

Curlew National Grasslands Off-Center Advanced Test Site
Summary of Progress 1992-97

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INTRODUCTION

The purpose of the Curlew National Grasslands Off-Center Advanced Test Site is to evaluate the potential of grasses for livestock and wildlife forage on sagebrush-grass range sites in southeast Idaho and northern Utah. The site is located just north of the ancient Lake Bonneville shoreline in Major Land Resource Area (MLRA) 13, Eastern Idaho Plateaus of the Northwestern Wheat and Range Region of the Intermountain United States. This report describes progress of work at the site from 1992 through 1997.

The site is located in the East Richards Pasture on the Curlew National Grasslands which is administered by the USDA - Forest Service. The project was implemented through a Memorandum of Understanding between the Natural Resources Conservation Service and the Forest Service.

The test site is located approximately 5 miles north of Holbrook, Idaho on a Ririe-Buist soil complex. The composition of this complex is 50% Ririe and similar inclusions, 25% Buist and similar inclusions, with 25% contrasting inclusions. The Ririe soil is a brown silt loam, very deep, well drained with moderate permeability. The available water holding capacity is 11.0-12.5 inches. The Buist soil is a brown, stony, silt loam, very deep, well drained and has moderate permeability. The available water holding capacity for the Buist soil is 4.0-5.5 inches. The pH of this soil complex is 7.4-7.6. The dominant vegetation in the natural plant community is bluebunch wheatgrass and mountain big sagebrush. The site is a loamy, 12-16 inch range site. The elevation is 5030 feet.

MATERIALS AND METHODS

The off-center advanced test site is composed of two components, the inter-center strain trial and a display nursery. The inter-center strain trial includes intermediate wheatgrasses, thickspike wheatgrasses, and alfalfas. The display nursery is composed of 91 accessions of grasses, forbs, and shrubs and the intended purpose is to make available to landusers examples of released cultivars and promising accessions that are adapted to the general area.

The site was originally scheduled to be planted in December, 1991 however, due to precipitation and resulting frozen ground the planting did not take place. During the last week of September, 1992 the Forest Service plowed the site. The PMC culti-packed the site on October 9, 1992. Due to extremely dry soil moisture conditions, the resulting seedbed was very fluffy which prevented seeding until adequate moisture was received to help firm the seedbed. Storms during the first week of November prevented seeding that had been scheduled for that week. However, dry conditions during the second week of November allowed seeding to take place on the 17th, 18th, and 19th.

All seed was mixed with rice hulls prior to seeding in order to plant approximately 20-25 seeds per square foot. A double disk drill with press wheels was used. Row spacing was ten inches. Due to non-uniform soil moisture conditions, there was some difficulty in controlling seeding depth, but 0.50-0.75 inch seeding depth was achieved overall. Because of the soil moisture conditions and soil being lifted by the tractor wheels, the press wheels on each end of the drill tended to collect mud. Since the press wheels were collecting mud, drag chains were used on the two outside rows of each plot to better cover the seed. Immediately following seeding, it began snowing and the site was snow-covered the entire winter.

Table 1 lists the accessions that were seeded at the Curlew Off-Center Advanced Test Site inter-center strain trial and Figure 1 is a plot map showing the layout of the site and the accessions which were included in the display nursery. The plots in the inter-center strain trial are 7 x 33 feet and are randomly replicated four times. The display nursery plots are 7 x 66 feet in size and are not replicated.

The spaces between the inter-center strain trial and the display nursery were seeded to a "cover crop" seed mixture or a "firebreak" seed mixture (refer to Figure 1 for locations seeded to the different mixes). The seed mixtures are composed of the following species and rates:

Cover Crop Mix

'P-27' Siberian Wheatgrass	1.8#PLS/ac
'Hycrest' crested wheatgrass	1.3
'Bannock' thickspike wheatgrass	1.1

Firebreak Mix

'Sodar' streambank wheatgrass	3.0#PLS/ac
'P-27' Siberian wheatgrass	2.0
'Ephraim' crested wheatgrass	2.0
'Wytana' fourwing saltbush	2.0
'Appar' Lewis flax	0.5

The evaluation data collected from the inter-center strain trial included total plant height (centimeters), plant vigor (rated 1 = best to 9 = dead), plant density (plants per square foot), and forage production (pounds air dry forage per acre).

Vigor is a subjective rating of plant health. A plant with a healthy green color without chlorosis would rate 1 versus a dead plant which would rate 9. Plant density was measured using a row count technique. Plants were counted from the middle two rows for a distance of 18.3 centimeters at the middle of the plot. Forage production data was collected by clipping forage from a 24 x 80 inch frame centered on the two middle rows of each plot. Forage samples were air-dried and yield calculated.

The site was evaluated twice each year in 1993 and 1994 with the first evaluation in May and the second evaluation later in the growing season. In 1995, 1996 and 1997 the site was evaluated only once per year. Table 1 summarizes the evaluation data for each year but only shows the later evaluation data from September 10, 1993 and July 10, 1994.

The following table summarizes precipitation data for the area during the evaluation period. The Arbon 2NW weather station which is maintained by the National Weather Service is located approximately 15 miles north of the test site. This station is the closest to the test site on terrain similar to the test site. The long term average precipitation is 16.76 inches. Yearly precipitation totals were below average for 1992 and 1994. Due to missing data, it is uncertain whether 1995 was below average. Precipitation was above average in 1993 and even though there is missing data for 1997, yearly precipitation for the year was much above average for the entire region.

