Kansas prairies have more species richness when larger numbers of species are sown initially (Piper & Primm 2002). Midwestern prairies, however, receive a larger proportion of mean annual precipitation during the summer and are therefore dominated by more summer active plant species. It is not know whether midwestern techniques are applicable to the Palouse Prairie due to the nearly complete differences in climate and species composition.

On the Palouse, spring grass seedings generally develop into better stands than fall seedings (Schwendiman 1970, 1974, 1975). Many of the native forbs, however, have some form of seed dormancy and may be better sown in the fall.

Seeding forbs in the initial stages of restoration seriously reduces the ability to control weedy species with herbicides. Thus, a more successful strategy might be to seed only the grasses initially and add the forb species sometime in the future. Grassy weeds such as *Bromus tectorum, Vulpia myuros,* and *Ventenata dubia* can also reduce the success of grass seedings. If problems with grassy weeds are anticipated, it might be advantageous to seed the forbs first and provide an opportunity to control weedy grasses with any of several grass herbicides.

Drilled seedings, where possible, are generally more successful than broadcast seedings of native grasses (Nelson et al 1970). Small landowners, however, are sometimes limited by equipment availability when attempting restoration of former cropland. Suitable seeding equipment is particularly scarce and especially equipment for seeding into

existing vegetation if planting is implemented in several stages over several years. Broadcasting some or all of the seed might be desired, but little is known of the success rate of forbs, in particular, to broadcast seeding.

DURATION OF STUDY: 10 years

STUDY LEADER: David M. Skinner

LOCATION: Pullman PMC field Q5A

COOPERATORS: Palouse Prairie Foundation

EXPERIMENTAL DESIGN: Randomized Complete Block

PROCEDURE: Establish plots with the Hege plot drill in the spring and fall of at least three different years on a mesic site which has been in cropland. Plots should consist of four 20 foot long rows of each treatment, randomized and replicated at least 3 times. *Pseudoroegneria spicata* ssp. *inermis* cv 'Whitmar", and *Festuca idahoensis* will comprise the grass species. Forbs will consist of *Achillea millefolium, Aster occidentalis, Gaillardia aristata, Galium boreale, Penstemon confertus, Potentilla arguta, Potentilla gracilis,* and *Solidago missouriensis.* These forbs comprise 8 of the 10 species identified by the Palouse Prairie Foundation as the most common and easily grown species for which to promote seed production, and thus are the most likely to be available for restoration efforts. The other two, *Linum lewisii* and *Helianthella uniflora*, are not yet available in sufficient quantities to include in the experimental design.
Treatments will consist of:

	Spring treatments	Fall treatments
1	broadcast grasses alone	broadcast grasses alone
2	seed grasses alone	seed grasses alone
3	seed forbs alone	seed forbs alone
4	seed forbs w/ seeded grasses	broadcast forbs alone
5	broadcast forbs alone	seed grasses alone
6	broadcast forbs w/ seeded grasses	broadcast forbs and grasses
7	seed grasses, fall broadcast forbs	seed grasses and broadcast forbs
8	seed PSSP, fall broadcast FEID	seed PSSP, broadcast FEID
9	seed grasses and forbs w/ mulch	seed grasses and forbs w/ mulch
10	broadcast forbs and grasses with mulch	broadcast grasses and forbs w/ mulch

All grass seedings will use both species and all forb seedings will use all 8 species. Seeding rates will be 20 PLS/ft for *P. spicata*, 30 PLS/ft for *F. idahoensis*, and 5 seeds/ft for each forb species (40 forb seeds/ft total). Germination data is not available for the forbs, thus they cannot be done on a PLS basis. Broadcast rates will be double the seeded rate for each species. The field will remain in cropland until the seeding are made. Fall treatments will be made in mid-October in stubble which has been disked and rolled. Spring treatments will be made in stubble which was fall chiseled, then cultivated, rod weeded, and rolled in the early spring. Exact timing will depend on spring weather and soil conditions.

A border of *P. spicata* and *F. idahoensis* will be seeded between each spring and fall treatment. Seeding rate will be the same as the grass seeding rate for the plots. The purpose of the border is to provide a uniform edge effect along the outside row of each plot and to allow for cultivation of the farm ground immediately next to the plots without risking damage to the outside row. A border will also be seeded across the ends of the plots. See "plot design" below for layout.

Weeds will only be controlled by mowing at a height above most of the seeded species in the first year. In following years the plots will only be mowed once after the seed has been disseminated in the fall. Perennial noxious weeds will be controlled on a spot basis as needed.

First year evaluations will consist of plant counts at 4, 8, 12, and 16 feet in each row of each plot to establish a baseline germination. Using the Daubenmire method (Daubenmire 1959), cover class estimates for each species in each plot will be made on the second, third, fifth, seventh and tenth years following seeding, using the initial data points for placement of the frames. Because a seeded stand is expected to be less heterogeneous than a natural stand, a ½ x1 meter frame will be used, rather than the 20 cm by 50 cm frame specified by Daubenmire.

The objective of the study is to evaluate different seeding times and techniques to determine the best method for restoring the grass and forb component of a *Festuca idahoensis - Symphoricarpos albus* plant community.

PROGRESS: First spring replications were seeded 4/20/04. High winds later blew most of the mulch off the mulched plots. The mulch was replaced and bird netting staked down over it to hold it in place. Fall seeding was done on 10/25/04.

The second spring seeding was done on 3/18/05, and the second fall seeding on 10/12/05. See "Plot layout" below for details.

Plant counts on the spring 2004 seeding were taken on 6/25/04. The fall 2004 and spring 2005 plant counts were began on 5/26/05 with volunteers from the Palouse Prairie Foundation. Only about half the plots were finished and they were unable to provide volunteers to complete the data collection. PMC staff completed the evaluations on 6/6, 6/8, and 6/10/05. By this time the grasses were tillered and the weeds were tall, making counting difficult. It was decided to record each species as absent, present, or abundant (>20 seedlings). A species was recorded as present or abundant if it occurred anywhere in the 4 rows within 1 foot of the data point, rather than recording each individual row as was done previously. This data will be less site specific and more difficult to analyze, but is much quicker to collect.

Cover class estimates were not taken on the spring 2004 seeding, again due to lack of assistance.

The Palouse Prairie Foundation assisted in the seeding of both the spring 2006 and fall 2006 plots on 5/10/06 and 10/24/06. PMC staff did all the data collection. Emergence data was take on 5/30 and 5/31/06 for the fall 2005 plots and 7/6/06 for the spring 2006 plots. Cover class data for the spring 2004, fall 2004, and spring 2005 plots was collected on 7/28, 8/4, 8/10. 8/11, and 8/14/06.

References cited:

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Plot design: Methods for restoring Palouse Prairie grasses and forbs in an agricultural field

	6 ft border, bluebunch and FEID			
	spring 04 rep 1	spring 04 rep 2	spring 04 rep 3	
	6 ft border, bluebunch and FEID			
	fall 04 rep 1	fall 04 rep 2	fall 04 rep 3	
	6 ft border, bluebunch and FEID			
	spring 05 rep 1	spring 05 rep 2	spring 05 rep 3	
	6 ft border, bluebunch and FEID			
	fall 05 rep 1	fall 05 rep 2	fall 05 rep 3	
	6 ft border, bluebunch and FEID			
	spring 06 rep 1	spring 06 rep 2	spring 06 rep 3	
	6 ft border, bluebunch and FEID			
	fall 06 rep 1	fall 06 rep 2	fall 06 rep 3	
	6 ft border, bluebunch and FEID			

Plot Layout: Methods for restoring Palouse Prairie grasses and forbs in an agricultural field. **N ↑**

	rep 104 S					rep 204 S					rep 304 S				
spring 04	1	3	5	7	9	6	5	1	4	0	4	2	6	7	5
4/20/04	2	4	6	8	10	4	2	3	7	9	1	6	4	3	0

	rep 104 F					rep 204 F					rep 304 F				
fall 04	9	1	4	5	6	3	2	4	9	8	2	6	8	1	9
10/25/04	3	7	10	8	2	5	10	6	1	7	5	10	3	7	4

	rep 105 S					rep 205 S					rep 305 S				
spring 05	5	8	7	3	4	8	7	1	5	4	4	7	6	1	8
3/18/05	6	1	9	10	2	2	9	10	3	6	10	9	5	3	2

	rep 105 F					rep 205 F					rep 305 F				
fall 05	5	10	9	4	6	7	6	3	9	2	7	5	1	6	4
10/12/05	2	7	8	1	3	1	5	4	8	10	10	2	8	9	3

	rep 106 S					rep 206 S					rep 306 S				
spring 06	4	9	6	5	10	5	6	9	8	2	2	7	3	1	4
	3	2	8	1	7	4	3	1	10	7	5	8	6	9	10

	rep 106 F					rep 206 F					rep 306 F				
fall 06	1	10	2	7	6	4	10	2	1	7	9	4	3	2	1
	8	3	9	4	5	9	6	8	3	5	10	6	7	8	5

Not to scale. Break between replications is shown on the layout for clarity, it does not exist in the field

Spring treatments

1 broadcast grasses alone
2 seed grasses alone
3 seed forbs alone
4 seed forbs w/ seeded grasses
5 broadcast forbs alone
6 broadcast forbs w/ seeded grasses
7 seed grasses, fall broadcast forbs
8 seed PSSP, fall broadcast FEID
9 seed grasses and forbs w/ mulch
10 broadcast grasses and forbs with mulch

Fall treatments

1 broadcast grasses alone
2 seed grasses alone
3 seed forbs alone
4 broadcast forbs alone
5 seed grasses
6 broadcast forbs and grasses
7 seed grasses and broadcast forbs
8 seed PSSP, broadcast FEID
9 seed grasses and forbs w/ mulch
10 broadcast grasses and forbs w/ mulch

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

STUDY NUMBER: WAPMC-T-0410-RA. Natural colonization of an established stand of hard fescue by native plants.

PROJECT NUMBER:

STUDY TYPE: Prairie Restoration

LAND USES:

VEGETATIVE PRACTICES: PRIMARY:
SECONDARY:

DESCRIPTION: Passive restoration involves the removal of disturbance and the use of natural processes to restore habitat without direct intervention and large-scale manipulation. Opportunities for passive restoration of Palouse Prairie are limited by the fragmentation, rarity, and limited size of remnants of native vegetation as well as the constant disturbance of agriculture in the land surrounding the remnant. Some agricultural land is being retired under the Conservation Reserve Program (CRP) and other land is being sold to small landowners who do not desire to continue farming operations. The ability of native species to spread from a nearby remnant and colonize land from which disturbance has been removed is not well understood or documented. Field 2 on the Pullman PMC was used for grain, grass seed and hay production since at least 1938, when the PMC acquired the land. Field 15A is steep and rocky ground which was never farmed, although some early maps indicate it may have been used for livestock pasture at one time. Much of field 15A is a *Crataegus douglasii – Heracleum lanatum* habitat type or the *Populus tremuloides* phase of that habitat type and the *Symphoricarpos albus* phase of the *Festuca idahoensis – Symphoricarpos albus* habitat type (Daubenmire 1970). The understory has been invaded by *Bromus inermis* to a large degree. There remains, however, a small open area near the center of the hillside which contains moderate quality *Festuca idahoensis – Symphoricarpos albus* and *Agropyron spicatum – Poa secunda* habitat types. A plant species survey was conducted in 1997. See "Species list field 15A:" below for species found in field 15A.

In 1978 a planting of hybrid poplars was made along the southern edge of field 2D. The area of the poplar planting was then designated field 2E. See Project 1-77A "Evaluation of Poplar Accessions for Erosion Control in Irrigated Areas of MLRA 7 and 8" in the 1978 ATR for details. In 1983 Durar hard fescue was seeded around and between the poplar planting.

In 1996 it was noticed that some native forbs had colonized the area of hard fescue between the poplar planting and the northern edge of field 15A. Photographs of the site were taken in 1999 and 2000. By 2003, it was obvious that the native forbs were actively increasing on the site.

DURATION OF STUDY:

STUDY LEADER: David M. Skinner

LOCATION: Pullman PMC field 2E

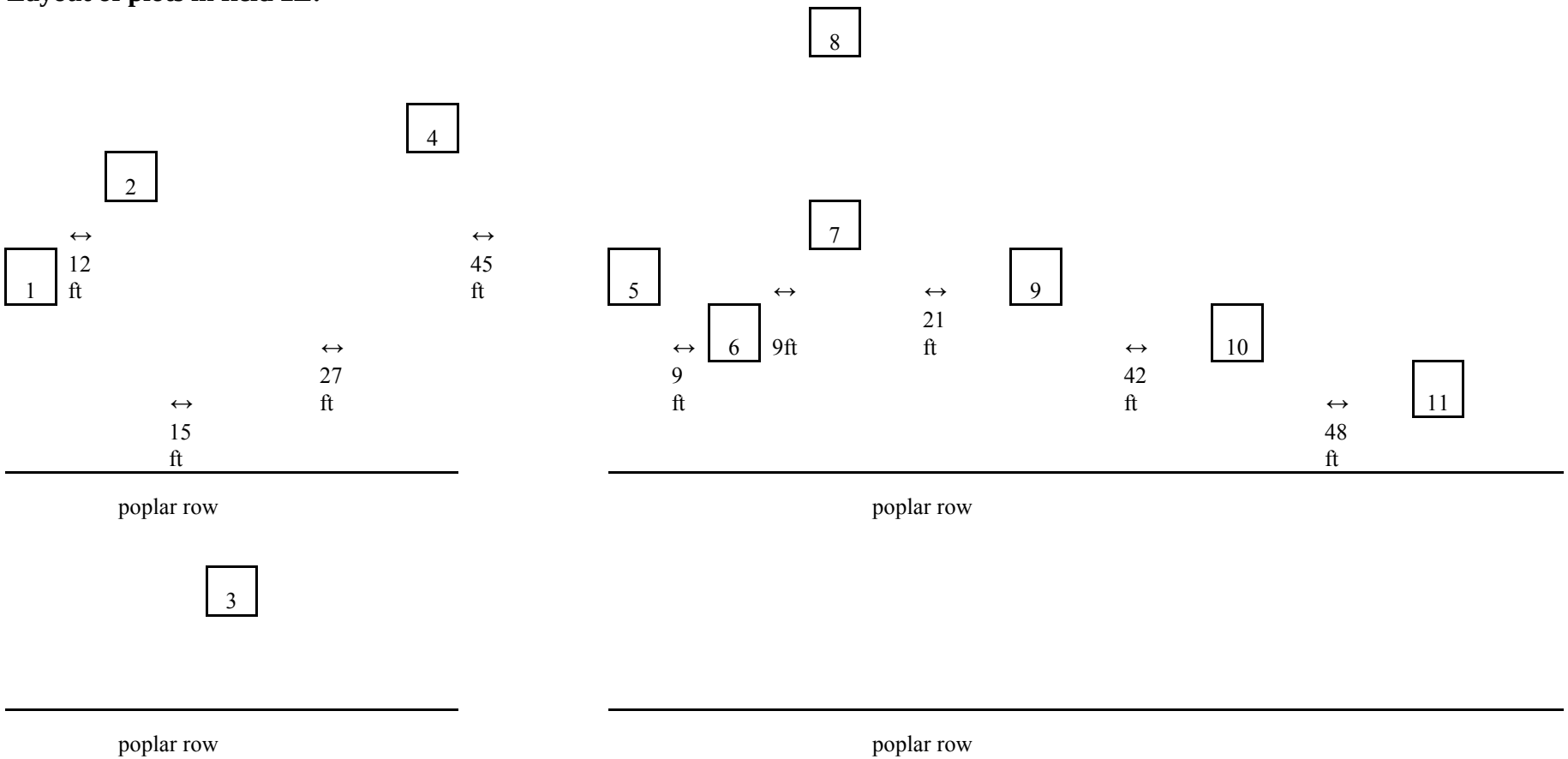
COOPERATORS:

EXPERIMENTAL DESIGN:

PROCEDURE: Establish permanent 1 meter square monitoring plots in field 2E. Record annually the number of juvenile and reproducing plants in each plot and the % basal cover of the hard fescue in each. At least one plot should be located outside the present known extent of the native plants to both the east and west of the colonized area. Document any new colonization outside the plot area.

