

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

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

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

## MATERIALS AND METHODS

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

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

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

The initial establishment evaluation was conducted on June 15, 2005 (27 days after planting) when most of the plants from both species had reached a one to two leaf stage. Plots were evaluated for percent stand, plant density and seedling vigor. Percent stand was measured using a twenty foot rope marked with one foot increments stretched the

length of the plot and anchored at either end. Plants intercepting the one foot increments were summed and recorded as a percentage. Plant density was measured by counting seedlings found in the middle two feet of row and converted to average plants per foot of row. Seedling vigor was measured on an ordinal scale of one to nine (one being most healthy and nine being dead). Entire plots as well as individual plants within plots were viewed and given a rating based on overall apparent vigor.

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

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

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

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

## EVALUATIONS AND DISCUSSION

### Slender Wheatgrass

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

At the first evaluation, percent stand ranged from 25.4 % (accession no. 9076496) to 85.1 (San Luis and Adanac). The high rating from San Luis and Adanac did not, however,

differ significantly from several collections with percent stands of 70% or greater. The best plant density rating came from Adanac with 18.1 plants/foot. The poorest density was recorded from accession 9076496 with a density of 2.3 plants/foot. This accession similarly had the lowest seedling vigor rating of 6.7, while the best vigor was observed in Revenue (1.2). Of the CTNF and BTNF accessions 9076495, 9076498 and 9076499 performed the best in the three evaluated categories (Table 1).

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

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



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

Hillcrest scored lowest in forage and height, and third lowest in seed yield.

Forage yields were generally greater in 2007 versus 2006. The Department of Defense accession had the highest yield with over 11,000 lbs/ac, significantly better than all others

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

Table 1. Slender wheatgrass.

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

<sup>1/</sup> Plants per foot of row

<sup>2/</sup> Rated 1-9 with 1best, 9 worst

<sup>3/</sup> Percent PLS based on estimated 95% purity for CTMF collections

<sup>4/</sup> Means followed by the same letter are not significantly different

\* Information not available from source

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

\*indicates missing data values in one or more plots.

### Mountain Brome

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

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

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

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

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



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



**Mountain brome infested with head smut. Photo taken July 2006**

Table 2. Mountain brome.

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

<sup>1/</sup> No significant difference detected between treatments.

<sup>2/</sup> Rated 1-9 with 1 best, 9 worst

Table 2 (continued).

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

## SUMMARY

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

## REFERENCES

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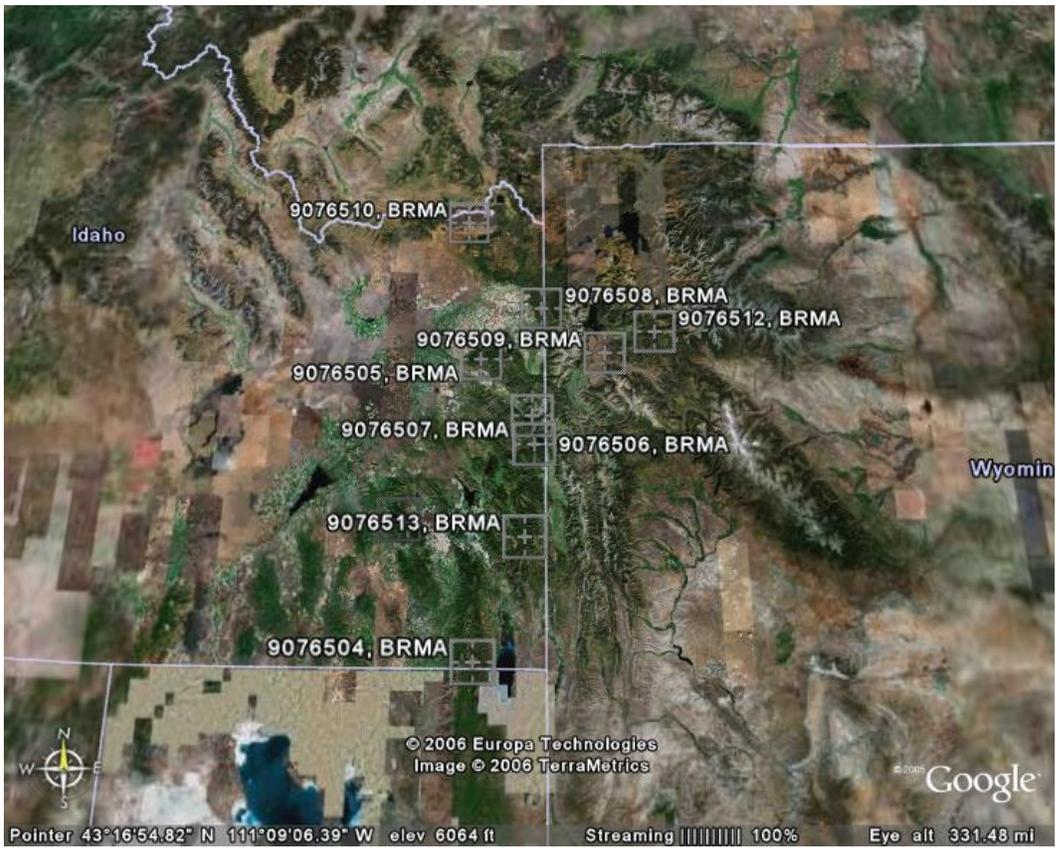
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### Appendix 1. Seed collection and origin data

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



**Geographic illustration of CTNF and BTNF collection locations**

**Mountain Brome**

I. Air Screen Cleaner

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

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

1. Drum: 7.25

**Slender wheatgrass**

I. Hammermill

1. Screen: 0.5 inch
2. Air: low

II. Air Screen Cleaner\*

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

\*Ran through three times to clean out inert matter.