Precipitation Data from Arbon, Idaho
(inches)

	Average	1992	1993	1994	1995	1996	1997
January	1.80	0.03	2.73	0.81	1.70	N.A.	N.A.
February	1.49	1.94	1.30	1.93	N.A.	N.A.	N.A.
March	1.54	0.97	2.34	0.36	2.82m	1.30m	0.23m
April	1.42	0.78	1.46	0.55	1.65m	1.94m	1.13
May	1.71	0.61	1.29	1.54	1.86	5.12	0.77
June	1.56	0.75	2.29	0.06	2.18	0.26	1.23
July	1.01	0.55	1.16	0.03	0.35	1.64	1.12
August	0.89	0.11	2.39	0.91	0.79	0.05	1.69
September	1.01	0.04	0.22	0.64	0.65	1.08	2.20
October	1.05	1.29	1.28	1.97	0.64	0.97	1.56
November	1.56	1.13	0.40	1.47m	2.22	1.83m	0.67
December	1.73	1.81	0.98	0.89m	N.A.	3.45	N.A.
Total	16.76	10.01	17.84	11.16m	14.86m	17.64m	10.60m

m = missing data

1993 EVALUATIONS AND DISCUSSION

The Curlew National Grassland inter-center strain trial was evaluated twice during the establishment year. The first evaluation was conducted on May 17, 1993. Most grasses were in the 2-3 leaf stage and 5-8 cm tall. The alfalfa accessions were 2-3 cm tall. Overall vigor of each plot was also recorded.

Plant density for the intermediate wheatgrass accessions averaged 4.2 plants per square foot and ranged from 1.0-6.8 for 'Amur' and 'Reliant' respectively. Vigor for the intermediate accessions averaged 4.7 (rated 1-9 with 1 best). 'Rush' had the best vigor rating (2.8) and Amur had the poorest vigor (7.3). The thickspike wheatgrasses had an overall average plant density of 5.6 plants per square foot, ranging from 4.8 for 'Bannock' to 6.3 for 'Critana'. Overall vigor averaged 4.5 with Bannock having the best vigor rating of 4. The alfalfa accessions had an overall average plant density of 1.7. 'Ranger' had the highest plant density of 3.5 and 'Ladak' had the lowest density of 0.8. Overall average vigor for the alfalfa accessions averaged 6.2. Ranger had the best vigor rating of 4.5.

There had been some ground squirrel activity in the plots but not enough to impact plant establishment. A few plants in each plot had been lightly grazed by either small rodents or mormon crickets. There were only 4 or 5 crickets observed in the plots on May 17 but adjacent to the site, crickets were very heavy. The Forest Service and the Animal and Plant Health Inspection Service (APHIS) were notified of the observance of crickets and bait was spread in the area. A visit to the site on June 4 indicated no significant additional damage by crickets.

On June 4, observations of the display nursery found most grass plots had emerged. An excellent stand of 'Lutana' cicer milkvetch was found. None of the plants in the shrub plots had emerged. Weeds such as lambsquarters, sunflower, blue mustard, and cheatgrass were dominating the site.

The second evaluation of the inter-center strain trial was conducted September 10, 1993. Plant density, vigor, and plant height data was collected and is shown on Table 1. Average plant density for the intermediate wheatgrass accessions ranged from 0.5 for Amur to 4.8 for Rush. Rush also had the best vigor rating (1.5) and Amur had the poorest vigor rating (7.0). 'Slate' was the tallest accession averaging 76.3 cm. Critana had the best plant density and vigor of the thickspike accessions. The tallest thickspike accession was 'Schwendimar'. Plant density for the alfalfa accessions improved from the spring evaluation, indicating that plant emergence had continued past May 17. 'Spreador II' had 3.0 plants per square foot. Vigor also improved over the summer with 'Servalra' having the best vigor. Spreador II was the tallest alfalfa accession.

The intermediate wheatgrass accessions had developed seedheads. Cheatgrass was heavy on the west end of the site but the seeded accessions appeared to be competing quite well. Volunteer sweetclover had invaded the spaces between the inter-center strain trial and the display nursery.

A tour of the site with representatives from the Franklin County Conservation District was held on June 25. The tour centered around the display nursery and a description was given of the uses and management of each of the cultivars in the display nursery.

1994 EVALUATIONS AND DISCUSSION

Two evaluations were conducted during 1994. The first evaluation was on May 18 and the second evaluation July 11.

The winter of 1993-94 was mild with above normal temperatures and below normal precipitation. Weather conditions during the spring and summer of 1994 were drastically different from the previous cool, wet growing season with very hot temperatures and below normal precipitation. At the time of the first evaluation in 1994, many plants were suffering from the effects of drought.

The volunteer stand of sweetclover was competing with the test accessions so it was decided to spray the site to control broadleaf weeds. On June 3 all the grass plots were sprayed with 1.5 pint per acre 2,4-D, 0.25 pint per acre Banvel and 0.50 pint per acre surfactant. Care was taken to avoid the broadleaf accessions which were seeded in the display nursery. The herbicide

application was successful in controlling broadleaf weeds and no observations of damage to any forb or shrub accessions were noted.

Percent stand and vigor data was collected during the first evaluation in 1994. Percent stand was determined by ocular estimate and vigor was evaluated as in 1993. 'Manska' intermediate wheatgrass had the best stand followed by Reliant and Rush. 'Tegmar' was the poorest of the intermediate wheatgrass accessions. Bannock thickspike wheatgrass had the best stand of the thickspike accessions and PI-23664 had the poorest stand. Servalra had the best stand in the alfalfa accessions and 'Travois' and 'Ranger' had the poorest stands. Vigor seems to correlate well with percent stand in that those accessions with high percent stands also had excellent vigor ratings and those accessions with the poorest stands had poor vigor ratings.

The display nursery was also evaluated for stand and vigor during the first evaluation in 1994 and the results are shown in Table 2. Because the display nursery is not replicated, only general observations can be made and no statistical analysis was performed. As a group, the crested wheatgrass accessions had the best stands followed by the pubescent-intermediate and bluebunch wheatgrass accessions. 'Appar' Lewis flax was the only broadleaf which had a respectable stand.

On July 11, plant density, vigor, total plant height, and forage production data was collected from the replicated plots and is summarized in Table 1. One-way analysis of variance (ANOVA) and means separation test using Duncan's Multiple Range Test were performed on the forage production data from the intermediate and thickspike wheatgrass accessions. The species groups were analyzed separately from each other. ANOVA was not performed on the alfalfa accessions because many of the plots were not clipped due to lack of measurable forage.