PROGRESS: 11 plots were established in 2004 and data collected on 8/2/04. See layout below. On 5/11/05 the plots were examined and data taken on any spring ephemeral species which had been missed in August of the previous year. *Viola adunca* was recorded in plots 7 and 8, and 1 *Calochortus elegans* was found in plot 9. *Achillea millefolium*, *Lomatium dissectum*, and *Geranium viscosissimum* were found outside the plot area to the east and to the west. One *Heracleum lanatum* was also found to the west of the plots. Since all the plants except the *H. lanatum* were flowering, it is likely these plants were there in 2004 but as juveniles which escaped notice. Data was taken on the plots on 9/2/05. See table "**Hard fescue cover and plant counts: field 2E**" below for data.
Two plants of *Lomatium grayi* were found and marked in field 11E off the west end of field 14A in 2003. In 2005, a plot was established around each of them and data taken on 5/12/05. The flowering plants were know to be present in 2004, but non-reproductive plants were not counted. See "**Hard fescue cover and plant counts: field 11E**" below for data. 4 additional non-reproductive *Lomatium grayi* were present outside plot 12 in 2005.
Data was taken on 7/21/06 from plots 1-11. No data was collected on plots 12 and 13.

Layout of plots in field 2E:



Distances are approximate and are from the east edge of 1 plot to the west edge of the next plot to the west.
Plot 1 was the eastern most *Geranium viscosissimum* plant in 2004.
Plot 3 is between the rows of poplars.
Plot 5 is the first plot after the break in the center of the poplar rows.
Plot 11 is about 20 feet west of the last *Geranium viscosissimum* plant in 2004.
All plots are marked with a fiberglass fencepost in the northeast and northwest corners. A 10 inch spike with a 1¾ flat washer is driven into the ground immediately west of each post.

Hard fescue cover and plant counts: field 2E

Plot 1		2004	2005
Festuca trachyphylla	%	50	40
Geranium viscosissimum	N	2	
Geranium viscosissimum	R	1	1
Symphoricarpos albus	N		1
Symphoricarpos albus	R		
Tragopogon dubius	N	1	
Tragopogon dubius	R	0	

Plot 2		2004	2005
Festuca trachyphylla	%	40	40
Dipsacus sylvestris	N	2	3
Dipsacus sylvestris	R	0	
Lactuca serriola	N	1	
Lactuca serriola	R	0	
Lupinus sericeus	N	5	5
Lupinus sericeus	R	0	
Rosa nutkana/woodsii	N	1	1
Rosa nutkana/woodsii	R	0	

Plot 3		2004	2005
Festuca trachyphylla	%	10	10
Bromus inermis	N	2	2
Bromus inermis	R	0	0
Cornus sericea	N	0	1
Cornus sericea	R	0	0
Crataegus douglasii	N	24	36
Crataegus douglasii	R	0	0
Cynoglossum officinalis	N	1	0
Cynoglossum officinalis	R	0	0
Epilobium paniculatum	N	1	0
Epilobium paniculatum	R	0	0
Lactuca serriola	N	6	0
Lactuca serriola	R	0	0
Lupinus sericeus	N	13	7
Lupinus sericeus	R	0	2
Senecio serra	N	1	1
Senecio serra	R	0	0

Plot 4		2004	2005
Festuca trachyphylla	%	40	40
Bromus inermis	N	0	1
Bromus inermis	R	0	0
Dipsacus sylvestris	N	0	0
Dipsacus sylvestris	R	2	0
Geranium viscosissimum	N	4	3
Geranium viscosissimum	R	2	2
Iris missouriensis	N	0	0
Iris missouriensis	R	2	4
Lupinus sericeus	N	25	14
Lupinus sericeus	R	5	4
Symphoricarpos albus	N	0	8
Symphoricarpos albus	R	6	5

Plot 5		2004	2005
Festuca trachyphylla	%	50	50
Bromus inermis	N	0	0
Bromus inermis	R	22	2
Clematis hirsutissima	N	0	0
Clematis hirsutissima	R	1	0
Gaillardia aristata	N	2	0
Gaillardia aristata	R	0	0
Geranium viscosissimum	N	1	2
Geranium viscosissimum	R	3	3
Lactuca serriola	N	0	0
Lactuca serriola	R	2	0
Lupinus leucophyllus	N	15	3
Lupinus leucophyllus	R	0	0

Plot 6		2004	2005
Festuca trachyphylla	%	45	50
Achillea millefolium	N	1	1
Achillea millefolium	R	0	0
Crataegus douglasii	N	1	0
Crataegus douglasii	R	0	0
Gaillardia aristata	N	6	0
Gaillardia aristata	R	3	1
Geranium viscosissimum	N	1	0
Geranium viscosissimum	R	4	3
Lupinus leucophyllus	N	12	13
Lupinus leucophyllus	R	9	4

Plot 7		2004	2005
Festuca trachyphylla	%	50	50
Achillea millefolium	N	1	0
Achillea millefolium	R	0	0
Dipsacus sylvestris	N	1	1
Dipsacus sylvestris	R	0	0
Gaillardia aristata	N	0	0
Gaillardia aristata	R	0	0
Geranium viscosissimum	N	2	4
Geranium viscosissimum	R	7	4
Lupinus leucophyllus	N	24	17
Lupinus leucophyllus	R	8	2
Prunus virginiana	N	0	1
Prunus virginiana	R	0	0
Viola adunca	all	NA	1

Plot 8		2004	2005
Festuca trachyphylla	%	20	20
Achillea millefolium	N	5	9
Achillea millefolium	R	1	0
Aster occidentalis	N	35	0
Aster occidentalis	R	0	0
Carex geyeri	%	20	
Carex geyeri	all		4
Gaillardia aristata	N	3	0
Gaillardia aristata	R	2	2
Gentiana affinis	N	0	2
Gentiana affinis	R	5	3
Geranium viscosissimum	N	2	6
Geranium viscosissimum	R	1	0
Heuchera cylindrica	N	3	0
Heuchera cylindrica	R	0	0
Iris missouriensis	N	4	2
Iris missouriensis	R	0	0
Lupinus leucophyllus	N	14	26
Lupinus leucophyllus	R	15	2
Spiraea betulifolia	N	0	0
Spiraea betulifolia	R	2	1
Symphoricarpos albus	N	0	1
Symphoricarpos albus	R	7	2
Viola adunca	all	NA	56

Plot 9		2004	2005
Festuca trachyphylla	%	30	40
Bromus inermis	N	0	0
Bromus inermis	R	30	6
Calochortus elegans	N	NA	0
Calochortus elegans	R	NA	1
Dipsacus sylvestris	N	0	1
Dipsacus sylvestris	R	2	1
Geranium viscosissimum	N	1	0
Geranium viscosissimum	R	2	2
Lupinus leucophyllus	N	8	7
Lupinus leucophyllus	R	1	1
Myosotis micrantha	all	0	1
Symphoricarpos albus	N	0	12
Symphoricarpos albus	R	7	4

Plot 10		2004	2005
Festuca trachyphylla	%	40	40
Bromus inermis	N	9	5
Bromus inermis	R	0	0
Cirsium arvense	N	2	1
Cirsium arvense	R	0	0
Crataegus douglasii	N	11	6
Crataegus douglasii	R	0	0
Geranium viscosissimum	N	5	2
Geranium viscosissimum	R	0	0
Lactuca serriola	N	1	0
Lactuca serriola	R	0	0
Lupinus leucophyllus	N	1	1
Lupinus leucophyllus	R	1	1
Populus tremuloides	all	2	2

Plot 11		2004	2005
Festuca trachyphylla	%	35	40
Cirsium arvense	N	17	10
Cirsium arvense	R	0	0
Dipsacus sylvestris	N	0	0
Dipsacus sylvestris	R	1	0
Taraxacum officinalis	all	1	0

Hard fescue cover and plant counts: field 11E

Plot 12		2004	2005
Festuca trachyphylla	%	NA	70
Lomatium grayi	N	NA	10
Lomatium grayi	R	1	2

Plot 13		2004	2005
Festuca trachyphylla	%	NA	60
Lomatium grayi	N	NA	1
Lomatium grayi	R	1	1

% = percent basal cover
N = number of non-reproductive individuals (See note below)
R = number of reproductive individuals (See note below)
all = combined number of reproductive and non reproductive individuals
Note: For the rhizomatous species *Bromus inermis, Cirsium arvense, Iris missouriensis, Rosa, Spiraea betulifolia*, and *Symphoricarpos albus*, each stem obviously arising from a separate point on a rhizome was counted as an individual. For the caespitose species, each number represents an obviously separate plant.

Species list field 15A:

Species	Family	Nativity
Achillea millefolium	Asteraceae	native
Allium acuminatum	Liliaceae	native
Alopecurus pratensis	Poaceae	introduced
Amelanchier alnifolia	Rosaceae	native
Antennaria luzuloides	Asteraceae	native
Arabis sp.	Brassicaceae	native
Arnica sororia	Asteraceae	native
Arrhenatherum elatius	Poaceae	introduced
Aster occidentalis	Asteraceae	native
Balsamorhiza sagittata	Asteraceae	native
Besseya rubra	Scrophulariaceae	native
Brodiaea douglasii	Liliaceae	native
Bromus inermis	Poaceae	introduced
Bromus tectorum	Poaceae	introduced
Calochortus elegans	Liliaceae	native
Castilleja lutescens	Scrophulariaceae	native
Cirsium brevifolium	Asteraceae	native
Cirsium vulgare	Asteraceae	introduced
Clarkia pulchella	Onagraceae	native
Clematis hirsutissima	Ranunculaceae	native
Crataegus douglasii	Rosaceae	native
Delphinium nuttallianum	Ranunculaceae	native
Dipsacus sylvestris	Dipsacaceae	introduced
Dodecatheon pulchellum	Primulaceae	native
Draba verna	Brassicaceae	introduced
Elymus glaucus	Poaceae	native
Erythronium grandiflorum	Liliaceae	native
Festuca idahoensis	Poaceae	native
Gaillardia aristata	Asteraceae	native
Galium aparine	Rubiaceae	?
Galium boreale	Rubiaceae	native
Gentiana affinis	Gentianaceae	native
Geranium viscosissimum	Geraniaceae	native
Geum triflorum	Rosaceae	native
Haplopappus liatriformis	Asteraceae	native
Helianthella uniflora	Asteraceae	native
Heracleum lanatum	Apiaceae	native
Heuchera cylindrica	Saxifragaceae	native
Hieracium albertinum	Asteraceae	native
Hydrophyllum capitatum	Hydrophyllaceae	native
Iris missouriensis	Iridaceae	native

Species list field 15A: (continued)

Species	Family	Nativity
Juniperus scopulorum	Cupressaceae	introduced
Linum lewisii	Linaceae	native
Lithophragma parviflora	Saxifragaceae	native
Lithospermum ruderale	Boraginaceae	native
Lomatium dissectum	Apiaceae	native
Lomatium gormanii	Apiaceae	native
Lomatium grayi	Apiaceae	native
Lomatium macrocarpum	Apiaceae	native
Lupinus leucophyllus	Fabaceae	native
Lupinus sericeus	Fabaceae	native
Mahonia repens	Berberidaceae	native
Microsteris gracilis	Polemoniaceae	native
Perideridia gairdneri	Apiaceae	native
Poa bulbosa	Poaceae	introduced
Poa pratensis	Poaceae	introduced
Polygonum douglasii	Polygonaceae	native
Populus tremuloides	Salicaceae	native
Potentilla arguta	Rosaceae	native
Potentilla gracilis	Rosaceae	native
Prunus virginiana	Rosaceae	native
Pseudoroegneria spicata	Poaceae	native
Rosa nutkana	Rosaceae	native
Rosa woodsii	Rosaceae	native
Senecio integerrimus	Asteraceae	native
Senecio serra	Asteraceae	native
Sidalcea oregana	Malvaceae	native
Silene douglasii	Caryophyllaceae	native
Silene scouleri	Caryophyllaceae	native
Solidago missouriensis	Asteraceae	native
Sorbus aucuparia	Rosaceae	introduced
Spiraea betulifolia	Rosaceae	native
Symphoricarpos albus	Caprifoliaceae	native
Valeriana edulis	Valerianaceae	native
Ventenata dubia	Poaceae	introduced
Veratrum californicum	Liliaceae	native
Viola adunca	Violaceae	native
Zigadenus venenosus	Liliaceae	native

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

STUDY NUMBER: WAPMC-T-0605-RA. Evaluation of herbicides for weed control in seed production of native forbs.

PROJECT NUMBER:

STUDY TYPE: Prairie Restoration

LAND USES:

VEGETATIVE PRACTICES: PRIMARY:
SECONDARY:

DESCRIPTION: Seed availability is a major impediment to restoring Palouse Prairie. Seed growers will need cultural information on seeding practices in order to successfully increase the seed supply, yet little is know about how to grow most of the native Palouse Prairie forbs in a seed production setting. Weed control can be especially problematic. Few herbicides are labeled specifically for seed production of native forbs and little is know of the effects of most herbicides on those species. Herbicides which are used in ornamental plants likely have the most potential for use on native forbs. The objective of this study is to screen various herbicides for effectiveness in weed control and low impact on native species of forbs.

DURATION OF STUDY: 5 years

STUDY LEADER: David M. skinner

LOCATION: Pullman PMC

COOPERATORS:

EXPERIMENTAL DESIGN:

PROCEDURE: Determine which herbicides can potentially be used in native forb seed production and screen them by applying at labeled rates to plantings in the field. Data collected will be determined by the specific application, forb species, and weed species.

PROGRESS: The labels of over 25 herbicides were examined. Of these, three were identified as being potentially useful. Gallery 75 Dry Flowable (Isoxaben) and Prowl 3EC (Pendimethalin) are germination inhibitors which must be applied prior to weed emergence. Both are rain activated. Buctril 4EC (bromoxynil) is a contact herbicide which can be used to control emerged weeds, but may cause injury to the desired species.

Early spring application of Buctril might control emerged winter annual broadleaf weeds and cause minimal damage to established perennial forbs.
The existing 2003 and 2004 forb plantings in field I1 were used for trials (see WAPMC-T-0307-RA. Evaluation of Seeding Time on Establishment of Palouse Prairie Forbs for Seed Increase). Application was made with a Jacto backpack sprayer with a 54 inch boom width. Flags were placed at points 8, 12, and 16 feet from the west end of each set of plots and a spray swath roughly north and south across the seeded direction of the plots was made with the center of the boom at the flag for each chemical. Prowl was applied at a rate of 2 pts/acre on the 8 foot mark, Gallery at 0.66lbs/acre at the 12 foot mark and Buctril at 1½ pts/acre at the 16 foot mark. Applications were made on 3/4/05. Plots were evaluated on 7/11 to 7/13/05. A 34" x 44" frame was centered over each spray swath and the average height of the seeded species was determined. The primary weed was *Lactuca serriola*. Canopy cover class estimates were made for the seeded species, for *Lactuca serriola*, and for all other weed species in the plot. 10 *Lactuca serriola* plants in each frame were randomly selected. Height in centimeters was measured and the number of leaves was counted. Means of the data for each species over all plots is shown below. *Pseudoroegneria spicata* and *Festuca idahoensis* were not seeded in 2002 and thus the data is for 2003 only.
None of the herbicide treatments provided consistent or adequate weed control. No precipitation was received from 2/12/05 until 3/16/05. The dry conditions probably resulted in poor activation of Gallery and Prowl and thus poor control of weeds germinating after rain was received in late March. Likewise, Buctril is a contact herbicide and would have had no effect on any weeds emerging after application. Plots with high percent cover of the seeded species did have much lower weed populations, but that was likely a function of the competition, not the herbicide application.

No further work was done in 2006.

