

USDA Forest Service, Region 1
Native Grass and Forb Initial Evaluation
2004 Progress Report
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INTRODUCTION

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

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

Appendix 1 lists the accessions collected, collection locations and the size of each seed collection. This report summarizes the evaluations conducted during 2004.

MATERIALS AND METHODS

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

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

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

GRASSES

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

Plots were seeded on May 10 and 11, 2004. Bluebunch wheatgrass and Idaho fescue accessions were planted using a Planet Jr. seeder. Blue wildrye, Sandberg bluegrass and tufted hairgrass accessions were planted using a belt seeder. Planting equipment was calibrated to plant approximately 25 Pure Live Seeds (PLS) per foot of row for large seeded species (bluebunch wheatgrass and blue wildrye) and 50 PLS per foot of row for small seeded species (Idaho fescue, Sandberg bluegrass and tufted hairgrass). Seeding depth ranged from $\frac{1}{4}$ inch for small seeded accessions to $\frac{1}{2}$ inch for the larger seeded accessions. Each species block contained at least two released cultivars to use as standards for comparison. Border rows of ‘Tegmar’ intermediate wheatgrass (*Thinopyrum intermedium*) were planted on the outside of the blocks to reduce edge effect. Plots were sprinkler irrigated as needed during the growing season. Weeds were controlled with herbicides and between row cultivation.

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

The second evaluation during 2004 was completed during the week of September 27. All accessions were rated for percent stand and plant volume. Plant volume was measured as plant height x width₁ x width₂ and recorded in cubic inch units. Blue wildrye and bluebunch wheatgrass were rated for percent of plants in flower per plot. Idaho fescue, Sandberg bluegrass and tufted hairgrass had not begun flowering by the time of the evaluation. Seed yield data was not collected during the first year of establishment,

because seed harvest during the first year of establishment is not generally recommended. Seed yield data will be collected beginning in the second growing season (2005). All species except blue wildrye were evaluated for plant density as described above. Plant density for the blue wildrye accessions was not collected during the second evaluation due to very tight and uniform stands that rendered data collection of plant density impossible.

All data except plant vigor evaluations were subjected to an Analysis of Variance (ANOVA) and means were separated using Duncan's Multiple Range Test using the MSTAT-C Microcomputer Statistical Program (Freed et al, 1991).

FORBS

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

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

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

2004 EVALUATIONS DISCUSSION (PRELIMINARY)

BLUE WILDRYE

The first evaluation of blue wildrye showed no significant differences in percent stand between the accessions tested. Plant density showed low levels of significance. Accession 9076447 rated highest (39.0 plants/foot), and Elkton (a western Oregon accession) rated lowest at 16.4 plants/foot. Best vigor was recorded from accessions 9076446, 9076447 and Mariposa (1.8). Poorest vigor rated was 3.8 from Arlington (a western Oregon accession) (see Table 1).

During the second evaluation there was again no significant difference in percent stand for the blue wildrye accessions. All accessions had stands ranging from 90 to 100% except accession 9076448 which had a stand of 76.4%. Mariposa, Elkton and accession 9076472 showed high percentages of flowering (93.4, 92.5 and 80.0% respectively). The other industry release, Arlington, had 55% flowering. The remainder of the accessions had little to no flower production ranging from 0.0 to 18.8%. Accessions showed a wide range of plant volumes from 117.3 in³ (accession 9076439) to 768.0 in³ (Mariposa) with Mariposa significantly higher than the rest of the plants in the trial.