Vigor for the intermediate wheatgrass accessions ranged from 2.3 for Manska to 9.0 for Amur. Plant density ranged from 0 to 4.0 for Amur and Manska respectively. Total plant height ranged from 0 cm (Amur) to 50.0 cm for 'Luna'. Forage production ranged from 0 pounds per acre for Amur to 629 pounds per acre for Manska and Reliant. The best performing intermediate wheatgrass accessions Manska, Reliant, Rush, and Slate produced significantly more forage than 'Greenleaf', 'Mandan', AI hybrid, 'Greenar', 'Topar', and Tegmar at the 5 percent level of significance but were not significantly different than Oahe or Luna. Amur was not included in the ANOVA because it did not produce any measurable forage.

Vigor for the thickspike wheatgrass accessions ranged from 3.0 for Bannock and PI-236663 to 4.8 for Schwendimar and plant height ranged from 15.8 cm for 'Sodar' to 27.5 cm for Bannock. Forage production ranged from 93 pounds per acre for Sodar to 185 pounds per acre for Bannock. There was no significant difference in forage production among the thickspike wheatgrass accessions.

Vigor for the alfalfa accessions ranged from 4.3 for 'Ladak' and Spreador II to 7.8 for 'Baker' and plant height ranged from 8.0 cm for Baker to 22.3 cm for Spreador II. Forage production ranged from 0 pounds per acre to 92.6 pounds per acre for Baker and Ladak respectively. The alfalfa accessions suffered from poor establishment and competition from cheatgrass.

The Curlew National Grasslands Off-Center Advanced Test Site was visited by 3 tour groups during 1994. The first tour was held on June 16 when approximately 40 people attending a regional rangeland resource monitoring school sponsored by the Cooperative Extension Systems of the University of Idaho, Utah State University, and the University of Wyoming visited the site. On June 22, the Plant Materials Training course sponsored by the Aberdeen Plant Materials Center brought approximately 25 individuals to the site and discussed the uses of the various accessions planted in the Display Nursery. On August 23, Gu Anlin and Yun Gen Feng, Plant Scientists from Inner Mongolia and China; Larry Holzworth, Plant Materials Specialist, Montana; John Scheetz, Manager, Bridger, Montana Plant Materials Center; Dan Ogle, Idaho Plant Materials Specialist and Gary Young, Manager, Aberdeen Plant Materials Center reviewed the trial as part of a western regional plant materials tour for the Chinese scientists.

On September 21, 1994 the plots were mowed to a stubble height of 2 inches to remove current years' growth.

1995 EVALUATIONS AND DISCUSSION

The winter of 1994-95 was mild with above normal temperatures and near normal precipitation. However, during the months of March through June, precipitation was much above average and temperatures were cool. By July, temperatures returned to normal and precipitation dropped back to average.

A visit to the site was made on April 4, 1995. A drainage ditch on the west side of the test site had over-topped earlier in the spring when the ground was still frozen. Runoff caused some erosion in the alfalfa test plots and in some of the westernmost display plots. Many of these plots never fully established and were mostly covered with cheatgrass. It was decided that the area would be left to heal on its own for the present time but if additional erosion took place, an effort would need to be made to stabilize the site.

The inter-center strain trial was evaluated on July 18 and 19, 1995. One-way analysis of variance (ANOVA) and means separation test using Duncan's Multiple Range Test were performed on the forage production data from the intermediate and thickspike wheatgrass accessions and is summarized in Table 1.

Plant density for the intermediate wheatgrass accessions ranged from 0 plants per square foot for Amur to 3.0 for Reliant. Plant height for the intermediate wheatgrass accessions ranged from 0 cm for Amur to 91.8 cm for Slate. Vigor for the intermediate wheatgrass accessions ranged from 1.8 (best) for Maska to 9.0 (poorest) for Amur. Forage production ranged from 231 pounds per acre (air-dried) for AI Hybrid to 1425 pounds per acre for Slate. The mean forage production for the intermediate wheatgrass accessions was 714 pounds per acre. In 1994, the mean forage production was 317 pounds per acre.

Plant density for the thickspike wheatgrass accessions ranged from 0.8 plants per square foot for PI-236663 to 2.5 plants per square foot for Critana. Plant height ranged from 14.0 cm for PI-236664 to 68.3 cm for Critana. Vigor for the thickspike wheatgrass accessions ranged from 3.8 (best) for Critana to 6.8 (poorest) for PI-236663. The most forage production was from Critana

(861 pounds per acre) and the least forage production was from PI-236663 (120 pounds per acre). The mean forage production for the thickspike wheatgrass accessions was 354 pounds per acre. In 1994, the mean forage production was 139 pounds per acre.

The alfalfa accessions suffered from poor establishment and competition from cheatgrass since they were planted. There was extreme variability in the stands and statistical analysis was not completed for the data collected in 1995. Travois had 1.3 plants per square foot for the best plant density. Spreador II was the tallest alfalfa accession at 43.5 cm and Ladak had the best vigor (4.5). The greatest forage production was from Travois at 398 pounds per acre. The mean forage production for the alfalfa accessions was 182 pounds per acre. In 1994, mean forage production was 42 pounds per acre.

Three randomly located plot frames were clipped in the cover crop area between the test plots and the display nursery for total above ground biomass production. Two of the plots were estimated to be 50 percent seeded species and 50 percent cheatgrass. The third plot was mostly composed of cheatgrass. The average total above ground biomass for these three plots was 3961 pounds per acre. The highest producing plot was 4850 pounds per acre and the lowest producing plot was 2925 pounds per acre.

Many of the test plots were contaminated with volunteer crested wheatgrass. Extremely dry conditions in 1994 set back the vigor of the test plants. The above normal precipitation during the spring of 1995 appeared to have favored the volunteer crested wheatgrass (which is known for its early spring growth) and gave it an advantage over the test plants. Statistical analysis of the data showed a higher coefficient of variability (CV) than from data collected in 1994 which may support this opinion. Without the competition from the volunteer crested wheatgrass, forage production from the test plots would be significantly greater.