Table. 2005 Herbicide Trials, field I1: Means of all plots by species seeded.

	check	Prowl	Gallery	Buctril
Agoseris grandiflora ht (cm)	24.6	37.67	31	41.8
Agoseris grandiflora % cover	13.83	13.75	7.5	12.08
Lactuca serriola no. of leaves	7.7	9.07	8.83	8.52
Lactuca serriola ht (cm)	22.42	26.4	27.55	24.77
Lactuca serriola % cover	34.17	26.25	42.08	49.58
Cover all other weeds (%)	41.25	32.92	40.83	31.25
Total weeds % cover	75.42	59.17	82.91	80.83
Achillea millefolium ht (cm)	62.33	60.5	63.83	64.5
Achillea millefolium % cover	67.92	73.33	85.42	73.75
Lactuca serriola no. of leaves	4.65	4.43	4.53	4.59
Lactuca serriola ht (cm)	13.63	11.6	12.94	12.33
Lactuca serriola % cover	8.75	4.58	2.5	10.42
Cover all other weeds (%)	10.83	6.42	9.58	10.42
Total weeds % cover	19.58	11	12.08	20.84
Gaillardia aristata ht (cm)	50.5	52.5	51.67	54.33
Gaillardia aristata % cover	60.08	62.08	65.42	57.92
Lactuca serriola no. of leaves	4.9	6.2	6.57	6.83
Lactuca serriola ht (cm)	13.53	18.41	19.65	20.27
Lactuca serriola % cover	18.33	18.33	12.5	12.5
Cover all other weeds (%)	28.33	37.92	32.5	39.17
Total weeds % cover	46.66	56.25	45	51.67
Aster occidentalis ht (cm)	49.83	35.5	50.5	43.83
Aster occidentalis % cover	42.5	34.58	43.75	32.08
Lactuca serriola no. of leaves	7.35	7.62	8.23	8.4
Lactuca serriola ht (cm)	21.15	25.03	25.92	22.9
Lactuca serriola % cover	26.67	30.42	26.25	18.33
Cover all other weeds (%)	29.58	27.08	31.67	45
Total weeds % cover	56.25	57.5	57.92	63.33
Geum triflorum ht (cm)	4.4	7	5.4	7.2
Geum triflorum % cover	4	4.17	4	9
Lactuca serriola no. of leaves	8.65	8.78	9.95	8.67
Lactuca serriola ht (cm)	26.83	27.15	26.87	27.45
Lactuca serriola % cover	42.08	32.5	32.5	40.42
Cover all other weeds (%)	46.67	50.42	50	65.83
Total weeds % cover	88.75	82.92	82.5	106.25

Table. 2005 Herbicide Trials, field I1: Means of all plots by species seeded (cont).

	check	Prowl	Gallery	Buctril
Galium boreale ht (cm)	20	17.33	15.33	19
Galium boreale % cover	5	5	2.5	5
Lactuca serriola no. of leaves	8.51	9.25	10.85	10.58
Lactuca serriola ht (cm)	27.02	30.02	36.17	26.23
Lactuca serriola % cover	37.92	24.17	37.92	48.33
Cover all other weeds (%)	75	67.5	50.42	52.08
Total weeds % cover	112.92	91.67	88.34	100.41
Helianthella uniflora ht (cm)	15.83	20	16.17	16.17
Helianthella uniflora % cover	18.33	21.5	8.75	10.83
Lactuca serriola no. of leaves	9.12	8.12	10.05	8.78
Lactuca serriola ht (cm)	28.93	24.48	31.18	24.57
Lactuca serriola % cover	36.25	27.92	28.33	32.08
Cover all other weeds (%)	40.83	50.42	37.75	47.67
Total weeds % cover	77.08	78.34	66.08	79.75
Haplopappus liatriformis ht (cm)	53.6	35.5	32.4	41.17
Haplopappus liatriformis % cover	26.5	13.69	25.83	13.69
Lactuca serriola no. of leaves	7.98	7.57	7.43	8.05
Lactuca serriola ht (cm)	26.52	23.33	26.83	24
Lactuca serriola % cover	30.42	20.83	27.91	20.42
Cover all other weeds (%)	50	50.83	59.17	47.92
Total weeds % cover	80.42	71.66	87.08	68.34
Lupinus leucophyllus ht (cm)	48	45.5	42.33	51
Lupinus leucophyllus % cover	42.08	42.08	42.08	36.25
Lactuca serriola no. of leaves	7.28	7.2	8.38	8.43
Lactuca serriola ht (cm)	26.12	25.28	31.73	29.51
Lactuca serriola % cover	28.33	30	32.08	26.25
Cover all other weeds (%)	50.42	35.83	41.67	48.33
Total weeds % cover	78.75	65.83	73.75	74.58
Heuchera cylindrica ht (cm)	0	0	0	0
Heuchera cylindrica % cover	0	0	0	0
Lactuca serriola no. of leaves	8.93	8.3	12.27	9.15
Lactuca serriola ht (cm)	27.83	26.15	34.28	27.55
Lactuca serriola % cover	42.83	38.33	44.58	42.08
Cover all other weeds (%)	38.75	45	39.58	43.33
Total weeds % cover	81.58	83.33	84.16	85.41

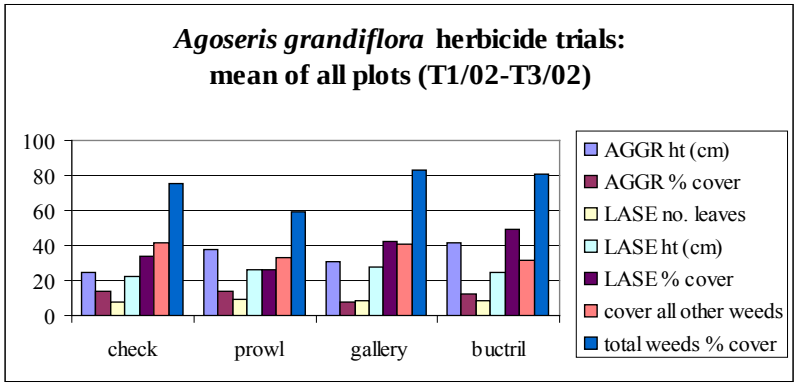
Table. 2005 Herbicide Trials, field I1: Means of all plots by species seeded (cont).

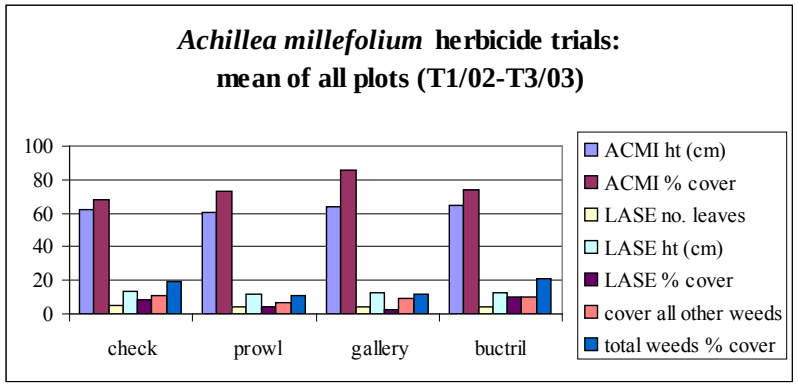
	check	Prowl	Gallery	Buctril
Potentilla arguta ht (cm)	24.67	15.5	15.25	12.8
Potentilla arguta % cover	12.5	20	17.5	12
Lactuca serriola no. of leaves	8.57	7.76	8.35	8.28
Lactuca serriola ht (cm)	26.57	24.18	26.57	25.88
Lactuca serriola % cover	37.92	34.58	37.92	32.08
Cover all other weeds (%)	43.75	28.75	49.17	36.25
Total weeds % cover	81.67	63.33	87.09	68.33
Penstemon confertus ht (cm)	19.8	21.4	38.2	34.6
Penstemon confertus % cover	23	14	33	26.5
Lactuca serriola no. of leaves	8.58	9	10.63	9.87
Lactuca serriola ht (cm)	26.6	28.35	34.4	30.12
Lactuca serriola % cover	38.33	31.67	38.33	24.17
Cover all other weeds (%)	36.25	48.33	22.08	31.67
Total weeds % cover	74.58	80	60.41	55.84
Sidalcea oregana ht (cm)	19.25	14.5	14.83	14
Sidalcea oregana % cover	14.38	11.88	10.83	12
Lactuca serriola no. of leaves	7.78	7.77	7.83	7.97
Lactuca serriola ht (cm)	23.77	21.53	23.81	21.13
Lactuca serriola % cover	36.25	34.58	34.58	24.17
Cover all other weeds (%)	52.08	64.58	60	57.08
Total weeds % cover	88.33	99.16	94.58	81.25
Potentilla gracilis ht (cm)	27.17	30.2	19.33	26
Potentilla gracilis % cover	22.5	24	18.33	18.75
Lactuca serriola no. of leaves	8.55	7.8	8.92	7.6
Lactuca serriola ht (cm)	25.95	24.1	27.37	23.17
Lactuca serriola % cover	34.17	26.25	37.92	36.25
Cover all other weeds (%)	24.58	40.83	51.67	38.75
Total weeds % cover	58.75	67.08	89.59	75
Lomatium dissectum ht (cm)	12.33	15.5	11.33	14
Lomatium dissectum % cover	10.83	10	2.5	6.67
Lactuca serriola no. of leaves	6.43	6.48	8.28	6.93
Lactuca serriola ht (cm)	17.65	16.73	21.98	18.7
Lactuca serriola % cover	31.67	30.42	26.25	22.92
Cover all other weeds (%)	38.75	48.33	47.92	23.33
Total weeds % cover	70.42	78.75	74.17	46.25

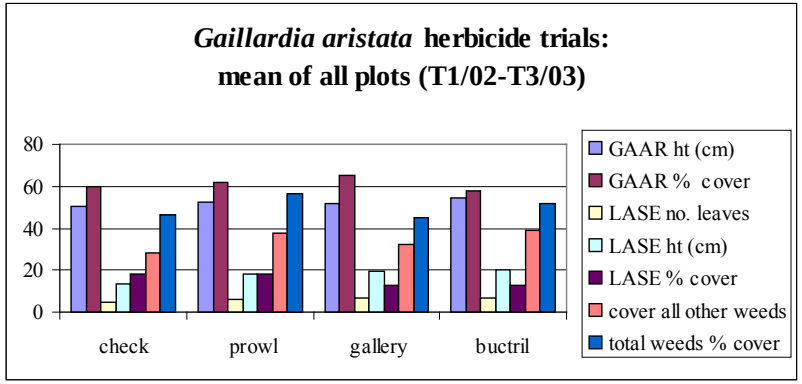
Table. 2005 Herbicide Trials, field I1: Means of all plots by species seeded (cont).

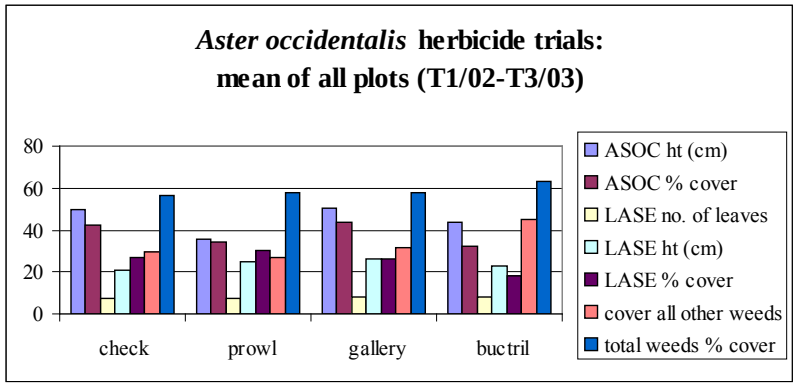
	check	prowl	gallery	Buctril
Solidago missouriensis ht (cm)	51.5	55.67	52	53.2
Solidago missouriensis % cover	52.08	62.08	55.83	40.5
Lactuca serriola no. of leaves	7.15	8.79	7.92	7.45
Lactuca serriola ht (cm)	20.37	21.48	22.42	19.43
Lactuca serriola % cover	16.25	16.25	20.42	20.83
Cover all other weeds (%)	27.92	17.92	31.25	36.25
Total weeds % cover	44.17	34.17	51.67	57.08
Pseudoroegneria spicata ht (cm)	64	69.67	73.67	70.67
Pseudoroegneria spicata % cover	25.83	22.5	30	38.33
Lactuca serriola no. of leaves	8.4	9.63	9.13	10.1
Lactuca serriola ht (cm)	26.23	29.2	22.5	22.5
Lactuca serriola % cover	45.33	46.67	22.5	22.5
Cover all other weeds (%)	35.83	39.17	42.5	24.17
Total weeds % cover	81.16	85.84	65	46.67
Festuca idahoensis ht (cm)	30	41.67	40	49
Festuca idahoensis % cover	15	15	30.83	30
Lactuca serriola no. of leaves	11.4	9.73	13.87	10.83
Lactuca serriola ht (cm)	35.57	33.1	39.43	31.63
Lactuca serriola % cover	61.67	46.67	37.5	22.5
Cover all other weeds (%)	39.17	35.83	50	45.83
Total weeds % cover	100.84	82.5	87.5	68.33

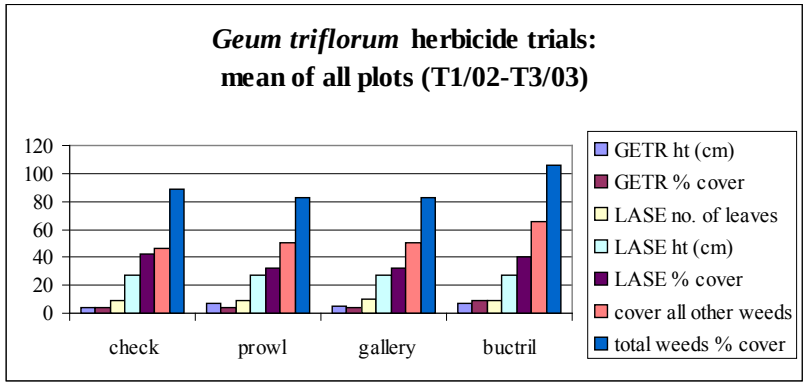
Graph. 2005 Herbicide Trials, field I1: Means of all plots by species seeded.