Accession No.	% Est. viability	% PLS ^{3/}	% Stand		Vigor ^{2/}		% Flower		Plant vol. (in ³)
			6/14	6/14	6/14	9/29	9/29	9/29	
9076439	79	71.1	92.8 ^{4/}	38.1 a-b ^{5/}	2.3 ^{4/}	98.6 ^{4/}	1.5 c	117.3 c	
9076445	77	69.3	91.5	30.1 a-c	2.8	100.0	0.0 c	132.5 b-c	
9076446	80	72.0	91.5	22.8 b-c	1.8	98.6	18.8 c	288.5 b-c	
9076447	72	64.8	93.0	39.0 a	1.8	100.0	3.5 c	132.5 b-c	
9076448	66	59.4	72.3	22.6 b-c	3.3	76.38	1.8 c	225.0 b-c	
9076449	69	62.1	95.8	36.6 a-b	2.0	100.0	3.0 c	193.3 b-c	
9076472	82	73.8	87.5	26.0 a-c	3.0	97.2	80.0 a	256.8 b-c	
Mariposa	*	94.0	95.8	28.4 a-c	1.8	95.8	93.8 a	768.0 a	
Arlington	*	93.0	91.5	31.5 a-c	3.8	100.0	55.0 b	353.5 b	
Elkton	*	92.0	95.5	16.4 c	3.5	94.4	92.5 a	299.0 b-c	
LSD (0.05)			22.1	13.7	1.8	20.4	20.1	195.3	

^{1/} Plants per foot of row

^{2/} Rated 1-9 with 1 best, 9 worst; not analyzed for significance

^{3/} Percent PLS of USFS R1 collections based on estimated 90% purity

^{4/} No significant difference detected between accessions

^{5/} Means followed by the same letter are not significantly different

* Data not available from source

SANDBERG BLUEGRASS

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

At the second evaluation Sherman dwarfed all other Sandberg bluegrass accessions in the trial. Sherman plants had an average volume of 262.4 in³, while the next largest, accession 9076465, measured a mere 8.8 in³. 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).

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

^{1/} Plants per foot of row

^{2/} Rated 1-9 with 1 best, 9 worst; not analyzed for significance

^{3/} Percent PLS of USFS R1 collections based on estimated 90% purity

^{4/} Means followed by the same letter are not significantly different

* Data not available from source

IDAHO FESCUE

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

The second evaluation showed industry release Winchester having the best percent stand at 75.0% followed closely by accession 9076469 with 72.2%. Accession 9076444 again had the poorest stand with 16.7%. Accession 9076469 had the greatest plant density rating of 6.8 plants/foot but did not differ significantly from accessions 9076427, 9076438, 9076437 and Winchester (5.1, 5.0, 4.8 and 4.8 plants/foot respectively). Winchester had the largest volume (28.1 in³) followed by accession number 9076427 with a volume of 22.3 in³. The smallest plants were those from accession 9076432 at 1.5 in³.

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

^{1/} Plants per foot of row

^{2/} Rated 1-9 with 1 best, 9 worst; not analyzed for significance

^{3/} Percent PLS of USFS R1 collections based on estimated 90% purity

^{4/} Means followed by the same letter are not significantly different

* Data not available from source

BLUEBUNCH WHEATGRASS

Bluebunch wheatgrass evaluations conducted in June 2004 showed numerous collections outperforming industry standards (Table 4). Accession 9076436 ranked highest for percent stand at 81.8%. Plant density and seedling vigor comparisons showed accession 9076433 as the best with 14.4 plants/foot of row and a 2.5 rating for vigor. Accession 9076463 ranked lowest in all three evaluations (27.8 % stand, 2.5 plants/foot and a vigor rating of 7.0).

Percent stand ranged from 83.3% (accession 9076466) to 33.3% (accession 9076463) at the second evaluation. Accession 9076433 had the best plant density at 5.8 plants/foot followed closely by accession 9076466 with 5.5 plants/foot. Lowest density was recorded by accession 9076463 (1.3 plants/foot). Density measurements may, however, be misleading, because a good stand of very small plants will show a much higher density than a good stand of robust plants (compare accession 9076433 with P-7). Plant volume measurements were dominated by the industry standards. P-7, Anatone and Goldar had the greatest volumes with 147.8, 125.0 and 109.8 in³ respectively. The next largest plant volume came from accessions 9076426, 9076464 and 9076436 at 64.0 in³. Accession 9076426, P-7 and Anatone all showed high first-year flower production (65.0, 58.8 and 48.8 %). There was also a large group of accessions that showed very little flower production: Goldar, 9076450, 9076466, 9076436, 9076441, 9076463, 9076442, 9076433 and 9076434 ranged from 22.5% down to 2.5% flower production.