On November 6, 1995 the plots were mowed to a stubble height of 2 inches to remove current year's growth.

1996 EVALUATIONS AND DISCUSSION

Precipitation during the Fall of 1995 was less than normal and winter precipitation was above normal. During 1996, Spring and Summer precipitation was below normal, summer temperatures were above normal, and hot winds were common.

The inter-center strain trial was evaluated on July 31 and August 1, 1996. Plant density, height, and forage production data were collected by the same procedure as in past years with the exception of location of forage sample collections. All plots showed decreased plant growth and vigor where previous samples had been collected, so the clipping frame was moved adjacent to previous clipping sites to sample plants representative of the entire plot. Forage samples were allowed to air-dry until September 15 when they were weighed and the data converted to pounds per acre, dry weight basis.

One-way analysis of variance (ANOVA) and means separation test using Duncan's Multiple Range Test were performed on the forage production data from the intermediate wheatgrass

accessions and is summarized in Table 1. Due to extreme variability in the data from the thickspike wheatgrass accessions and the poor, non-uniform stands of the alfalfa accessions, the range test was not performed on those groups.

Plant density for the intermediate wheatgrass accessions ranged from 0.3 plants per square foot for Amur to 2.5 for Slate and Maska. Plant height for the intermediate wheatgrass accessions ranged from 14.3 cm for Amur to 81.0 cm for Luna. Vigor for the intermediate wheatgrass accessions ranged from 2.3 (best) for Maska and Rush to 8.0 (poorest) for Amur. Forage production ranged from 335 pounds per acre (air-dried) for Oahe to 1292 pounds per acre for Slate and Maska. The mean forage production for the intermediate wheatgrass accessions was 702 pounds per acre.

Plant density for the thickspike wheatgrass accessions ranged from 1.3 plants per square foot for Schwendimar, SL Hybrid and Sodar to 2.0 plants per square foot for PI-236663. Plant height ranged from 14.8 cm for Sodar to 37.0 cm for Bannock. SL Hybrid had the best vigor rating of the thickspike wheatgrass accessions. The most forage production was from Critana (260 pounds per acre) and the least forage production was from PI-236663 (65 pounds per acre). The mean forage production for the thickspike wheatgrass accessions was 159 pounds per acre.

The alfalfa accessions continued to suffer from poor establishment and competition from cheatgrass since they were planted. There was extreme variability in the stands and statistical analysis was not completed for the data collected in 1996. Travois had 1.5 plants per square foot for the best plant density. Spreador II was the tallest alfalfa accession at 45.5 cm and also had the best vigor of the alfalfa accessions. The greatest forage production was from Spreador II at 799 pounds per acre. The mean forage production for the alfalfa accessions was 293 pounds per acre.

Volunteer crested wheatgrass appeared to be increasing each year. Without the competition from the volunteer crested wheatgrass, forage production from the test plots would be significantly greater.

1997 EVALUATIONS AND DISCUSSION

Precipitation during the 1997 crop year was above normal for southeast Idaho. Precipitation was much above normal during the winter and summer months.

The inter-center strain trial was evaluated on August 5, 1997. Data collected included plant density, plant height, forage production and vigor. The data is summarized in Table 1. Plant density, height, and forage production data were collected by the same procedure as in past years with the exception of location of forage sample collections. All plots showed decreased plant growth and vigor where previous samples had been collected, so the clipping frame was moved adjacent to previous clipping sites to sample plants representative of the entire plot. Forage samples were allowed to air-dry until August 21 when they were weighed and the data converted to pounds per acre, dry weight basis.

Due to extreme variability in the data, one-way analysis of variance (ANOVA) and means separation tests were not performed on the forage production data as in previous years. Evaluation data is summarized in Table 1.

Plant density for the intermediate wheatgrass accessions ranged from 0.3 plants per square foot for Oahe to 2.0 for Slate and Rush. Plant height for the intermediate wheatgrass accessions ranged from 11.0 cm for Oahe to 82.8 cm for Rush. Vigor for the intermediate wheatgrass accessions ranged from 2.3 (best) for Rush to 7.8 (poorest) for Oahe. Forage production ranged from 74 pounds per acre (air-dried) for Oahe to 1515 pounds per acre for Slate. The mean forage production for the Intermediate wheatgrass accessions was 701 pounds per acre.

The thickspike wheatgrass plots were not been able to compete with the volunteer crested wheatgrass which established in the plots. Only three accessions remained; Bannock, SL Hybrid, and PI 236663. Bannock had the best plant density (1.0), vigor (6.3) and was the tallest (34.0 cm) and most productive (130 pounds per acre). The mean forage production for the thickspike wheatgrass accessions was 28 pounds per acre.

Plant density of the alfalfa accessions ranged from 0.3 plants per square foot for Ranger to 1.3 for Spreador II and Servalra. Servalra was the tallest accession. Vigor ranged from 8.0 (poorest) for Ranger to 4.0 (best) for Spreador II. Spreador II had the most forage production, 1515 pounds per acre. Although the alfalfa accessions suffered from poor establishment and competition from cheatgrass since they were planted, forage production has continued to increase. The mean forage production from the alfalfa accessions in 1995, 1996 and 1997 were 182, 293, and 593 pounds per acre, respectively.

Eight accessions in the Display Nursery which established fairly uniform stands and are well adapted to the region were clipped to obtain forage production data and are shown as follows:

Whitmar beardless wheatgrass	1115	pounds per acre
Goldar bluebunch wheatgrass	706	
Magnar basin wildrye	1635	
Trailhead basin wildrye	1338	
Prairieland Altai wildrye	1004	
Regar meadow brome	2081	
Paddock meadow brome	1709	
Fleet meadow brome	1561	

A public tour of the Off-Center Test Site was held on June 26, 1997 to observe the plant materials. The attachment to this report was given to tour participants and describes the plant varieties planted at the test site which are best adapted to the area.