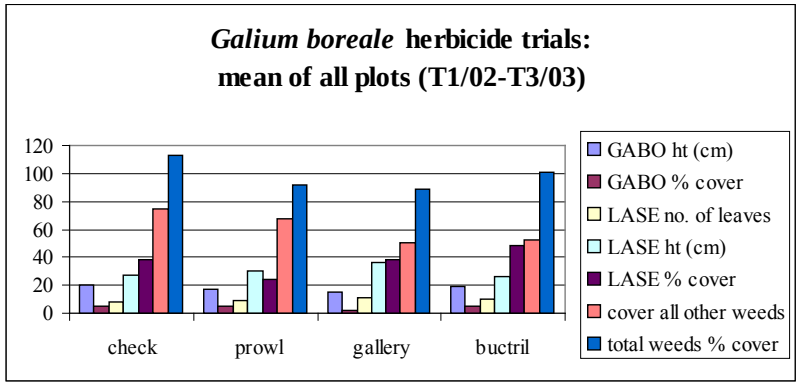






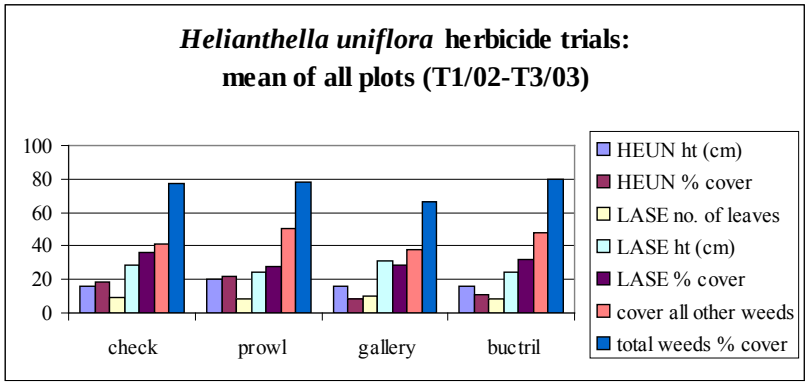


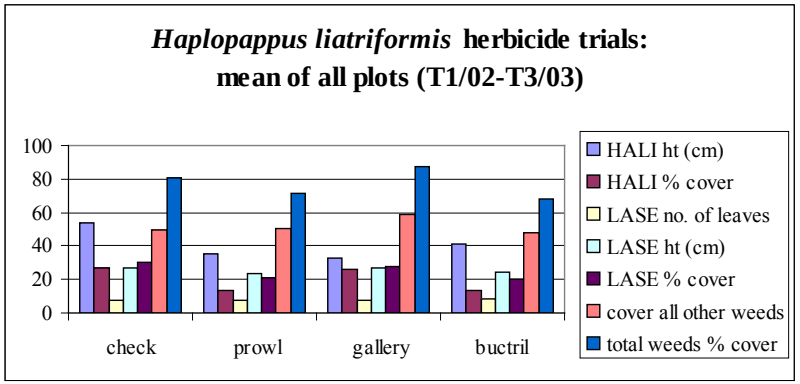


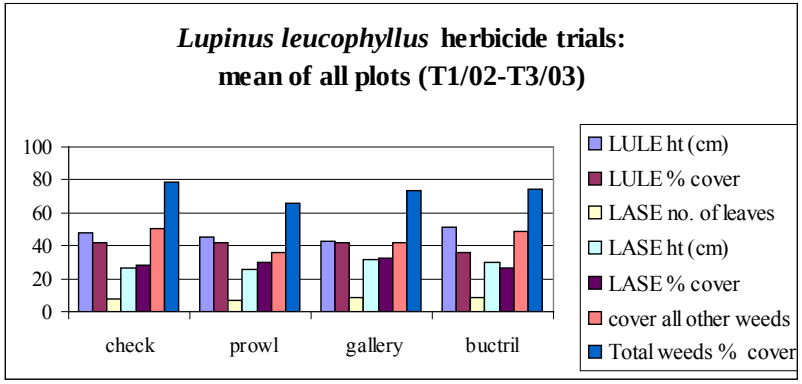


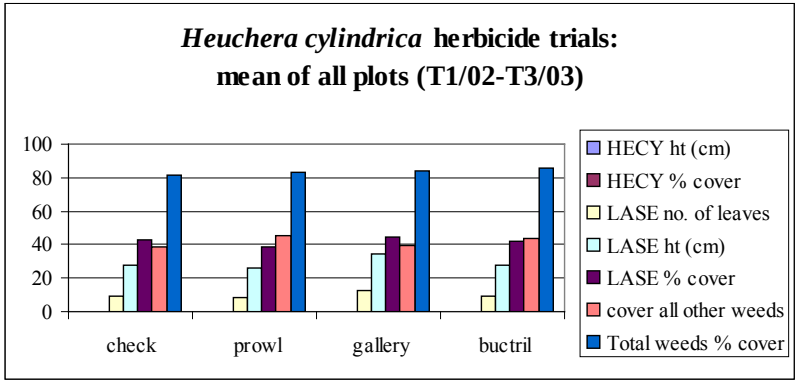
T1 = early fall seeding. T2 = late fall seeding. T3 = spring seeding.

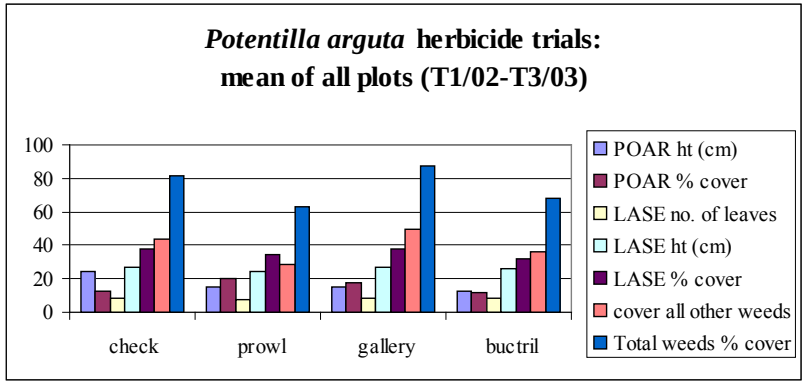
Graph. 2005 Herbicide Trials, field I1: Means of all plots by species seeded (continued).

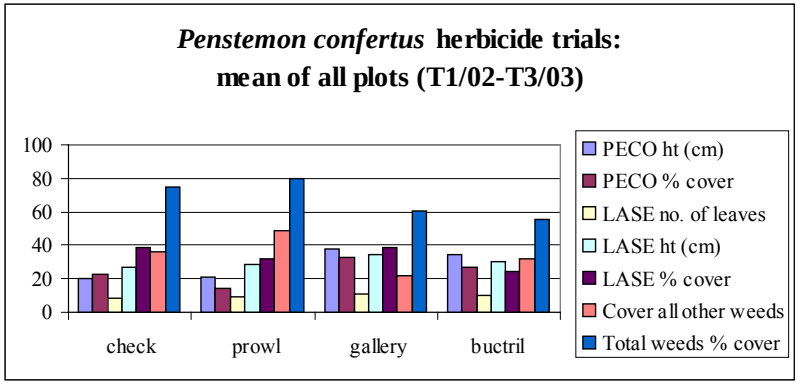






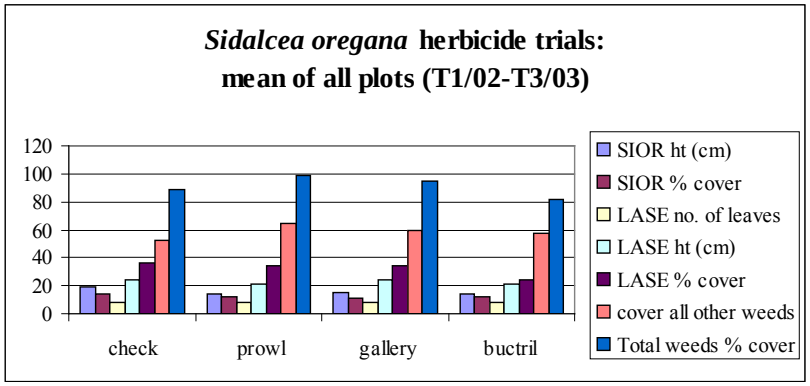


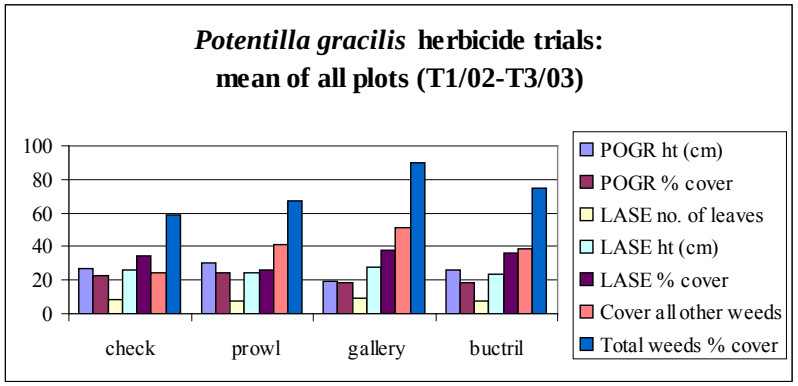


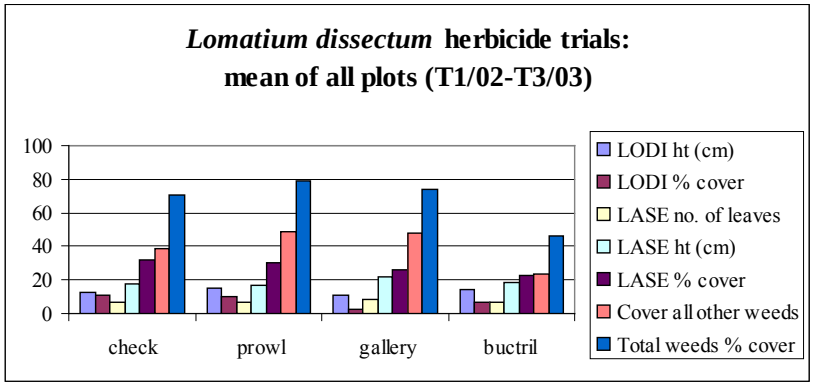


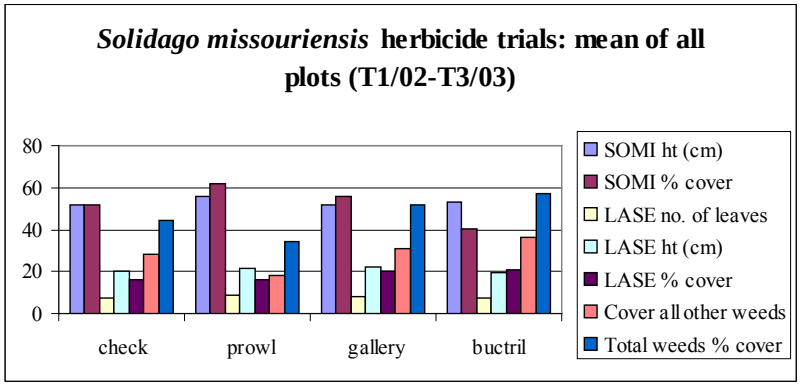
T1 = early fall seeding. T2 = late fall seeding. T3 = spring seeding.

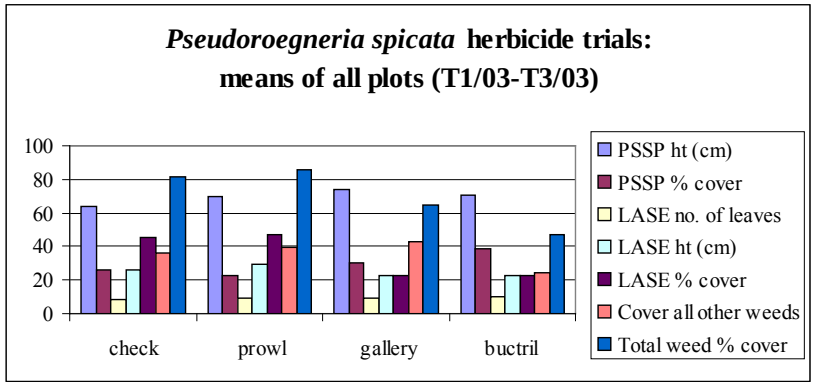
Graph. 2005 Herbicide Trials, field I1: Means of all plots by species seeded (continued).

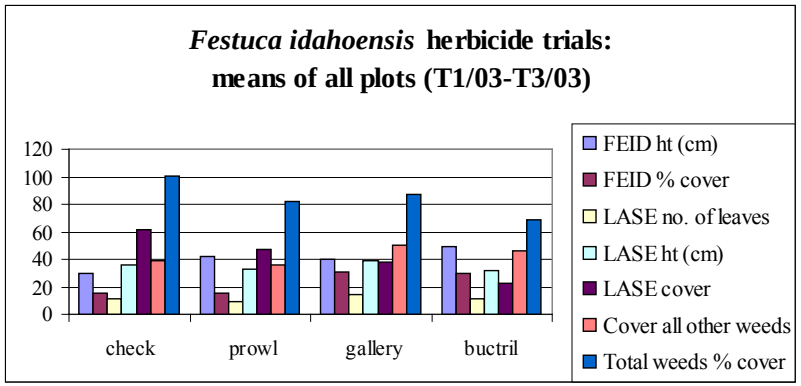












T1 = early fall seeding. T2 = late fall seeding. T3 = spring seeding.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

STUDY NUMBER: WAPMC-T-0703-RA Evaluation of spring and fall alternate row seeding of grasses and forbs as a technique for Palouse Prairie restoration.

PROJECT NUMBER:

STUDY TYPE: Prairie Restoration

LAND USES:

VEGETATIVE PRACTICES: PRIMARY:
SECONDARY:

DESCRIPTION: The Palouse Prairie was a complex ecosystem with over 100 species of grasses, forbs, and shrubs. Frequently 30 or 40 species are found growing in close association in areas as small as 4 square meters. Total forb coverage often exceeds 150% (Daubenmire 1970). The plant community was dominated by species which were active in the spring and early summer, then avoided the deepening drought of mid summer by becoming dormant.

When all the native vegetation has been removed, as in an agricultural situation, little is know about the best procedure to begin restoration of a Palouse native plant community. Study number WAPMC-T-0408-RA, "Methods of Restoring Palouse Prairie Grasses and Forbs in an Agricultural Field", examines some of the techniques available. This study will evaluate another technique, that of alternate row seeding.

The alternate row seeding technique, whereby 2 species are sown in alternating paired rows, was widely used in the Pacific Northwest in the 1940's and 1950's for establishing mixed stands of grasses and legumes for hay, forage, and green manure. It resulted in better stands of both species by reducing interspecific competition compared to plantings where both species were sown in the same drill row (MacLauchlan & Hafenrichter 1961). Native grasses establish more rapidly than many of the native forbs and may reduce forb establishment due to competition for light and moisture. This study will examine whether planting native forbs in alternate rows with native grasses will result in a more diverse mix of species compared to seeding both in a mixed row.

DURATION OF STUDY:
10 years

STUDY LEADER:
David M. Skinner

LOCATION:
Pullman PMC fields F1, M1, Q5A

COOPERATORS:

EXPERIMENTAL DESIGN:

PROCEDURE: Establish alternate row plots of mixed native grasses and mixed native forbs on a south facing slope, a hilltop, and the toe of a north slope. Establish another plot on each site with all the species mixed together in each row. Plots will be sown in the spring and late fall of each year for at least 3 years.

Species to be used and seeding rates:

forb species	rate
Achillea millefolium	5 seeds/LF
Aster occidentalis	5 seeds/LF
Clarkia pulchella	10 seeds/LF
Collomia grandiflora	10 seeds/LF
Gaillardia aristata	5 seeds/LF
Galium boreale	5 seeds/LF
Geum triflorum	5 seeds/LF
Helianthella uniflora	5 seeds/LF
Lomatium triternatum	5 seeds/LF
Penstemon confertus	5 seeds/LF
Penstemon deustus	5 seeds/LF
Potentilla arguta	5 seeds/LF
Potentilla gracilis	5 seeds/LF
Sidalcea oregana	5 seeds/LF
Solidago missouriensis	5 seeds/LF
Wyethia amplexicaulis	5 seeds/LF
grass species	
Festuca idahoensis	30 seeds/LF
Pseudoroegneria spicata	20 seeds/LF

Using the Daubenmire method (Daubenmire 1959), cover class estimates for each species in each plot will be made on the second, third, fifth, seventh and tenth years following seeding. Because a seeded stand is expected to be less heterogeneous than a natural stand, a 1 meter square frame will be used, rather than the 20 cm by 50 cm frame specified by Daubenmire.

Plot layout:

grass guard row
grass guard row
grass row 1
forb row 1
grass row 2
forb row 2
grass row 3
forb row 3
grass row 4
forb row 4
grass guard row
grass guard row

field F southeast → field M1 north → field Q5 east →

PROGRESS: Alternate row plots were seeded on 5/19/06 in field M1 and field F. Rain prevented the seeding of the plot in field Q5 until 5/25/06. The plots were mowed once during the summer to reduce weed competition and seed set. All fall plots were sown on 10/26/06. Plots with all the species mixed in each row were not seeded in 2006.

references cited:

Daubenmire, R.F. 1959. A Canopy-coverage Method of Vegetational Analysis. Northwest Science 33:43-65.

Daubenmire, R.F. 1970. Steppe Vegetation of Washington. Washington State Univ. Coop. Ext. Service publication EB 1446. Pullman, WA.