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

^{1/} Plants per foot of row

^{2/} Rated 1-9 with 1 best, 9 worst; not analyzed for significance

^{3/} Percent PLS of USFS R1 collections based on estimated 90% purity

^{4/} Means followed by the same letter are not significantly different

* Data not available from source

TUFTED HAIRGRASS

Percent stand of 'Willamette' tufted hairgrass were significantly higher than all other accessions at the first evaluation (86.0%). Lowest percent stand was observed in accession 9076435 (53.0%). Accession 9076429 had the best seedling vigor rating of 4.8, while accession 9076435 showed the lowest vigor (7.8). Plant density showed no significant differences (see Table 5).

At the second evaluation, Willamette, Tillamook and accession 9076429 had 93.1, 84.7 and 79.1 percent stand but did not differ significantly. Lowest percent stand came from accession 9076435 at 57.0%. Plant density measurements were tight among the tufted hairgrass plots. Densities ranged from 6.3 plants/foot (Willamette) to 4.1 plants/foot (accession 9076435). Plant volume showed a broad range of measurements (Willamette, 68.7 in³ to accession 9076435, 16.6 in³) and also did not differ significantly.

Accession No.	% Est. viability	% PLS ^{3/}	% stand 6/14	Density ^{1/} 6/14	Vigor ^{2/} 6/14	% Stand 9/29	Density 9/29	Plant vol. (in ³) 9/29
9076429	49	44.1	68.0 b ^{5/}	19.0 ^{1/}	4.8	79.2 a-b	5.6a-b	31.0 ^{4/}
9076430	52	46.8	62.8 b-c	17.8	6.5	72.2 b-c	5.5 a-b	48.7
9076435	55	49.5	53.0 c	6.1	7.8	57.0 c	4.1 b	16.6
Willamette	*	81.0	86.0 a	23.0	5.3	93.1 a	6.3 a	68.7
Tillamook	*	81.0	69.8 b	21.8	5.5	84.7 a-b	5.4 a-b	60.2
LSD (0.05)			11.6	11.6	1.5	16.4	1.8	49.1

^{1/} Plants per foot of row

^{2/} Rated 1-9 with 1 best, 9 worst; not analyzed for significance

^{3/} Percent PLS of USFS R1 collections based on estimated 90% purity

^{4/} No significant difference detected between accessions

^{5/} Means followed by the same letter are not significantly different

* Data not available from source

COMMON YARROW

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

Accession 9076460 recorded the best percent stand at the second evaluation (73.6%), while accession 9076456 had the lowest stand at 29.15%. No significant difference was detected for plant density. Means ranged from 3.0 plants/foot (accession 9076458) to 0.3 plants/foot (accession 9076457). Industry standards Great Northern and Eagle had the largest plant volumes (753.8 and 691.5 in³ respectively). Great Northern also had the greatest percentage of flowering plants (38.8%).