CONCLUSION

Plant performance of the test accessions was affected by the competition of volunteer crested wheatgrass and cheatgrass in the plots. The accessions planted would have performed better if

the site was plowed a year prior to planting and then had been mechanically or chemically fallowed to eliminate volunteer plant competition prior to planting. However, the presence of volunteer plants did provide the opportunity to observe the competitive ability of the test accessions.

The best 3 performing intermediate wheatgrass accessions in terms of forage production were Manska, Slate and Rush. These accessions performed consistently during the five year evaluation period and were able to compete well with the volunteer plants. Slate was the best overall performer over the four years of clipping data.

The thickspike wheatgrass accessions had difficulty in maintaining stands through the evaluation period due to competition from volunteer crested wheatgrass. Critana produced the most forage over the five year evaluation period but it was overcome by volunteer crested wheatgrass by the fifth year. Bannock was able to maintain forage production throughout the evaluation period.

The alfalfa accessions suffered from poor establishment and competition from cheatgrass. The only accession which consistently produced forage was Spreador II.

Table 1.
Curlew National Grasslands Off-Center Advanced Test Site
Summary of Evaluation Data 1993-1997

Accession	Source	Plant Height (cm) 1/					Vigor				
		1993	1994	1995	1996	1997	1993	1994	1995	1996	1997
<u>Intermediate Wheatgrass (<i>Elytrigia intermedia</i>)</u>											
Manska	ARS-North Dakota	69.5	34.3	75.8	78.0	55.3	2.8	2.3	1.8	2.3	4.0
Reliant	ARS-North Dakota	62.8	33.3	75.5	57.0	56.8	2.3	2.3	2.3	3.3	3.0
Amur	Los Lunas PMC	21.3	0.0	0.0	14.3	0.0	7.0	9.0	9.0	8.0	9.0
Tegmar	Aberdeen PMC	57.3	24.3	54.5	48.5	21.3	4.5	5.3	5.5	3.8	7.3
Oahe	AES-South Dakota	67.0	36.0	59.0	62.0	11.0	3.3	3.5	6.0	4.0	7.8
AI Hybrid	ARS-Utah	49.0	33.5	37.5	68.0	42.8	3.8	5.0	6.5	3.5	6.0
Greenleaf	Canada	61.0	33.0	67.3	65.3	50.3	3.5	3.8	3.0	2.8	4.3
Luna	Los Lunas PMC	67.0	50.0	88.3	81.0	80.0	3.0	3.3	2.3	5.0	3.3
Rush	Aberdeen PMC	74.8	35.0	82.0	72.8	82.8	1.5	3.0	3.3	2.3	2.3
Slate	ARS-Nebraska	76.3	42.8	91.8	80.3	71.5	2.5	2.8	2.3	2.5	2.7
Mandan	ARS-North Dakota	57.0	32.8	83.0	62.8	60.0	3.5	4.0	3.3	3.3	2.8
Greenar	Pullman PMC	60.3	23.5	42.8	45.8	56.5	4.8	5.8	5.8	5.0	4.3
Topar	Aberdeen PMC	43.5	25.5	40.8	62.3	23.3	5.0	6.5	6.0	4.0	7.0
<u>Thickspike Wheatgrass (<i>Elymus lanceolatus</i>)</u>											
SL Hybrid	ARS-Utah	24.3	21.0	59.5	26.3	5.8	3.8	3.3	4.3	4.8	7.8
Schwendi mar	Pullman PMC	33.3	21.0	32.5	22.8	0.0	4.0	4.8	6.3	6.5	9.0
PI-236664	Pullman PMC	15.3	16.8	14.0	17.5	0.0	4.3	4.3	6.5	6.0	9.0
PI-236663	Pullman PMC	17.5	17.8	16.0	21.0	7.8	3.8	3.0	6.8	5.0	7.5
Bannock	Aberdeen PMC	23.0	27.5	42.3	37.0	34.0	3.3	3.0	5.5	5.3	6.3

Accession	Source	Plant Height (cm) 1/					Vigor				
		1993	1994	1995	1996	1997	1993	1994	1995	1996	1997
Sodar	Aberdeen PMC	12.8	15.8	26.3	14.8	0.0	4.5	3.8	6.3	6.8	9.0
Critana	Bridger PMC	18.3	20.8	68.3	22.3	0.0	3.0	3.8	3.8	5.3	9.0
<u>Alfalfa (Medicago sativa)</u>											
Spreador II	Commercial	17.8	22.3	43.5	45.5	38.8	4.3	4.3	5.0	5.3	4.0
Travois	Commercial	14.3	11.5	37.0	39.8	33.0	4.3	5.5	5.0	5.8	5.0
Baker	Commercial	13.3	8.0	28.8	0.0	0.0	4.5	7.8	5.8	9.0	9.0
Ladak	Commercial	14.3	15.3	41.5	20.8	22.8	4.0	4.3	4.5	7.5	6.8
Ranger	Commercial	16.0	10.5	34.0	23.3	8.3	4.0	5.8	5.3	7.5	8.0
Serveira	Commercial	16.5	12.0	33.5	39.8	43.5	3.5	6.0	4.8	6.0	4.0