MacLauchlan, Robert S., and A.L. Hafenrichter. 1961. Alternate-Row Grass-Legume Seedings. Journal of Soil and Water Conservation 16:61-64.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

Title	Dryland forbs: Initial evaluation to improve upland diversity and pollinator habitat in the Columbia River Basin
Study Number	WAPMC-P-0901-WL
Study Leader	Pamela Scheinost, WAPMC Agron.
Duration	2008 - 2018
Description	Seeds will be collected from forbs in the Columbia Basin, propagated at the Pullman PMC, transplanted to the Othello, WA research station (9" precipitation) and evaluated for vigor, survival and desirable seed production characteristics. Top performing plants will be increased, and seed will be placed into advanced trials to determine methods of establishing forbs into CRP and other natural areas.
Status of Knowledge	Within the last several years there has been a great deal of attention focused on improving wildlife values of CRP land and on improving pollinator habitat in agricultural areas. Both of these objectives can be achieved by planting forbs. In the Columbia River Basin, there is no seed commercially available for several desirable forb species. Propagation protocols have already been developed for many of the species or species of the same genus, but protocols have not been developed for stand establishment.
Materials and methods	Species selected for evaluation include: *Eriogonum niveum* *Eriogonum thymoides* *Gaillardia aristata* *Lomatium dissectum* *Penstemon pruinosus* *Salvia dorrii* *Sphaeralcea munroana* Seeds of *E. thymoides, G. aristata, P. pruinosus* and *S. munroana* were collected from Dry Moses Coulee on 8/26/08. Seeds of *E. niveum, E. thymoides, G. aristata, L.*

dissectum and *S. munroana* were ordered from GRIN on 9/9/08. More seeds will be collected from Dry Moses Coulee in subsequent years.

Seeds will be propagated at the Pullman PMC. They will be planted into 10 cu. in. Ray Leach Super cell conetainers filled with Sunshine #4 mix and covered with pea gravel. The containers will be watered frequently and kept outside for 90 days to allow for stratification. They will be moved into a greenhouse in January and to a cold frame in April. In May the plants will be transplanted to field locations at Lind. The plants will be evaluated for survivability, time and length of flowering, and number of flowers produced. Plants with desirable characteristics will be increased and seeds will be placed into advanced trials.

Technology Transfer The information generated in this study will be useful in developing stand establishment protocols for land managers.

Release The PMC will generate releases of the material evaluated as needed.

Progress

Pollinator and Upland Diversity Project Activity Log

10/15/09 Visited Othello to harvest seed and make observations. Harvested seed from accessions in bold:
GAAR HC Some mature seed. Many heads not mature, some flowers still in bloom.
GAAR W6 30198 Same as above. Larger seed heads; larger plants.
SADO BLM87 All seed appears to be mature; no remaining flowers.
SPMU W6 32635 Tall, upright plants. Some mature seed present; also immature seed and flowers in bloom.
SPMU PI564589 Prostrate; few flowers remain; not many mature seed heads.
SPMU HC Growth form in between other two; lots of mature seed heads; few flowers remain.
PEPR BLM 85 Only 2 plants had flower heads; seeds appear to be mature. One other plant flowered but appears to be off-type. Taller and has more narrow leaves. Did not harvest this plant.
ERSP HC Did not flower this year
ERTH W627239 Did not flower this year
ERNI W6 27040 Still flowering. No mature seed heads.
ERNI PI537595 Still flowering. No mature seed heads.

10/6/09 Cleaned newly collected seed and planted into cones. See study data excel sheet for details. Set cones outside to stratify.

8/20/09 Mowed, rototilled and hoed weeds at Othello.

8/1/09 Hoed weeds, evaluated plots and updated signs at Othello.

7/8/09 Visited Dry Moses Coulee with Tim Dring and Richard Fleenor. Found good deal of *Penstemon pruiosis* seed to collect. Collection sites included on rock outcrop at top of hill, E side of N-S side road, along N side of E-W road, and W side of main N-S road on edge of bench. Seed of other unknown penstemon still not ready yet. Collected large amount of seed from *Salvia dorii* from N side of E-W road and W side of main N-S road. Also collected more *Spaelarcea munroana* seed from along both sides of E-W road. Need to return in two weeks to collect seed of unknown Penstemon. Also need to return perhaps in beginning of September to collect seed from *Eriogonum thymoides*. Determined seed collected last year was not from *E. thymoides*, but from *E. sphaerocephalum* (round-headed buckwheat). Need to change signs at Othello.

6/24/09 Hoed weeds at Othello. Some SPMU HC flowering. A few GAAR W6 30198 about to flower.

6/23/09 Visited Dry Moses Coulee with Tim Dring to observe flowering plants. Seed should be ready to collect from *Penstemon pruiosis*, another larger penstemon, and *Salvia dorii* in two weeks. Collected plants to identify and/or investigate for pollinator value. Include: Hoary false yarrow, a borage species and a yellow aster species. These may not be showy enough to include.

6/5/09 Hoed remaining grass and weeds.

6/12/09 Sprayed plot with 210ml of Poast + 2 TBSP ADWET90 + 2 TBSP Kicker AMS.

6/11/09 Sprayed 320ml of Credit Extra on border and around plot with pump sprayer. Hoed weeds and grass within plot. Orchardgrass vigorously regrowing.

6/4/09 Hoed weeds and grass.

5/21/09 The remainder of the plants were planted at Othello:

60 ERTH HC
10 ERNI W6 27040
65 ERNI PI 537595

Holes were drilled using a power auger. Plants were watered same afternoon for period of 3 hours with hand line irrigation.

5/14/09 The following plants were planted at Othello:

162 GAAR HC
91 GAAR W6 30198
42 SADO BLM 87
12 SPMU W6 32635
5 SPMU PI 564589
140 SPMU HC
230 PEPR BLM 85
111 ERTH HC

Holes were drilled using a power auger. Plants were watered same afternoon for period of 3 hours with hand line irrigation.

4/6/09 Moved conetainers to cold frame.

1/20/09 Planted *Gaillardia* in conetainers.

1/12/09 Moved conetainers into growth chamber. Lights set at 8 hrs/day.

10/16/08 Planted all seed (except *Gaillardia*) in conetainers and set outside for stratification. *Gaillardia* does not require stratification and will be planted directly in pots in the growth chamber in January.

10/14/08 Cleaned seed collected at Moses Dry Coulee. Acquired good amounts of *Gillardia aristata, Sphaeralcea munroana,* and *Eriogonum thymoides*. Combined all the sites of each species (4 sites each) into one packet. No seed of *Penstemon pruinosis.*

10/6/08 Have received the following seed:

Species	Accession	Wt (g)	# Seeds	Place of Origin	Source
Eriogonum niveum	PI 537595	0.16	100	UMATILLA	GRIN
Eriogonum niveum	W6 27040	0.14	100	US	GRIN
Eriogonum thymoides	W6 27239	0.28	100	US	GRIN
Eriogonum thymoides	none			Moses Dry Coulee	Hand coll
Gillardia aristata	W6 30198	0.29	100	US	GRIN
Gillardia aristata	none			Moses Dry Coulee	Hand coll

Lomatium dissectum	W6 26761	1.9	100	US	GRIN
Penstemon pruinosis	BLM # 85	0.5	500	WA	BLM
Salvia dorrii	BLM # 87	1	600	Wa	BLM
Sphaeralcea munroana	W6 32635	0.23	100	US	GRIN
Sphaeralcea munroana	PI 564589	0.1	100	UT	GRIN
Sphaeralcea munroana	none			Moses Dry Coulee	Hand coll

9/22/08 Spoke with Julie Sanderson, BLM botanist in Wenatchee, who received my email forwarded from Pam Camp. Discussed species I need and how much of each and what she has tried. She said *Erioginum thymoides* tends only to do well in lithosols (thin rocky soils) and not the deep soils in ag areas. They have grown *E. heracliodes* with success, however *E. compositum* has been difficult to establish. She recommends planting *Lomatium* seed directly in the ground or keeping the seedlings in plugs for more than 1 year, because they are too fragile to transplant as 1 yr plugs. She says they work with Jerry Benson and several other growers in the area to do seed increases for them, and that Bob Gillespe, entomologist at Wenatchee Valley College would be a good person to work with to evaluate pollinator use of the plants: bgillespe@wvc.edu, 509-682-6624.

9/9/08 Ordered all available plant accessions from GRIN except one acc of *Gaillardia aristata* from Ohio.

Wrote Study Plan.

9/4/08 Talked w Dave about propagation protocols. He showed me Native Plants propagation protocols database and a document he developed.

Mark mentioned possibly taking cuttings of *Salvia dorrii*. Maybe next year. Too far for another trip this year.

8/28/08 Talked with Mark about project. He suggested contacting Pam Camp (BLM), the GRIN database, Dan Ogle and Loren St. John to find out if they have seed available of the species we're interested in. Also to contact Roger Amerman (NRCS Toppenish sub office) who might have Yakima Nation assistance.

Mark mentioned adding rabbitbrush and aster to the species list. I looked up species availability for the Basin big sagebrush habitat type of the Columbia Plateau on the Native Seed Network. Yellow rabbitbrush is

available, but longflower and spearleaf rabbitbrush are not. Aster species are not listed. None of the other species we collected are commercially available according to this site.

Number of accessions available from GRIN:

Eriogonum niveum 2
Eriogonum thymoides 1
Gaillardia aristata 2
Lomatium dissectum 1
Penstemon pruinosus 0
Salvia dorrii 0
Sphaeralcea monroana 2

8/26/08 Visited Dry Moses Coulee with Tim Dring, State Biologist. Collected seed of *Eriogonum thymoides* (4 pkts), *Gaillardia aristata* (1 pkt), *Penstemon pruinosus* (1 pkt) and *Sphaeralcea munroana* (4 pkts). Could not collect seed from *Lomatium dissectum* or *Salvia dorrii* because seed had already dropped. Seed from *Eriogonum niveum* not ready yet.

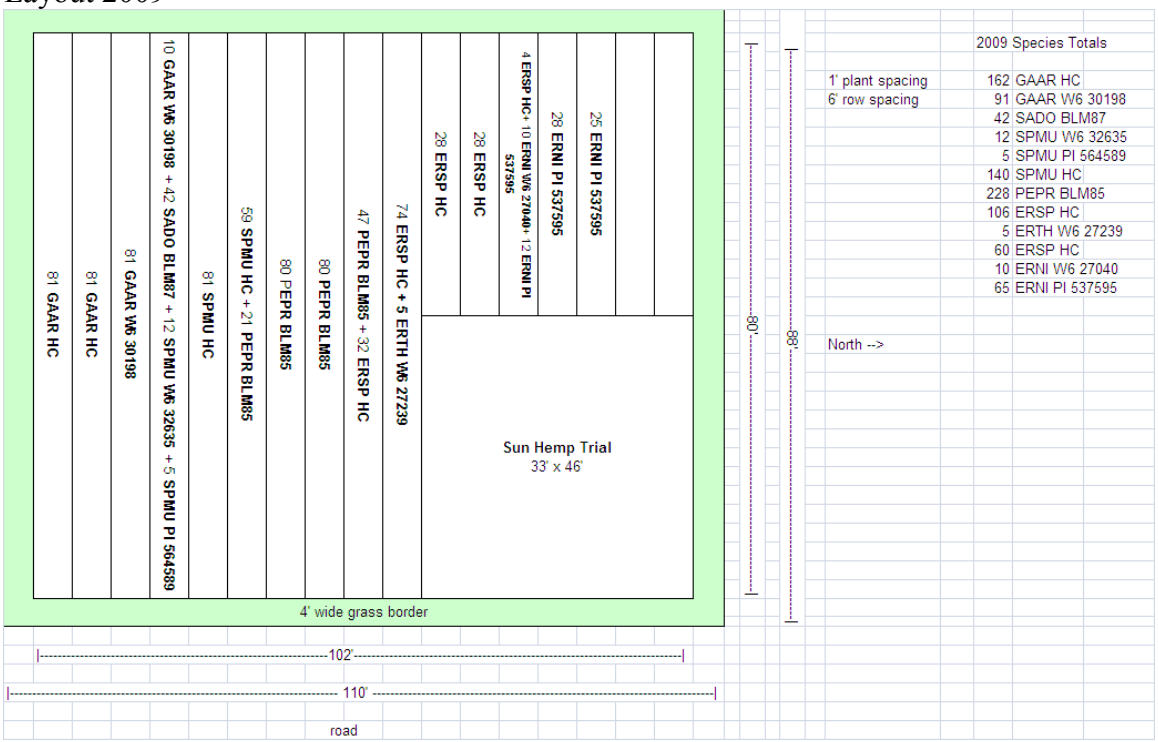
Seed planted October 2008.

Species	Accession	Wt (g)	Place of Origin	Source	Tag Code	Cones planted 10/16/08	Cones planted 1/20/09	Notes	Plants in growing chamber 3/2/09	Plants planted in Othello 5/14/09 and 5/21/09
Eriogonum niveum	PI 537595	0.16	UMATILLA	GRIN	ERNI PI 537595	98			67	65
Eriogonum niveum	W6 27040	0.05	WA	GRIN	ERNI W6 27040	14			10	10
Eriogonum thymoides	W6 27239	0.28	WA	GRIN	ERTH W6 27239	49			11	5
Eriogonum sphaerocephalum	none	1.1	Moses Coulee	Hand coll	ERSP HC	196			166	166
Gaillardia aristata	W6 30198	0.29	WA	GRIN	GAAR W6 30198		121	planted dir in GC	95	91
Gaillardia aristata	none	1.1	Moses Coulee	Hand coll	GAAR HC		196	planted dir in GC	185	162
Lomatium dissectum	W6 26761	1.9	ID	GRIN	LODI W6 26761	49			18	0
Penstemon pruinosis	BLM # 85	0.5	WA	BLM	PEPR BLM85	294			228	228
Salvia dorrii	BLM # 87	1	WA	BLM	SADO BLM87	182			48	42
Sphaeralcea munroana	W6 32635	0.23	US	GRIN	SPMU W6 32635	49			14	12
Sphaeralcea munroana	PI 564589	0.1	UT	GRIN	SPMU PI 564589	49			6	5
Sphaeralcea munroana	none	0.9	Moses Coulee	Hand coll	SPMU HC	294			146	140

Field evaluation results 2009

Plant Tag Code	Number of Plants Growing 8/12/09	Bloom Begin Date	Bloom End Date	Height at Maturity (cm)	Approx. Number of Bloom Stalks per Plant	Other Observations
GAAR HC	104	7/1/2009	cont.	40	8	variation in leaf color and shape, weedier appearance
GAAR W6 30198	81	7/1/2009	cont.	55	40	broader leaves, more blooms/plant, lots of leaf variation
SADO BLM87	40	8/1/2009	9/15/2009	40	15	only 5 plants blooming
SPMU W6 32635	8	6/27/2009	cont.	100	20	upright
SPMU PI 564589	4	6/27/2009	cont.	80	15	laying down, greenest
SPMU HC	140	6/20/2009	cont.	75	15	laying down
PEPR BLM85	199	8/1/2009	9/15/2009	28	1	4 plants blooming
ERSP HC	103	9/15/2009		20		
ERTH W6 27239	2			2		
ERNI W6 27040	9	8/20/2009		40		
ERNI PI 537595	55	8/20/2009		35		

Layout 2009



2009 Species Totals	
162	GAAR HC
91	GAAR W6 30198
42	SADO BLM87
12	SPMU W6 32635
5	SPMU PI 564589
140	SPMU HC
228	PEPR BLM85
106	ERSP HC
5	ERTH W6 27239
60	ERSP HC
10	ERNI W6 27040
65	ERNI PI 537595

Seed planted October 2009.