			% stand	Density ^{1/}	Vigor ^{2/}	% Stand	Density	Plant vol. (in ³)	% Flower
Accession No.	% Est. viability	% PLS ^{3/}	7/16	7/16	7/16	9/29	9/29	9/29	9/29
9076454	84	75.6	37.5 ^{4/}	2.4 ^{4/}	4.8	48.6 a-b ^{5/}	2.4 ^{4/}	441.0 a-b	22.5 a-c
9076456	73	65.7	32.0	1.5	6.0	29.1 b	1.9	342.0 b	16.3 a-c
9076457	86	77.4	32.0	0.3	5.5	31.9 a-b	0.3	679.0 a	22.5 a-c
9076458	80	72.0	59.7	2.8	3.8	63.9 a-b	3.0	595.8a-b	32.5 a-b
9076459	91	81.9	47.2	1.3	4.0	45.9 a-b	1.3	513.3 a-b	37.5 a
9076460	67	60.3	75.0	3.1	3.5	73.6 a	2.9	481.3 a-b	37.5 a
9076474	37	33.3	45.9	2.9	5.8	50.0 a-b	1.8	323.0 b	6.3 c
9076475	71	63.9	45.9	3.0	4.5	48.6 a-b	2.6	507.0 a-b	12.5 b-c
Great Northern	93	71.6	45.9	2.3	2.8	45.9 a-b	1.8	753.8 a	38.8 a
Eagle	*	*	33.3	0.5	5.5	37.5 a-b	0.5	691.5 a	15.0 a-c
LSD (0.05)			33.6	3.3	3.2	36.8	2.7	283.6	21.4

^{1/} Plants per foot of row

^{2/} Rated 1-9 with 1 best, 9 worst; not analyzed for significance

^{3/} Percent PLS of USFS R1 collections based on estimated 90% purity

^{4/} No significant difference detected between accessions

^{5/} Means followed by the same letter are not significantly different

* Data not available from source

SUMMARY

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

REFERENCES

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

Appendix 1. Collection data

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

Appendix 1. Collection data (continued)

Accession No.	Species	Date collected	Fresh wt. (lbs)	Cleaned wt. (lbs)	Forest	Location	Elevation (ft)
9076458	Common yarrow	8/20/2003	1.4	0.20	Flathead	T26NR21W section 29	?
9076459	Common yarrow	9/4/2003	2.5	0.86	Bitterroot	T2NR20W section 2,10,11	5600
9076460	Common yarrow	9/22/2003	0.5	0.38	Lolo	N46 42 14.7 W114 35 56.8	4500
9076461	Pearly everlasting	9/23/2003	1.8	0.03	Lolo	N46 41 48.5 W114 36 10.5	4600
9076462	Idaho fescue	7/24/2003	0.4	0.20	Bitterroot	T2NR20W section 11	5600
9076463	Bluebunch wheatgrass	7/24/2003	1.8	0.54	Bitterroot	T2NR20W section 2	5700
9076464	Bluebunch wheatgrass	7/14/2003	17.5	1.86	Gallatin	N45 40 08.32279 W1100026.177	5500
9076465	Sandberg bluegrass	7/15/2003	7	1.58	Gallatin	N45 58 43.57899 W1110012.792	6700
9076466	Bluebunch wheatgrass	7/30/2003	17	1.88	Gallatin	N452733.66724 W1104630.334	7200
9076467	Idaho fescue	7/30/2003	19	5.25	Gallatin	N452743.68577 W1104630.334	7400
9076468	Bluebunch wheatgrass	7/31/2003	9.5	0.00	Gallatin	N444430. W1110954	6570
9076469	Idaho fescue	8/4/2003	12.5	3.92	Gallatin	N454842. W1104642.	7200
9076470	Lupine	8/4/2003	9.5	1.08	Gallatin	N454842. W1104642.	7600
9076471	Idaho fescue	7/16/2003	17.5	3.00	Gallatin	N45 58 06. W110 57 24.	6400
9076472	Blue wildrye	8/1/2003	4.5	3.08	ID Panhandle	T45NR2W sec. 26	2800
9076473	Idaho fescue	7/25/2003	1	0.46	ID Panhandle	T48NR3W section 12	2400
9076474	Common yarrow	7/15/2003	15	0.98	Custer	T25NR46E section 19	4000
9076475	Common yarrow	9/5/2003	2.1	0.12	ID Panhandle	T19N R4E section 15	5200

Appendix 2. Seed cleaning calibrations

Blue Wildrye (*Elymus glaucus*)

1. Thrashing
 - A. 3/8" screen followed by 1/4" 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 1/4" 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