Accession	Plant Density (Plants per ft ²)					Forage Production (pounds per acre dry weight)					
	1993	1994	1995	1996	1997	1994	1995	1996	1997	4 Yr. Avrge	
<u>Intermediate Wheatgrass (Elytrigia intermedia)</u>											
Manska	3.3	4.0	2.5	2.5	1.5	629 a*	1351 a*	1292 a*	809	1020	
Slate	3.0	2.5	2.8	2.5	2.0	583 a	1425 a	1292 a	1515	1203	
Rush	4.8	2.8	2.0	2.3	2.0	592 a	1148 ab	1041 ab	1255	1009	
Luna	3.3	2.5	2.8	2.0	1.8	324 ab	1203 ab	975 abc	827	832	
Greenleaf	2.8	3.5	1.3	2.3	1.5	278 b	546 abc	920 abc	1217	740	
Reliant	4.3	3.5	3.0	2.3	1.5	629 a	1129 abc	715 abc	1013	872	
Mandan	1.8	3.0	2.3	1.3	1.8	241 b	824 abc	697 abc	836	650	
Topar	1.5	3.5	0.5	2.0	0.5	102 b	306 bc	548 bc	40	341	
Tegmar	1.8	1.5	1.3	2.0	0.8	84 b	315 bc	483 bc	288	293	
AI Hybrid	1.8	2.3	0.5	1.3	0.8	176 b	231 c	418 bc	288	278	
Greenar	2.0	1.3	0.8	0.8	1.3	139 b	352 bc	409 bc	957	464	
Oahe	2.3	1.8	0.8	1.8	0.3	342 ab	453 bc	335 c	74	301	
Amur	0.5	0.0	0.0	0.3	0.0	0+	0+	0+	0	0	
Mean						317	714	702	701	616	
<u>Thickspike Wheatgrass (Elymus lanceolatus)</u>											
Critana	4.3	3.3	2.5	1.8	0.0	157	861 a*	260	0	319	
Schwendi mar	2.5	2.3	1.8	1.3	0.0	130	389 ab	167	0	172	
SL Hybrid	3.5	3.0	2.0	1.3	0.5	148	343 b	153	19	165	

Accession	Plant Density (Plants per ft ²)					Forage Production (pounds per acre dry weight)				
	1993	1994	1995	1996	1997	1994	1995	1996	1997	4 Yr. Avrge
Bannock	3.8	2.3	1.5	1.5	1.0	185	333 b	251	130	224
PI-236664	2.8	2.5	1.0	1.5	0.0	102	241 b	130	0	118
Sodar	2.3	3.5	1.5	1.3	0.0	93	194 b	84	0	93
PI-236663	3.8	2.8	0.8	2.0	0.5	157	120 b	65	46	97
Mean						139	354	159	28	170
<u>Alfalfa (Medicago sativa)</u>										
Spreador II	3.0	1.5	0.3	1.3	1.3	56	296	799	1515	667
Servelra	2.3	1.5	1.0	0.8	1.3	46	194	288	1041	392
Travois	2.3	1.5	1.3	1.5	1.0	37	398	429	716	395
Ranger	2.0	1.3	0.3	0.5	0.3	19	0	93	158	68
Ladak	1.8	1.0	1.0	0.5	0.5	93	204	149	130	144
Baker	1.8	0.8	0.3	0.0	0.0	0	0	0	0	0
Mean						42	182	293	593	278

* Means followed by the same letter are not significantly different as determined by Duncan's Multiple Range Test, P=0.05.

**Table 2. Curlew Inter-Center Strain Trial - Display Nursery
Seeded November 18, 1992
Evaluation May 18, 1994**

Cultivar	% Stand 1/	Vigor 2/
Nordan crested wheatgrass	60	3
Parkway crested wheatgrass	40	3
Ephraim crested wheatgrass	40	4
Ruff dwarf crested wheatgrass	40	4
Vinall Russian wildrye	0	9
Cabree Russian wildrye	0	9
Mankota Russian wildrye	0	9
Shoshone beardless wildrye	0	9
Rio beardless wildrye	0	9
Canbar canby bluegrass	1	5
Sherman big bluegrass	1	5
Nezpar indian ricegrass	1	5
Pryor slender wheatgrass	1	7
Primar slender wheatgrass	2	6
San Luis slender wheatgrass	2	6
Greenleaf pubescent wheatgrass	15	4
Topar pubescent wheatgrass	20	4
Mandan pubescent wheatgrass	40	3
Luna intermediate wheatgrass	20	3
Amur intermediate wheatgrass	10	6
Tegmar intermediate wheatgrass	20	5
Slate intermediate wheatgrass	40	2
Greenar intermediate wheatgrass	20	2
Oahe intermediate wheatgrass	30	3
PI575702 intermediate wheatgrass	40	2
Critana thickspike wheatgrass	5	4
9021076 thickspike wheatgrass	10	2
Deborah mountain brome	10	5
Bromar mountain brome	15	5
Paddock meadow brome	30	3
Fleet meadow brome	25	4
Regar meadow brome	30	3
Umatilla snow buckwheat	0	9
Sierra sulfurflower buckwheat	0	9
Lassen bitterbrush	0	9
Maybelle bitterbrush	0	9
Fountain Green bitterbrush	0	9
Ranger alfalfa	1	5
Nomad alfalfa	1	5
Servelra alfalfa	1	5
Ladak alfalfa	1	5

Cultivar	% Stand 1/	Vigor 2/
Travois alfalfa	1	6
Spredor II alfalfa	1	3
Baker alfalfa	1	5
Eski sanfoin	1	2
Delar small burnet	1	2
Fairway crested wheatgrass	50	3
Kirk crested wheatgrass	60	2
Hycrest crested wheatgrass	65	2
Hycrest II crested wheatgrass	50	2
P-27 Siberian wheatgrass	30	4
Bozoisky Russian wildrye	5	5
Swift Russian wildrye	5	5
Syn A Russian wildrye	10	3
Prairieland altai wildrye	5	4
Magnar basin wildrye	5	4
Trailhead basin wildrye	5	3
Covar sheep fescue	1	4
Durar hard fescue	1	4
Newhy hybrid wheatgrass	20	2
Whitmar bluebunch wheatgrass	40	2
Secar snakeriver wheatgrass	5	3
Goldar bluebunch wheatgrass	30	3
Sodar streambank wheatgrass	30	2
SL Hybrid hybrid wheatgrass	40	2
AI Hybrid wheatgrass	40	2
Barton western wheatgrass	15	4
Rodan western wheatgrass	15	3
Rosana western wheatgrass	15	3
Arriba western wheatgrass	10	5
Alkar tall wheatgrass	5	3
Largo tall wheatgrass	10	2
Jose tall wheatgrass	5	3
9053788 smooth brome	30	3
Manchar smooth brome	10	5
Matua rescue grass	0	9
Paiute orchard grass	5	4
Latar orchard grass	20	5
Hatch winterfat	0	9
Pamirian winterfat	0	9
Hobble creek sagebrush	0	9
Immigrant forage kochia	0	9
Bandera penstemon	0	9
9008487 Venus penstemon	0	9
9008469 Eaton penstemon	0	9
Cedar palmer penstemon	0	9

Cultivar	% Stand 1/	Vigor 2/
Appar lewis flax	30	2
Lutana cicer milkvetch	10	2
Tretana birdsfoot trefoil	0	9
Kaneb purple prairieclover	0	9
Puna chickory	0	9

1/ Ocular estimate of Cover.