Species	Accession	Place of Origin	Source	Tag Code	Cones planted 10/6/08	Cones planted 1/15/10	Notes
Antenaria	none	Colville Reservation	Hand coll	AN HC	98		
Gaillardia aristata	none	Othello	Hand coll	GAAR2 HC		294	planted dir in GC
Mentzelia laeviculmis	none	Moses Coulee	Hand coll	MELA HC	357		
Penstemon pruinosis	none	Moses Coulee	Hand coll	PEPR1 HC	525		
Salvia dorrii	none	Moses Coulee	Hand coll	SADO1 HC	588		
Sphaelarcea munroana	none	Moses Coulee	Hand coll	SPMU1 HC	588		

Gaillardia aristata in Pollinator Species Evaluation Plot, Othello, Washington, July 2009, Pamela Scheinost

NATURAL RESOURCES CONSERVATION SERVICE
PLANT MATERIALS CENTER
PULLMAN, WASHINGTON

PMC STUDY PLAN

I. Study Title: Reed Canarygrass: Effect of Embark and reduced rates of glyphsate on suppression of RCG and growth of transplanted cottonwoods and willow.

Study Number: WAPMC-T-0407-RI

II. Problem: Reed canaryggrass (RCG) has become the dominant species growing in riparian areas of the inland PNW. Its presence greatly impedes establishment of growth of woody species. Killing RCG almost always results in a weed shift, and the weeds replacing RCG as just as competitive as the RCG.

III. Objective: Determine if Embark (a turf grass growth suppressant) and/or low rates of glyphosate will suppress growth of RCG without killing the RCG.the different seed types are related to seed pod development.

Procedure: Waverly plots were established on April 23, 2004. They are located between Waverly Road and Hangman Creek. The plots are approximately 1 mile east of the town of Waverly (NW1/4, Sec 2, T21N, R45E). Embark was applied at 1.5 pt/ac using a solo backpack sprayer. RCG was 12" tall and actively growing. Rodeo was applied at 2 rates, 10 oz/ac and 20 oz/ac. Surfactant was added at 1% v/v. Temp was 52F. Mowing treatments were applied the same day. Checks were planted but site disturbance was kept to a minimum. Each plot was planted to 5 containerized cottonwoods and 5 containerized willows.

	15 ft	15 ft	15 ft	15 ft	15 ft
30 ft	Embark	Gly 10 oz	Gly 20 oz	Mow	Check
30 ft	Gly 10 oz	Gly 20 oz	Mow	Check	Embark
30 ft	Mow	Embark	Check	Gly 20 oz	Gly 10 oz
30 ft	Gly 20 oz	Check	Gly 10 oz	Embark	Mow

IV. Progress: The Glyphosate treatments totally killed the RCG. Field bindweed, Canada thistle, mullen,and common tansy colonized these plots.

The Embark treatments suppressed growth of RCG for the entire growing season.

The single mowing treatment was unnoticeable after 3 weeks.

The summer of 2004 was unusually dry in the area and not rainfall occurred the month of June. As a result, all of the trees died.

The Embark shows great promise and should be repeated when time allows.

NATURAL RESOURCES CONSERVATION SERVICE
PLANT MATERIALS CENTER
PULLMAN, WASHINGTON
PMC STUDY PLAN

I. Study Title: PM-10: Evaluation of liquors, MgCl, and PAM for reducing road dust.

Study Number: WAPMC-T-0611-CR

I. Problem: Billowing clouds of dust kicked up by vehicles traveling down dirt and gravel roads are not only highly visible, they are also a source of dust particulates (PM10), and can aggravate wind erosion conditions. The airborne road particles can start the saltation process and result in tremendous soil losses downwind.

II. Objective: Stabilize road dust by spreading wheat, grass, and alfalfa based pulp liquors for reduction of PM-10 dust particulates into the air. Compare other dust control agents, Magnesium Chloride and PAM to Pulp liquor.

III. Procedure: University of Washington prepared pulp liquors (high lignin, high K biosolid material) from grass straw, wheat straw and alfalfa. Approximately 200 gallons of each liquor was provided to the WSU Prosser Experiment Station in July 2006.

The east-west main road on the WSU Prosser Rosa Unit was selected for treatment.

Treatments:
- Alfalfa Liquor 20 gallons/1000 sqft
- Wheat Straw liquor 20 gallons/1000 sqft
- Grass straw liquor 20 gal/1000 sqft
- PAM 100 grams/1000 sqft
- Magnesium chloride solution 50 gallons/acre
- Alfalfa Liquor 20 gallons/1000 sqft + MgCl 20 gallons/1000 sqft
- Wheat Straw liquor 20 gallons/1000 sqft+ MgCl 20 gallons/1000 sqft
- Grass straw liquor 20 gal/1000 sqft + MgCl 20 gal/1000 sqft

IV. Progress: The Pullman Plant Materials Center in cooperation with WSU and UW established a trial at the Prosser Irrigated Agriculture Experiment Station. Three straw liqueurs, PAM, and Magnesium chloride were applied to the Rosa Unit main access road on July 20th. Each plot was 50 feet long and replicated 4 times. Dust reduction was documented a few weeks later and again a few months later. An orchard fan was used as a wind source and dust was documented via video. The overall consensus of the investigators was: 1) PAM was not effective, 2) straw liqueur was not as effective as magnesium chloride, 3) mixing liqueur and magnesium chloride seemed to improve dust suppression initially but the effects were not long lasting.

Eric Harwood, PMC agronomist, and Bill Pan, WSU Soil Scientist, applying wheat straw liqueur plus magnesium chloride to the Prosser Experiment Station Roza unit main access road.
The "wet look" to the road lasted for several weeks after application because the magnesium chloride, being a salt, has a very strong affinity for moisture.

Surface one hour after application. The surface would dry each day but would "regain" moisture from dew each morning.

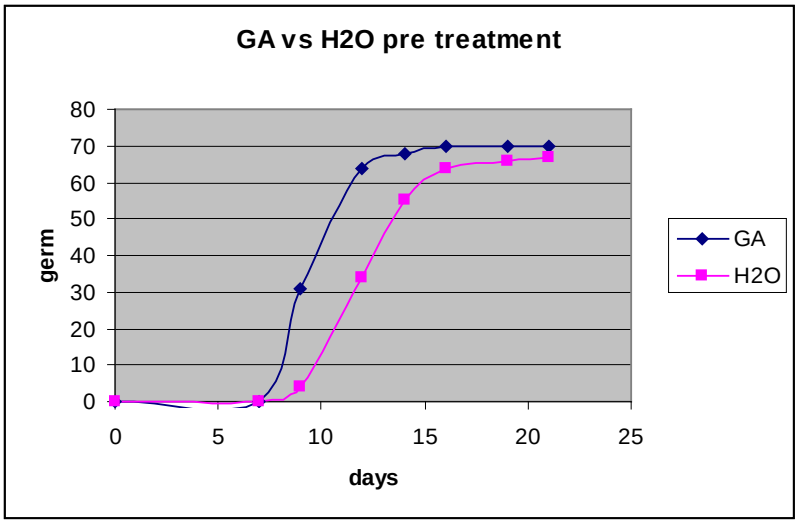
UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

STUDY NUMBER: WAPMC-T-0704-RA
STUDY TITLE: Range Revegetation: Germination ability of 'Trailar' *Clematis ligusticifolia* Nutt.

NATIONAL PROJECT NUMBER: Rangeland 1.1
STUDY TYPE: Cultural

PROBLEM: 'Trailar' western clematis was released in 1992 as a vegetatively propagated release. A review of prior work documented in the 1983 Pullman Plant Materials Center Annual Technical Report found eight pre-germination treatments were tried for enhancing germination of western clematis seed, but the seed used was a wild collection on the Palouse River banks near Hooper, WA. No prior work documents the ability of 'Trailar' to reproduce successfully by seed. Since 'Trailar' is composed of material from two different locations which were near Walla Walla and Prosser, WA, germination trials need to be accomplished in order to document ability of this release to reproduce from seed.

The 2 best treatments with the particular seed lot used were 1) pre-soaking with 10^{-3} Molar gibberellic acid for 48 hours and 2) pre-soaking in distilled water for 48 hours, both at room temperature. The gibberellic acid treatment produced the best early results, with germination of 64% at 12 days. Germination peaked at 70% at 16 days. Water soaking produced slower results with 12 day germination of 34% and a 21 day peak of 67%.



OBJECTIVE: Document germination ability of seed produced from 'Trailar' western clematis.

Document seed source, collection year, treatment and handling prior to germination. Document germination conditions.

DURATION OF STUDY: 2007
STUDY LEADER: Wayne Crowder
LOCATION: Pullman PMC
COOPERATORS: Washington State University

STUDY DESIGN: Replicated 5x, 100 seeds per rep using 2005 seed. Plant germinating seed in conetainers.

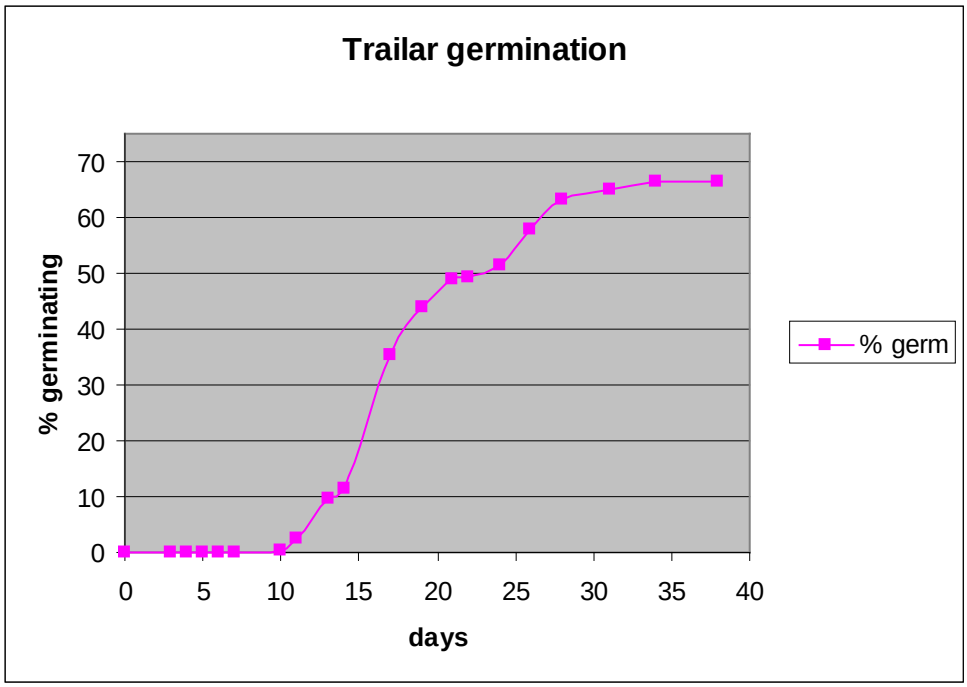
PROGRESS: Seeds collected in November, 2005 from the "Trailar" clematis breeder block in field H1 were cleaned in February, 2006. The cleaning consisted of using a rub board and hand screens then an Oregon seed blower for final cleaning. Final clean seed weight was 23 grams. They were then stored in the PMC controlled atmosphere seed storage facility. Lot number was B-05-01.

They were planted on 4 layers of water moistened Whatman #4 filter paper on January 26, 2007. No gibberellic acid treatment was used. Germination was done at room temperature, which ranged from 74° F in daytime to 65° F at night. Water was added as needed to keep the filter paper moist. The first germination occurred on February 5, 2007. The last count was taken at 38 days on March 5, 2007. Counts appear in the following table.

Germination counts are number of seeds germinating on that day

Days elapsed /date	0 1/26	3 1/29	4 1/30	5 1/31	6 2/1	7 2/2	10 2/5	11 2/6	13 2/8	14 2/9	17 2/12	19 2/14	21 2/16
rep 1	0	0	0	0	0	0	2	4	16	3	22	10	3
rep 2	0	0	0	0	0	0	0	2	7	3	18	8	6
rep 3	0	0	0	0	0	0	0	1	4	1	14	11	7
rep 4	0	0	0	0	0	0	0	3	4	2	31	4	5
rep 5	0	0	0	0	0	0	0	1	4	1	33	10	5
total per day	0	0	0	0	0	0	2	11	35	10	118	43	26

Days elapsed /date	22 2/17	24 2/19	26 2/21	28 2/23	31 2/26	34 3/1	38 3/5						
rep 1	0	1	6	5	1	4	0						
rep 2	1	4	2	13	3	2	0						
rep 3	0	1	10	6	1	0	0						
rep 4	0	3	7	0	2	1	0						
rep 5	1	2	6	3	2	0	0						
total per day	2	11	31	27	9	7	0						


Trailar germination
% germinating
70
60
50
40
30
20
10
0
0
5
10
15
20
25
30
35
40
days
% germ

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

STUDY TITLE: Riparian Plants: Evaluation of the effects of shading on root development of various species of woody plants used in riparian revegetation efforts

STUDY NUMBER: WAPMC-T-0404-RI
NATIONAL PROJECT NUMBER: CA 1.1
STUDY TYPE: Advanced Evaluation

PROBLEM: Field office reports have indicated that there is a question as to whether some riparian species root well and develop roots as rapidly in shaded conditions, i.e. Reed canarygrass vegetated sites.

OBJECTIVE: Determine if shading is detrimental to root development or speed of root development in woody species evaluated.

DURATION OF STUDY: 2004-2005, with follow-up studies as needed
STUDY LEADER: Wayne Crowder
LOCATION: Pullman PMC
COOPERATORS: Washington State University

STUDY DESIGN: 5 reps, 1 plant per rep of each species, shaded and unshaded treatments

Species: (Hardwood cuttings)

Drummond willow	Coyote willow	Lemmon's willow
Mackenzie willow	Pacific willow	Black cottonwood
Redosier dogwood		

Planting: Place cuttings in PMC plant bed with and without shade. Shaded Plants will be provided with 50% shade. Cuttings will be placed in 40 cubic inch Deepots and buried in plant bed media. Use 1-2 year old wood if possible, minimum top diameter of ¼ inch and minimum 6 inch cutting length except Redosier dogwood will be a minimum of 2 nodes, regardless of 6 inch minimum length. Space plants to prevent between plant shading.

Cuttings will be placed in rooting media to a uniform depth of 4 inches.

Evaluations: Number of roots, root length or dried root weights if numbers and length are not feasible.

PROGRESS: Cuttings were taken in March, 2004 when dormant. Coyote, Lemmon's, Mackenzie, Drummond and Pacific willow were taken from stock at the Pullman PMC. Black cottonwood stock was from Eastern Washington material grown at the WACD Nursery in Bow,

WA. It was received on approximately February 25, 2004 and stored in the PMC seed storage area at about 42 deg. F.

Cuttings were planted March 23, 2004 in screened Ritzville silt loam soil in 40 cubic inch Deepots. Cuttings were a minimum ¼ inch diameter at the top ends and 6 inches long, except Redosier dogwood which had at least 2 nodes, therefore at times exceeding 6 inches long. Redosier dogwood had a 1 inch long knife slit made at the base of each cutting to promote rooting. The black cottonwood was rooting in storage. It is surmised that the bag had too much moisture for the length of time stored, in addition to the storage temperature (40° F+) being a bit too high for the storage time frame. Black cottonwood cuttings were stripped of roots prior to planting. All cuttings were placed 4 inches deep into soil in the Deepots. Cuttings then were placed in a dark room prior to being transferred outside into the PMC plant beds.

On March 30 and 31, Deepots with cuttings were placed in soil in the north PMC plant bed. Plants were placed on approximate 6" centers each way. On April 5, the shade structure was completed and placed over the "shaded" portion of the planting. None of the cuttings were showing signs of breaking dormancy at the time.

On April 12 a very few plants had a new leaf showing.

On May 13 and 14 Deepots with cuttings were pulled from the plant bed, soil rinsed off roots, roots were removed from each cutting, placed in envelopes to air dry. Once dry, root weights were taken.

