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NATIVE GRASS AND FORB INITIAL EVALUATION
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INTRODUCTION

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

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

MATERIALS AND METHODS

Harvested seed collections were cleaned at the PMC seed cleaning facilities using a wide range of machines and settings. Each accession was treated separately due to differences in the quality of pre-cleaned materials and variation in seed size. Appendix 2 provides general information regarding machine calibration and settings used for each species. Minor adjustments were made to the seed cleaning equipment to achieve the best seed purity for each collection. Estimated viability was obtained using the kerosene heater

"popping" method outlined in Ogle and Cornforth (2000). Some collections were also evaluated for viability using standard germination tests.

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

GRASSES

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

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

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

The first evaluation was conducted on June 14, 2004 when all grasses had reached the one to two leaf stage. Plots were evaluated for percent stand, plant density and seedling vigor. Percent stand was measured using a twenty foot rope marked with one foot increments stretched the length of the plot and anchored at either end. Plants intercepting the one foot increments were summed and recorded as a percentage. Plant density was

measured by counting seedlings found in the middle two feet of row and converted to average number of plants per foot of row. Seedling vigor was measured on a subjective scale of one to nine (one being most healthy and nine being dead). Each plot was assessed and given a rating based on overall apparent vigor.

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

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

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

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

FORBS

The native forb evaluation trial was planted on May 19, 2004 at the PMC Home Farm approximately two miles north of Aberdeen. Site information, seedbed preparation and experimental design are identical to the grass trial. There are two industry standards included in the western yarrow plots, Eagle and Great Northern. There are no releases of lupine or pearly everlasting that would be comparable to the collections received for testing, so no standards of comparison were included for these two species. Yarrow plots were seeded with a target rate of 50 PLS per foot using a belt seeder. Lupine plots were

seeded at 25 PLS per foot, and pearly everlasting plots were seeded at 50 PLS per foot using a Planet Jr. seeder. A border row of 'Appar' blue flax (*Linum perenne*) was planted on either side of the trial to reduce edge effect. The first evaluation was conducted on July 19, 2004. Plants ranged from the two to six leaf stage.

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

DISCUSSION

BLUE WILDRYE

2004 Evaluations

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

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

2005

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

yield but low seed production. Accession 9076439 is a shorter statured plant but scored in the top three in forage and seed production.

2006

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

2007

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

Table 1. Blue wildrye

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

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

Table 1 (continued).

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

SANDBERG BLUEGRASS

2004 Evaluations

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

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

2005

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

Sandberg bluegrass

2006

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

2007

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

Table 2. Sandberg bluegrass

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

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

Table 2 (continued).

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

IDAHO FESCUE

2004

The Idaho fescue trial contained three industry releases. Joseph and Nezpurs are both synthetic cultivars comprised of collections made throughout the northwestern United States and Canada. Winchester Source Germplasm is a non-manipulated release from a collection made near Winchester, Idaho in the Idaho Panhandle (Ogle et al 2003a). The

first evaluation of Idaho fescue indicated a wide range in stand establishment (Table 3). Accession 9076469 had the best stand averaging 80.5%. Accession 9076469 also ranked first in plant density with 12.0 plants/foot of row. Seedling vigor ratings showed industry release Winchester as the most vigorous with a rating of 2.8. Accession 9076444 had the poorest ratings of stand, density and plant vigor (16.8 % stand, 1.8 plants/foot and 7.8 vigor).

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

2005

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

2006

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

2007

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

Table 3. Idaho fescue

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

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

Table 3 (continued).

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

BLUEBUNCH WHEATGRASS

2004

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

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

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

2005

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

2006

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

2007

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

Table 4. Bluebunch wheatgrass

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

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

Table 4 (continued).

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

TUFTED HAIRGRASS

2004

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

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

2005

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

2006

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

2007

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

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

Table 5. Tufted hairgrass

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

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

Table 5 (continued).

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

WESTERN YARROW

2004

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

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

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

2005

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

Western Yarrow

2006

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

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

2007

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

Table 6. Western yarrow

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

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

Table 6 (continued).

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

SUMMARY

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

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

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

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

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

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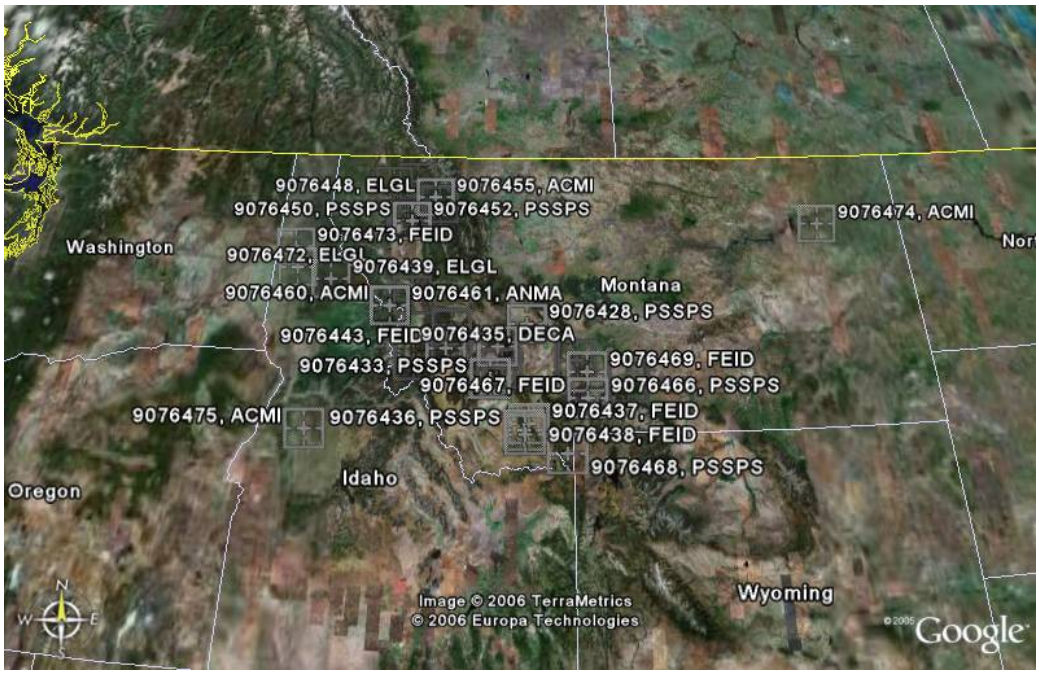
Appendix 1. Collection data and maps

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

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



Composite map of all collections

Blue wildrye

Idaho fescue

Tufted hairgrass

Bluebunch wheatgrass

Western yarrow

Appendix 2. Seed cleaning calibrations

Blue Wildrye (*Elymus glaucus*)

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

Bluebunch Wheatgrass (*Pseudoroegneria spicata*)

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

Idaho Fescue (*Festuca idahoensis*)

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

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

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