2/ Vigor rating 1=Best, 9=Worst.

Attachment to Curlew National Grasslands Off-Center Advanced Test Site, Summary of Progress 1992-1997

Curlew Off-Center Test Site Display Nursery All-Stars

'Ephraim' Fairway Crested Wheatgrass (*Agropyron cristatum*)

A very long lived, drought tolerant, vigorous, introduced bunchgrass from Siberia. Early maturing, with fine stems and leaves which are extremely palatable early in spring becoming less palatable during summer dormancy and after seed formation. Ephraim is weakly rhizomatous in higher rainfall areas. Adapted to a wide range of soils and areas which receive at least 8-10 inches annual precipitation. Recommended for range seedings and critical area stabilization. Released by USFS and NRCS, 1983.

'P-27' Siberian Wheatgrass (*Agropyron fragile*)

An introduced bunchgrass similar to crested wheatgrass but has finer leaves and retains palatability later into the summer as compared to crested wheatgrass. Once established it can withstand extended periods of drought better than most crested varieties. Especially adapted to droughty sites with a wide range of soil textures. Will persist on sites with as little as 4-8 inches annual precipitation. Recommended for range seedings. Released by NRCS and Experiment Stations, 1953.

'Prairieland' Altai Wildrye (*Leymus angustus*)

A long lived, bunchgrass sometimes with short rhizomes from northern Asia. Tolerant of cold, drought, and saline conditions. Seedlings develop slowly and good seedbed preparation and weed control are essential. Coarse, erect, basal leaves retain much of their nutritive value throughout the summer and fall. Adapted to clay and clay-loam soils with 12-16 inches annual precipitation. Useful for fall and winter grazing as leaves stay erect in deep soil. Released by Agriculture Canada, 1976.

Basin Wildrye (*Leymus cinereus*)

'Magnar' released by Aberdeen PMC, 1979

'Trailhead' released by Bridger, MT PMC, 1991

A slightly spreading, robust grass native to the Intermountain U.S. Tall, coarse, and long-lived. Poor seedling vigor may result in sparse stands, but once established, highly productive. Relatively poor palatability in summer but is a good source of energy during winter. Adapted to lowlands with deep, fine textured soils that receive at least 10-14 inches annual precipitation. Because of its stiffness, it provides excellent cover for both wildlife and livestock calving and cover for upland game.

'Covar' Sheep Fescue (*Festuca ovina*)

Long lived, short statured bunchgrass with short leaf blades indigenous to northern hemisphere. Used as a durable turfgrass on sandy soils and for erosion control. Ground cover and root production is excellent and is cold and drought tolerant once established. Best adapted to 10-18 inch precipitation zones. Not intended for grazing because forage production is minimal. Recommended for erosion control, turf and critical area stabilization. Released by Pullman, WA PMC, 1977.

'Durar' Hard Fescue (*Festuca trachyphylla*)

A very fine leaved, low growing bunchgrass introduced from Europe. Produces a dense root system excellent for erosion control on critical areas. Seedlings are slow to establish but persist through the development of abundant, fibrous roots. Best adapted to 10-18 inch precipitation zones and a wide range of soil types. Used for reclamation areas where a low growing, competitive cover is needed. Released by Pullman, WA PMC, 1949.

'Whitmar' Beardless Wheatgrass (*Pseudoroegneria spicata* ssp. *inermis*)

Long lived, drought tolerant, native bunchgrass very similar to bluebunch wheatgrass except awns are missing. It begins growth in early spring and readily greens up after fall rains. Highly palatable and recovers rapidly after grazing but does not tolerate repeated grazing. Best adapted to areas receiving at least 8 inches annual precipitation and a wide range of soil types. Recommended for range seeding mixtures to re-establish native plant communities. Released by Pullman, WA PMC, 1946.

'Goldar' Bluebunch Wheatgrass (*Pseudoroegneria spicata* ssp. *spicata*)

Long lived, drought tolerant, native bunchgrass valuable in the Intermountain west. It begins growth in early spring and readily greens up after fall rains. Highly palatable and recovers rapidly after grazing but does not tolerate repeated grazing. Best adapted to areas receiving at least 10 inches annual precipitation and a wide range of soil types. Recommended for range seeding mixtures to re-establish native plant communities. Released by Aberdeen PMC, 1989.

'Sodar' Streambank Wheatgrass (*Elymus lanceolatus* ssp. *lanceolatus*)

A long lived, native sod forming grass widely distributed in the Intermountain region. It is drought resistant and has excellent seedling vigor. Because of its low growth form, it is not suited for forage production. This creeping sod former is adapted to fine-medium textured soils with 10-18 inches annual precipitation. Primarily used for erosion control where a low growing vegetative cover is needed. Released by Aberdeen PMC, 1954.

'Rosana' Western Wheatgrass (*Pascopyrum smithii*)

Native, widely distributed and strongly rhizomatous. Begins spring growth later than most wheatgrasses and is typified by poor germination, low seedling vigor and low quality forage. Plantings usually result in scattered stands that spread to dominate the site in 3-4 years. Very productive in clayey swales and waterways with annual precipitation above 12 inches. This is the most aggressive native sod grass available to provide excellent soil binding for erosion control. Released by Bridger, MT PMC, 1972.

Tall Wheatgrass (*Elytrigia elongata*)

'Alkar' released by Pullman, WA PMC, 1951

'Jose' released by Los Lunas, NM PMC, 1965

Perennial tall-growing, vigorous, very late maturing introduced bunchgrass from Turkey and Russia. It is very tolerant of salt, alkali and shallow water tables. Palatability is fair early in the growing season, but mature plants become unpalatable. Can provide winter forage if supplemental protein is provided. Has a very wide range of soil and climate adaptation and is useful for erosion control on critical areas. Especially adapted to salty sites where the water table is shallow.