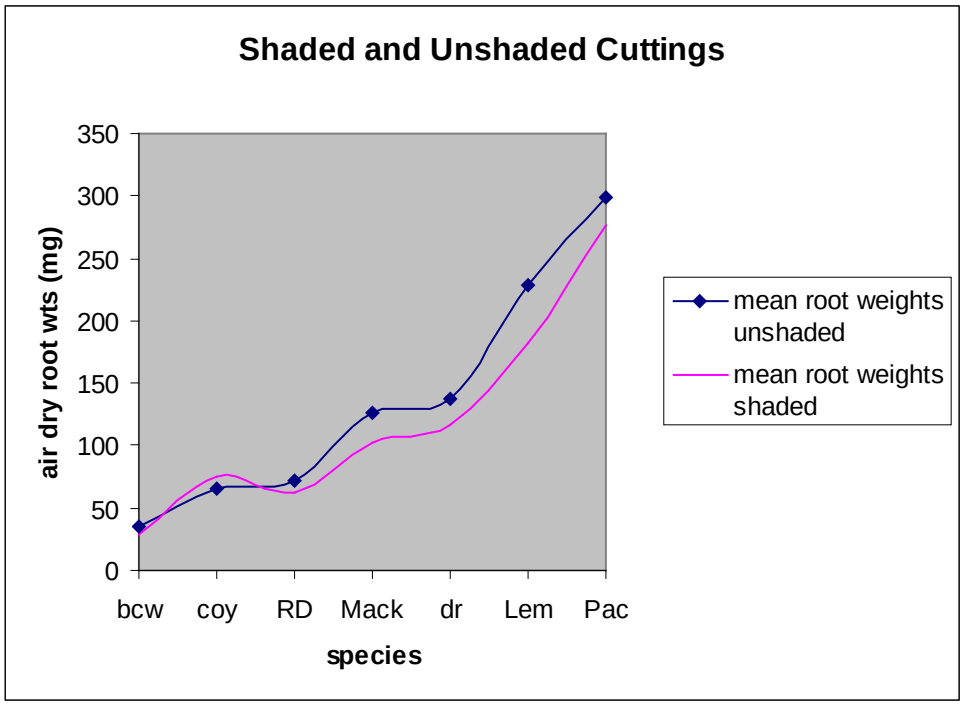
Conclusions: Cuttings total root weight increases ranged from 8.5 to 23% in unshaded versus shaded conditions. Gains were Lemmon's 25%, Mackenzie 23%, black cottonwood 18%, Drummond 18%, Redosier dogwood 14% and Pacific willow 9%. Coyote willow had a negative response to unshaded versus shaded conditions (-14%) consistently across all 5 replications.

An analysis of variance indicated a significant difference (p=.05) between air dry root weight means of shaded versus unshaded cuttings. Also, there were species differences for air dry root weight (p=.05).

Wounding of Redosier dogwood cuttings did not positively impact rooting in this study.

Percent gain for cuttings in unshaded conditions, when comparing total air dry root weight (mg) for all five replications follows:

species	% difference over shaded
Pacific willow	8.5
Lemmon's willow	24.6
Drummond willow	17.8
Mackenzie willow	23.0
Redosier dogwood	13.9
Coyote willow	-13.7
Black cottonwood	18.3



bcw Black cottonwood
coy Coyote willow
RD Redosier dogwood
Mack Mackenzie willow
Dr Drummond willow
Lem Lemmon's willow
Pac Pacific willow

Analysis of Variance Table for Air Dry Root Weight

Source	DF	SS	MS	F	P
Rep	4	3592	898.1		
species(spp)	6	478121	79686.9	83.66	0.0000
Error Rep*species	24	22861	952.6		
shading	1	4983	4983.0	8.72	0.0063
species*shading	6	4419	736.4	1.29	0.2942
Error Rep*spp*shading	28	15993	571.2		
Total	69	529970			

Grand Mean	129.32
CV(Rep*spp)	23.87
CV(Rep*spp*shading)	18.48

LSD All-Pairwise Comparisons Test of Air Dry Root Weight for shading

shading	Mean	Homogeneous Groups	
none	137.76	A	
shaded	120.89		B

Alpha	0.05	Standard Error for Comparison	5.7131
Critical T Value	2.048	Critical Value for Comparison	11.703

Error term used: Rep*spp*shading, 28 DF

All 2 means are significantly different from one another.

LSD All-Pairwise Comparisons Test of Air Dry Root Weight for species

species	Mean	Homogeneous Groups				
Pacific	287.51	A				
Lemmon's	205.40		B			
Drummond	127.66			C		
Mackenzie	114.98			C		
Coyote	70.27				D	
R. dogwood	67.50				D	
B. cottonwood	31.94					E

Alpha	0.05	Standard Error for Comparison	13.803
Critical T Value	2.064	Critical Value for Comparison	28.487

Error term used: Rep*spp, 24 DF

There are 5 groups in which the means are not significantly different from one another.

Shaded and unshaded cuttings root weight data, grouped by species

		root weights	
	rep	unshaded (mg)	shaded (mg)
bcw	1	60.9	48.6
	2	0	0
	3	54.0	0
	4	58.2	47.2
	5	0	50.5
total		173.1	146.3
Coyote	1	74.0	76.8
	2	50.6	82.8
	3	54.0	57.5
	4	74.3	67.3
	5	75.9	89.5
total		328.8	373.9
Drummond	1	154.1	117.6
	2	75.0	100.6
	3	177.3	134.2
	4	157.0	126.4
	5	127.1	107.3
total		690.5	586.1
Lemmon's	1	205.3	157.9
	2	205.4	172.9
	3	259.9	259.1
	4	226.0	175.3
	5	243.0	149.2
total		1139.6	914.4
Mackenzie	1	150.3	86.2
	2	120.1	107.2
	3	115.4	113
	4	104.1	112.2
	5	144	96.8
total		633.9	515.4
Pacific	1	255	223.7
	2	294.3	305.5
	3	291.3	294.7
	4	269.7	290.2
	5	386	264.7
total		1496.3	1378.8
Redosier dogwood	1	73.7	51.5
	2	79.4	63.7
	3	59.7	65
	4	67	72.6
	5	79.6	62.8
total		359.4	315.6

	total root weights (mg)	
	unshaded	shaded
bcw	173.1	146.3
coy	328.8	373.9
RD	359.4	315.6
Mack	633.9	515.4
Dr	690.5	586.1
Lem	1139.6	914.4
Pac	1496.3	1378.8
mean	688.8	604.4

	mean root weights (mg)	
	unshaded	shaded
bcw	34.6	29.3
coy	65.8	74.8
RD	71.9	63.1
Mack	126.8	103.1
Dr	138.1	117.2
Lem	227.9	182.9
Pac	299.3	275.8
mean	137.8	120.9

Shaded and unshaded cuttings data, 2004.

Unshaded Rep	species	air dry root wt.(mg)	Shaded Rep	species	air dry root wt.(mg)
1	BCW	60.9	1	BCW	48.6
1	C	74	1	C	76.8
1	D	154.1	1	D	117.6
1	L	205.3	1	L	157.9
1	M	150.3	1	M	86.2
1	P	255	1	P	223.7
1	RD	73.7	1	RD	51.5
	mean	139.0		mean	108.9
2	BCW	0	2	BCW	0
2	C	50.6	2	C	82.8
2	D	75	2	D	100.6
2	L	205.4	2	L	172.9
2	M	120.1	2	M	107.2
2	P	294.3	2	P	305.5
2	RD	79.4	2	RD	63.7
	mean	117.8		mean	119.0
3	BCW	54	3	BCW	0
3	C	54	3	C	57.5
3	D	177.3	3	D	134.2
3	L	259.9	3	L	259.1
3	M	115.4	3	M	113
3	P	291.3	3	P	294.7
3	RD	59.7	3	RD	65
	mean	144.5		mean	131.9
4	BCW	58.2	4	BCW	47.2
4	C	74.3	4	C	67.3
4	D	157	4	D	126.4
4	L	226	4	L	175.3
4	M	104.1	4	M	112.7
4	P	269.7	4	P	290.2
4	RD	67	4	RD	72.6
	mean	136.6		mean	127.4
5	BCW	0	5	BCW	50.5
5	C	75.9	5	C	89.5
5	D	127.1	5	D	107.3
5	L	243	5	L	149.2
5	M	144	5	M	96.8
5	P	386	5	P	264.7
5	RD	79.6	5	RD	62.8
	mean	150.8		mean	117.3
	grand mean	137.8		grand mean	120.9

BCW=black cottonwood, C=coyote willow, D=Drummond willow, L=Lemmon's willow, M=Mackenzie willow, P=Pacific willow, RD=Redosier dogwood

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

STUDY NUMBER: WAPMC-P-0504-RI
STUDY TITLE: Riparian Shrubs: Speed of rooting of hardwood cuttings of riparian species

NATIONAL PROJECT NUMBER: Water Quality 2.1
STUDY TYPE: Cultural
LAND USES:
VEGETATIVE PRACTICES: PRIMARY: Tree and shrub establishment
SECONDARY:

PROBLEM: The speed of rooting of various riparian species is not known. This information is needed to ensure establishment of riparian plants from hardwood cuttings

OBJECTIVE: Determine number of days to rooting of several riparian species. Document days to rooting, stage of rooting.

DURATION OF STUDY: 2005

STUDY LEADER: Wayne Crowder

LOCATION: Pullman PMC plant bed

COOPERATORS: Washington State University

STUDY DESIGN: 4 reps per species, 5 willow species, 1 Redosier dogwood accession. Monitor rooting progress with each species represented with cuttings in glass jar in ambient temperature in the office.

PROGRESS: 2005: Hardwood cuttings of Wallowa Redosier dogwood, Silvar coyote willow, Curlew Drummond willow, Palouse Lemmon's willow, Rivar Mackenzie willow and Pacific willow were taken from field locations on the Pullman PMC on April 26, 2005. They were cut to lengths of approximately 3 inches, stored in a cool side room of the PMC growth chamber and planted in the plant bed on April 28. No rooting hormone was used. Planting maximum depth was approximately 3 inches. Soil temperature on April 29, 6:30 AM, at 2 inch depth was 36 deg F. On May 3, at 3:00 PM the soil temperature was 78 deg F. Rooting data was taken on May 9, since significant rooting had occurred. All willow cuttings had significant rooting in 10 days.

Plant bed layout

Rep 4	Palouse	Wallowa	Coyote	Drummond	Mackenzie	Pacific
Rep 3	Coyote	Drummond	Mackenzie	Pacific	Palouse	Wallowa
Rep 2	Drummond	Palouse	Wallowa	Pacific	Coyote	Mackenzie
Rep 1	Wallowa	Palouse	Mackenzie	Coyote	Pacific	Drummond

↑ N

Statistical analysis with Statistix 8 software was performed on root lengths for species. Some of the species root length means were significant at the p=.05 level after data was transformed using logarithmic function in order to reduce nonadditive effect.

Randomized Complete Block AOV Table for NEW_rtln (log(total root length))

Source	DF	SS	MS	F	P
rep	3	0.54713	0.18238		
spp	4	1.90623	0.47656	6.33	0.0056
Error	12	0.90339	0.07528		
Total	19	3.35675			

Grand Mean 1.7920 CV 15.31

Tukey's 1 Degree of Freedom Test for Nonadditivity

Source	DF	SS	MS	F	P
Nonadditivity	1	0.02003	0.02003	0.25	0.6273
Remainder	11	0.88336	0.08031		

Relative Efficiency, RCB 1.19

Means of NEW_rtln for spp

spp	Mean
coyote	1.9916
drumm	1.9348
mack	1.4616
pacific	2.1779
palouse	1.3943

Observations per Mean 4
Standard Error of a Mean 0.1372
Std Error (Diff of 2 Means) 0.1940

Statistix 8.1 9/28/2006, 12:32:54 PM

LSD All-Pairwise Comparisons Test of NEW_rtln(log(total root length)) for spp

spp	Mean	Homogeneous Groups	
pacific	2.1779	A	
coyote	1.9916	A	
drumm	1.9348	A	
mack	1.4616		B
palouse	1.3943		B

Alpha 0.05 Standard Error for Comparison 0.1940
Critical T Value 2.179 Critical Value for Comparison 0.4227
Error term used: rep*spp, 12 DF
There are 2 groups (A and B) in which the means
are not significantly different from one another.

Summary

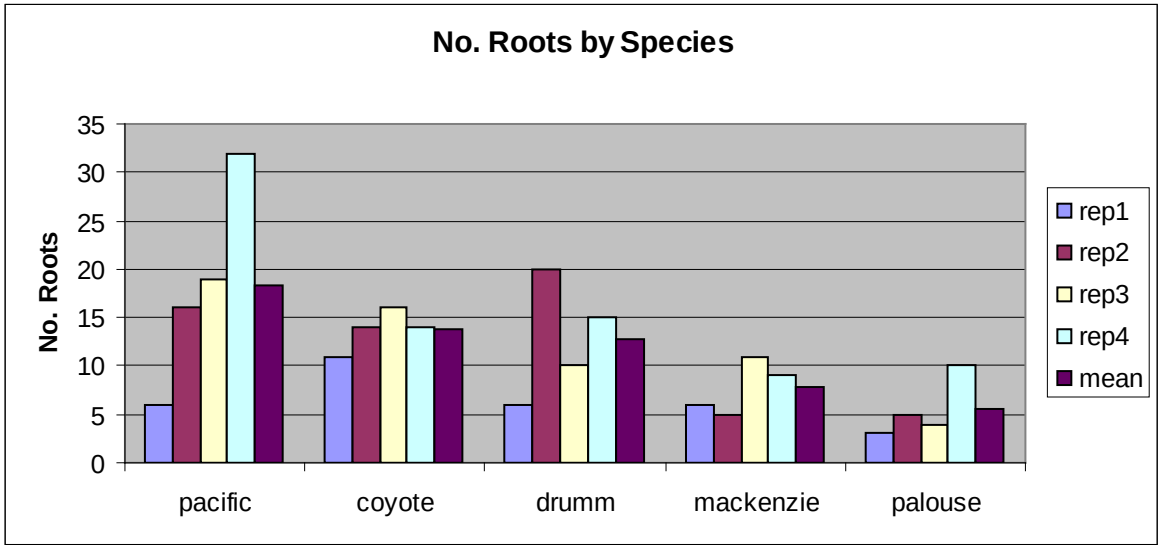
no. roots	pacific	coyote	Drummond	Mackenzie	Palouse	R. dogwood
rep1	6	11	6	6	3	0
rep2	16	14	20	5	5	0
rep3	19	16	10	11	4	0
rep4	32	14	15	9	10	0
mean	18.25	13.75	12.75	7.75	5.5	0