'Manchar' Smooth Brome (*Bromus inermis*)

Perennial, sod-forming grass introduced from eastern Europe. Very palatable, productive, and shade tolerant. Seedlings are often weak, but once established, spreads vegetatively to provide full stands. Stands tend to become sodbound over time, requiring occasional ripping and high fertility. Will go dormant during high summer temperatures. A very useful plant for erosion control, pasture and hay in areas receiving at least 14 inches annual precipitation. Released by NRCS and Experiment Stations, 1946.

'Appar' Lewis Flax (*Linum perenne* ssp. *lewisii*)

A native, perennial semi-evergreen forb that is readily eaten by livestock and wildlife especially during spring and summer. The flowers are an attractive shade of blue and add color to the landscape. Prefers well drained soils and is intolerant of areas with poor drainage or high water tables. Best used as a component of a seed mixture for range seedings or for critical area stabilization. Recent research has identified Appar as a naturalized, introduced species from European origins. Released by Aberdeen PMC, 1980.

'Eski' Sainfoin (*Onobrychis viciaefolia*)

A leafy, early blooming, non-bloating legume introduced from Europe. Is highly palatable but is not as productive as alfalfa. Stands seldom persist more than 10 years due to susceptibility to stem and root rot. Adapted to deep, medium-textured soils and areas with at least 16 inches annual precipitation. Not tolerant of excessively wet soils or frequent irrigation. More compatible in mixtures with bunchgrasses than with sod grasses. Flowers are attractive to bees. Released by MT Experiment Station, 1964.

'Spredor II' Alfalfa (*Medicago sativa*)

Alfalfa is a very productive, palatable, introduced legume with numerous varieties which have been developed for specific characteristics and purposes. Spredor II was specifically developed for its creeping or spreading ability for use in pasture seedings. Alfalfa requires fertile soil, adequate water and a good seedbed at establishment. Alfalfa requires a minimum of 12 inches annual precipitation in dryland areas and is not suited for sites with a shallow water table. Grazing management is important to maintain stands and prevent bloating by livestock.

Maybelle Source Antelope Bitterbrush (*Purshia tridentata*)

Antelope bitterbrush is a native shrub varying in stature from low, prostrate forms to erect forms, 3-6 feet tall. Is an important browse for mule deer and elk especially in winter. Best suited to deep, well-drained, medium to coarse textured soils and requires a minimum of 10 inches annual

precipitation. Stands can be established by transplanting or seeding. Dormant seed to a depth of 1 inch at a rate of 1/2-1 pound per acre. Establishment may take 5-10 years. Test material from Upper Colorado Environmental Plant Center.

Meadow Brome (*Bromus erectus*)

'Regar' released by Aberdeen PMC, 1966

'Fleet' released by Agriculture Canada, 1987

'Paddock' released by Agriculture Canada, 1987

Perennial, bunchgrass introduced from Turkey. Seedling vigor is strong and palatability to livestock and wildlife is excellent. Does not go dormant under high summer temperatures like smooth brome. Recovers quickly after grazing. Adapted for pasture seedings where annual precipitation is above 14 inches or under irrigation. Moderately shade tolerant and is winter hardy.

'Bannock' Thickspike Wheatgrass (*Elymus lanceolatus* ssp. *lanceolatus*)

A long lived, native sod forming grass widely distributed in the Intermountain region. It is drought tolerant and has excellent seedling vigor. Palatability is fair but forage production is limited. Is adapted to medium textured soils in areas with 8-16 inches annual precipitation. Primarily used as a component of a range seeding mixture for erosion control and critical area stabilization. Released by Aberdeen PMC, 1995.

Intermediate Wheatgrass (*Elytrigia intermedia*)

'Rush' released by Aberdeen PMC, 1994

'Greenar' released by NRCS and Experiment Stations, 1945

'Slate' released by Nebraska Experiment Station, 1969

'Reliant' released by ARS, North Dakota, 1991

A mildly sod forming perennial introduced from Eurasia. Begins growth early in spring and remains green and palatable into the summer, producing large amounts of quality forage. Excellent for situations where only one or two irrigation applications are possible. Adapted to a wide range of soil types but needs 12-16 inches annual precipitation for dryland forage production and critical area stabilization. Rush was selected for rapid emergence after planting and its ability to compete with cheatgrass. Greenar was selected for forage production. Slate was selected for erect growth habit. Reliant was selected for sustained forage and seed yields.

Pubescent Wheatgrass (*Elytrigia intermedia*)

'Luna' released by Los Lunas, NM PMC, 1963

'Manska' released by ARS, North Dakota, 1992

A mildly sod forming perennial introduced from Eurasia. Begins growth early in spring and remains green and palatable into the summer, producing large amounts of quality forage. Excellent for situations where only one or two irrigation applications are possible. Adapted to a wide range of soil types but needs 11-16 inches annual precipitation for dryland forage production and critical area stabilization. Luna was selected for drought resistance and seedling vigor. Manska was selected for improved forage quality.

'Sherman' Big Bluegrass (*Poa secunda*)

Bunchgrass native to northwest U.S. Well adapted to spring grazing, beginning growth as much as four weeks ahead of crested wheatgrass. Does become unpalatable earlier than most grasses. Low seedling vigor requires as much as 4-8 years to reach full productivity. Adapted to fine to medium textured soils and 9-15 inches annual precipitation. Recommended for range seedings and critical area stabilization. Released by Pullman, WA PMC, 1945.

'Bozoisky' Russian Wildrye (*Psathyrostachys juncea*)

Bunchgrass native to central Asia. Used primarily for pasture over general area where crested wheatgrass is adapted. Starts growth early and has dense basal leaves. Cures well and is used extensively for late summer and fall grazing. Released by ARS Logan, UT, 1984.