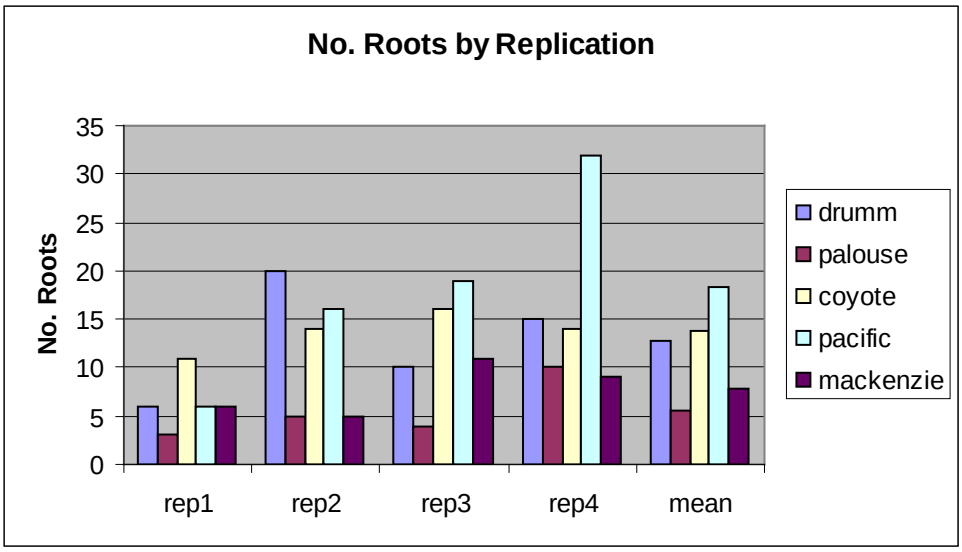
Summary

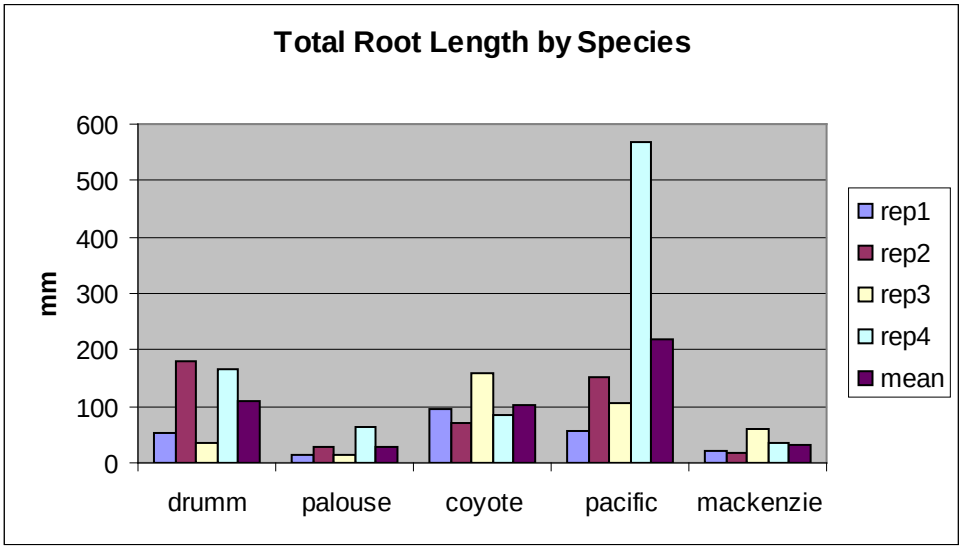
total root length	pacific	Drummond	coyote	Palouse	Mackenzie
rep1	56	54	97	15	20
rep2	153	180	71	29	17
rep3	106	34	160	14	59
rep4	567	166	84	62	35
mean	220.5	108.5	103.0	30.0	32.8

Summary

mean root length	pacific	Drummond	Palouse	coyote	Mackenzie
rep1	9.3	9	5	8.8	3.3
rep2	9.6	9	5.8	5.1	3.4
rep3	5.6	3.4	3.5	10	5.4
rep4	17.7	11.1	6.2	6	3.9
mean	12.1	8.5	5.5	7.5	4.2




No. Roots by Replication
No. Roots
35
30
25
20
15
10
5
0
rep1
rep2
rep3
rep4
mean
drumm
palouse
coyote
pacific
mackenzie


Total Root Length by Species
mm
600
500
400
300
200
100
0
drumm
palouse
coyote
pacific
mackenzie
rep1
rep2
rep3
rep4
mean

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

STUDY NUMBER: WAPMC-T-0604-RI
STUDY TITLE: Riparian Shrubs: Pre-conditioning of hardwood cuttings of Redosier dogwood

NATIONAL PROJECT NUMBER: WQ 2.1
STUDY TYPE: Cultural
LAND USES:

PROBLEM: Planting Redosier dogwood (*Cornus stolonifera*) hardwood cuttings is a preferred method of establishing new plants in riparian zones. Cuttings from plants east of the Cascade Mountains in Washington (and probably Oregon) are much slower to root than many of the willows used in the same sites. This slowness in rooting reduces the ability of the plants to readily establish from cuttings. Pre-conditioning/pre-callusing of cuttings may enable rooting in cuttings planted in the field to occur sooner, enabling better survival over "cut and plant" method.

OBJECTIVE: Determine if pre-conditioning of eastern Washington source Redosier dogwood hardwood cuttings provides an advantage in rooting and/or survival of the cuttings.

DURATION OF STUDY: 2005-2007
STUDY LEADER: Wayne Crowder
LOCATION: Pullman PMC
COOPERATORS: Washington State University

STUDY DESIGN:
Phase 1: (growth chamber) 10 hardwood cuttings per rep; 4 reps; hold 0, 2, 4, 6 weeks in moisture in refrigerator; then plant in Deepots in PMC growth chamber. Treatments: with and without rooting hormone (.3% IBA). Hormone on lower 1" of the cuttings, with a 1" long shallow slice through the bark ~1/16 in. wide starting at the butt end cut, applied at time of planting in the growth chamber. Use the same accession in the trial, Cheney Origin Redosier dogwood.

Evaluation: 1). stages of rooting in pre-conditioned cuttings: no roots or callus, callused but no roots, roots started but showing as bumps in bark, few roots (1-3), some roots (4-5), many roots (>5). 2). While in Deepots, note survival, days to roots through bottom of Deepots, days to adequate plug cohesion for outplanting.

Phase 2: (field) Utilizing information gathered in Phase 1, cut cuttings, hold ½ of the cuttings in moisture in refrigeration, direct plant the other ½, then plant the held cuttings after the holding time is elapsed. Plant 5 hardwood cuttings per treatment per replication, 4 replications, in a field site. Use the same accession as the growth chamber trial.

Evaluate survival, vigor and growth of plants. Protect from voles/mice.

	rooting hormone				no rooting hormone			
	Rep 1	Rep 2	Rep 3	Rep 4	Rep 1	Rep 2	Rep 3	Rep 4
0 weeks	10	10	10	10	10	10	10	10
2 weeks	10	10	10	10	10	10	10	10
4 weeks	10	10	10	10	10	10	10	10
6 weeks	10	10	10	10	10	10	10	10

PROGRESS: (Phase 1): On Nov. 29, 2005 70 whips of Cheney Origin Redosier dogwood were cut in the field and stored in the PMC growth chamber. On Dec. 1 and 2, cuttings were cut to lengths of about 6 to 8 inches, leaving at least a bottom node and a top node; bundled, wetted, placed in a plastic bag then refrigerated. Target refrigerator temperature was about 30-35 degrees F, but monitoring showed temps ranged from 25 to 40 deg. even though the temperature control was set at the highest temperature possible without turning the unit off.

The 0 week treatments were planted on Dec. 2, the 2 week treatments on Dec. 13, the 4 week treatments on Dec. 29, 2005 and the 6 week treatments on Jan 13, 2006. None of the treatments had callused or bumps(root initials) present in the bark. Hormone treatment and bark slice was done at planting.

On Dec. 27, 2006, the following data was taken on the cuttings.

treatments	no. w/leaves	treatment	no. w/leaves
0-0-1	7	2-0-1	1
0-0-2	4	2-0-1	0
0-0-3	4	2-0-3	0
0-0-4	4	2-0-4	2
total	19	total	3
0-H-1	4	2-H-1	0
0-H-2	5	2-H-2	1
0-H-3	6	2-H-3	0
0-H-4	7	2-H-4	0
total	22	total	1

Note: 0-0-1 designates weeks held prior to planting - no hormone treatment- Rep 1
H designates treatment with hormone

Two cuttings were pulled and replaced on Dec. 27 in the 0-0-1 treatment. No development of any signs of bumps on the bark or callus or roots were present. 1 cutting in 0-H-1 was pulled. Bumps and callus had started. Room temp was 68 deg F.

Note: Throughout the rooting process, no advantage to wounding the cuttings was noted, either in the no hormone or the hormone treatment.

On Jan 4, 2006, the following data was taken (Phase 1)

treatments	no. w/leaves[1]	rooting status[2]
0-0-1	8	oc/ob
0-0-2	8	oc/ob
0-0-3	8	oc/ob
0-0-4	6	oc/ob
total	30	
0-H-1	4	oc/b swelling at cut end
0-H-2	6	oc/b swelling at cut end
0-H-3	8	oc/ob
0-H-4	7	oc/b
total	25	
2-0-1	3	oc/b
2-0-1	2	oc/b
2-0-3	2	oc/b
2-0-4	3	oc/b
total	10	
2-H-1	2	oc/b
2-H-2	6	oc/b
2-H-3	2	oc/b
2-H-4	2	oc/b
total	12	
4-0-1	0	oc/b
4-0-2	0	oc/ob
4-0-3	0	oc/ob
4-0-4	0	oc/ob
total	0	
4-H-1	0	oc/ob
4-H-2	0	oc/ob
4-H-3	0	oc/ob
4-H-4	0	oc/ob
total	0	

[1] Green portion of leaf present, but maybe not full leaf
[2] Pulled 1 cutting in each rep.
oc = no callusing
ob = no bumps
b = at least 1 bump in bark

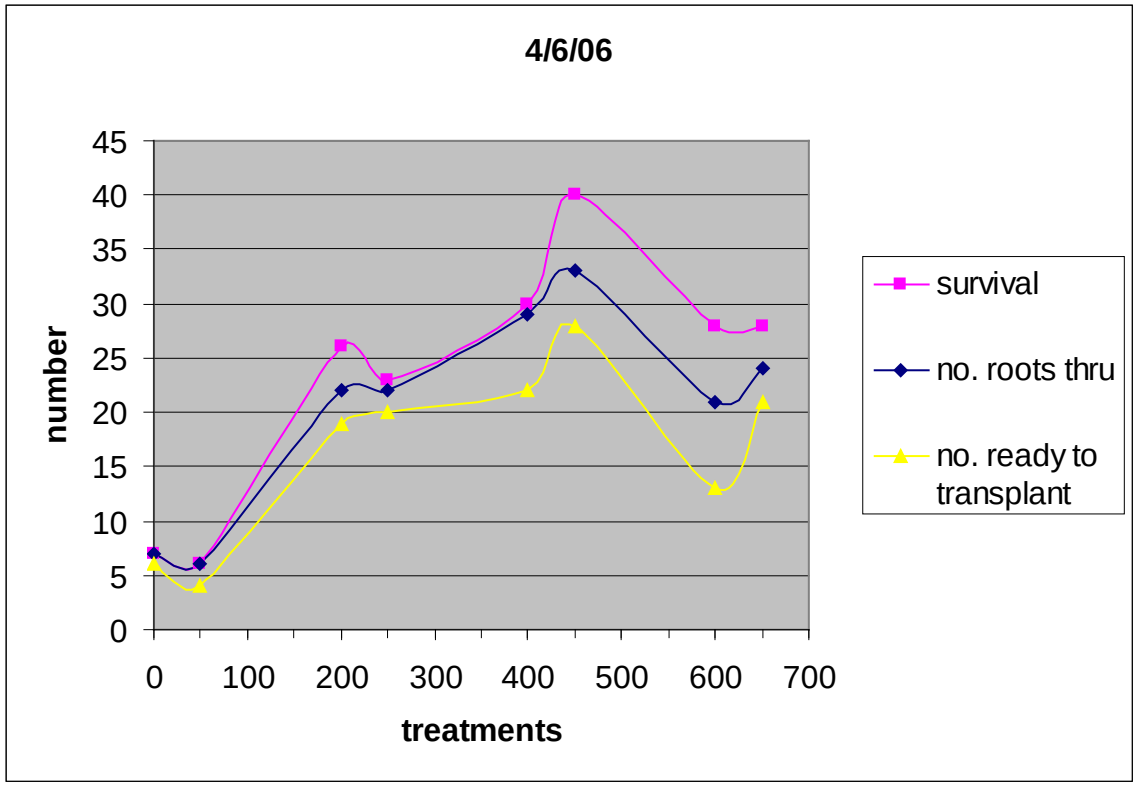
On Jan 26, 2006, the following evaluation data was noted (Phase 1)

treatments	no. w/leaves[1]	rooting status: no. bumps on 1 cutting that was pulled	comments
0-0-1	9	3	
0-0-2	9	1	
0-0-3	8	0	
0-0-4	9	9	
total	35	13	
0-H-1	7	3	
0-H-2	7	2	1 rotting 5.5 cm up from bottom
0-H-3	9	0	1 w/leaves dead
0-H-4	9	0	
total	32	5	
2-0-1	8	8	
2-0-1	10	16	
2-0-3	9	0	callused, roots 20, 24, 8 mm long
2-0-4	10	10	
total	37	34	
2-H-1	10	0	rooted in slice, 12 mm long
2-H-2	9	2	callused
2-H-3	10	2	
2-H-4	10	1	callused
total	39	5	
4-0-1	1	2	
4-0-2	2	2	
4-0-3	6	-	rooted 20 mm long
4-0-4	8	9	
total	17	13	
4-H-1	7	-	callused
4-H-2	6	2	callused
4-H-3	8	1	callused
4-H-4	10	2	
total	31	5	
6-0-1	0	0	
6-0-2	0	0	
6-0-3	1	0	
6-0-4	1	4	
total	2	4	
6-H-1	0	0	
6-H-2	0	0	
6-H-3	0	0	
6-H-4	3	0	callused
total	3	0	

Evaluation Data (Phase 1)

2/10/06		2/16/06	3/6/06			3/23/06			4/6/06		
treatments	no. w/leaves[1]	no. w/roots thru the pot (out of 10)	no. with roots thru the pot	no. alive (with green leaves)	Comments	no w/roots thru pot	no. alive	no ready to transplant	no roots thru	no. surf	no ready to transplant
0-0-1	8	0	0	6	Feb 10, 1 dying	1	3	0	1	1	1
0-0-2	7	0	0	4		0	3	0	0	0	0
0-0-3	9	1	3	6		3	4	2	3	3	2
0-0-4	8	0	0	6		2	4	0	3	3	3
total	32	1	3	22		6	14	2	7	7	6
0-H-1	6	0	1	5		2	3	1	2	2	2
0-H-2	7	0	2	6		3	3	2	3	3	2
0-H-3	5	0	0	3		0	2	0	1	1	0
0-H-4	7	0	0	6		0	4	0	0	0	0
total	25	0	3	20		5	12	3	6	6	4
2-0-1	10	0	4	8		6	8	6	7	8	7
2-0-1	9	3	4	9		5	7	5	7	8	6
2-0-3	10	0	2	8		5	7	4	6	7	4
2-0-4	9	0	3	5		2	4	2	2	3	2
total	38	3	13	30		18	26	17	22	26	19
2-H-1	9	1	6	8		6	6	4	6	6	6
2-H-2	9	0	3	7		5	5	3	5	5	4
2-H-3	10	4	5	8		5	6	5	5	5	5
2-H-4	10	1	5	9		6	7	6	6	7	5
total	38	6	19	32		22	24	18	22	23	20

Feb. 10		Feb. 16	Mar. 6			3/23/2006			4/6/06		
treatments	no. w/leaves[1]	no. w/roots thru the pot (out of 10)	no. with roots thru the pot	no. alive (with green leaves)	Comments	no w/roots thru pot	no. alive	no ready to transplant	no roots thru	no. surv	no ready to transplant
4-0-1	7	0	3	8		4	8	4	6	6	4
4-0-2	9	0	1	9		6	9	5	7	7	5
4-0-3	9	0	5	10		6	9	5	7	8	6
4-0-4	9	1	4	9		7	9	5	9	9	7
total	34	1	13	36		23	35	19	29	30	22
4-H-1	10	1	4	10		8	10	5	9	10	8
4-H-2	10	0	3	10		7	10	3	9	10	7
4-H-3	10	3	8	10		9	10	6	9	10	8
4-H-4	10	2	3	10		6	10	4	6	10	5
total	40	6	18	40		30	40	18	33	40	28
6-0-1											
6-0-2	4	0	0	8		2	8	0	4	8	2
6-0-3	7	0	1	8		4	8	1	6	8	3
6-0-4	6	0	0	10		3	8	2	5	6	3
total	24	0	1	36		13	34	3	21	28	13
6-H-1	9	0	1	10		8	9	5	9	9	9
6-H-2	8	0	0	9		2	7	1	3	7	3
6-H-3	9	0	0	10		0	8	0	5	5	5
6-H-4	9	0	0	10		1	8	0	7	7	4
total	35	0	1	39		11	32	6	24	28	21


4/6/06
45
40
35
30
25
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15
10
5
0
number
0
100
200
300
400
500
600
700
treatments
survival
no. roots thru
no. ready to transplant