ABERDEEN PLANT MATERIALS CENTER GRASS DISPLAY NURSERY ESTABLISHED GRASSES TREATED WITH PLATEAU® HERBICIDE YEAR 2001 OBSERVATIONS

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The purpose of this evaluation was to observe the effects of Plateau® herbicide on established perennial grasses that had been burned. The evaluation was conducted during the 2001-growing season at the display nursery on the Aberdeen Plant Materials Center Home Farm located two miles north of Aberdeen, Idaho. The display nursery was seeded on August 8, 1995. Fifty-four accessions of perennial grasses adapted for the Intermountain Region were drilled with a double disk drill with 10-inch row spacing. Plots were 7 feet wide by 40 feet long. Soils are a Declo silt loam, well drained and nearly level. Soil pH is 7.4 to 8.4.

The plots were arranged so that species were established according to three precipitation zones. Ten accessions adapted to the 16-inch or greater precipitation zone for irrigated pasture and hay land; 22 accessions adapted to the 12 to 16-inch precipitation zone; and 22 accessions adapted to precipitation zones of 12-inches or less. During the first several years after the plots were established, irrigation (applied by handline sprinklers) was scheduled to simulate each precipitation zone; however, for the last several years the grasses were irrigated two or three times for all three zones at the same rate and time interval.

Plateau herbicide is an aqueous solution mixed with water and adjuvant and applied as a spray solution to provide weed control on non-cropland areas (including Conservation Reserve Program Land) and for weed control during the establishment of native grasses.

The plots were burned in August, 2000 to remove standing cover and to simulate a wildfire. Dr. Pamela J.S. Hutchinson, Weed Scientist at the University of Idaho Agricultural Experiment Station, Aberdeen, sprayed the north half of each plot with 10 ounces Plateau per acre plus one quart per acre methylated seed oil (MSO) on October 27, 2000.

Plots were evaluated on May 14 and June 28 and clipped the 27th through 29th of June 2001. Height was estimated by holding a steel tape at arm length and sighting along the top of the grass reading the tape to the nearest centimeter. Vigor is a subjective judgement of plant health based on experience with the particular species of grass. A rating of 1 is best and 9 worst. The clipping plot frame was 24 inches by 79 inches, and was placed in the center of both the control plot and treated plot for each accession evaluated for forage yield and quality. Each accession was clipped as low to the ground as possible, and the material weighed and recorded. A “grab sample” was taken from the entire plot, net weight recorded, and air-dried in a paper bag. Final air-dried net weights were used to calculate the dry weight forage yield in pounds per acre and kilograms per hectare. An additional "grab sample" was taken from each plot, dried, and sent to the Jamie L. Whitten Plant Materials Center, Plant and Water Analysis Laboratory at Coffeeville, Mississippi for forage quality analysis. Forage quality analysis included total digestible nutrients (TDN), nitrogen, protein, acid detergent fiber (ADF), and neutral detergent fiber (NDF). Percent nitrogen was determined from Kjeldahl N digest using flow injection analysis on a Lachat Quick Chem Automated Ion Analyzer (Lachat Instruments, Milwaukee, Wisconsin). Acid detergent fiber and NDF were analyzed with an ANKOM $^{200/220}$ Fiber analyzer using the Van Soest Analysis (Joel Douglas, Jamie L. Whitten PMC, personal communication).

16- inch or greater precipitation group

Height of the accessions in the 16-inch or greater precipitation group was shorter for each of the Plateau treated plots (Table 1). Vigor ratings were lower in late June than in mid May for the control plots, whereas, the grasses in the treated plots had a better vigor rating at the June evaluation as compared to the

May evaluation. Average growth during the 45-day interval between evaluations in height was almost three times greater for the control plots as compared to the treated plots. On May 14 the growth of the treated plots was more uniform than the control plots. On June 28 growth of the grasses in the control plots had slowed as they approached maturity, and were more uniform than the grasses in the treated plots (Table 1). The treated plot of 'Johnstone' tall fescue was most affected with virtually no growth and a vigor rating of 9. This was not surprising to Joel Douglas (personal communication) who said that Plateau affects all tall fescue varieties substantially in the southeastern U.S. The height of 'Jose' and 'Alkar' tall wheatgrass and 'Latar' orchardgrass were least affected within the group, but were still only about half as tall as their control plots.

Table 2 documents the forage yield data collected from the Display nursery during 2001. Forage yields from the control plots ranged from 3,097 pounds per acre for 'Garrison' creeping foxtail to 8,415 pounds per acre for 'Paddock' meadow brome. In the treated plots, forage yields ranged from 1,433 pounds per acre for Garrison to 3,586 pounds per acre for 'Fleet' meadow brome. Percent change between the control and treated plot of each accession was calculated to show the decrease in forage yield that was caused by the herbicide application [1]. Latar orchardgrass and Alkar tall wheatgrass were least affected with -24 and –36 percent change respectively. The higher yielding accessions of the 16-inch or greater precipitation group were most affected as 'Paddock,' 'Fleet,' and 'Regar' meadow brome, Jose, and 'Largo' tall wheatgrass all had more than 50 percent decrease in yield between treatments (Table 2). The treated plot of Johnstone tall fescue was not clipped because the plants were killed by the treatment.

Forage analysis results are shown in Table 3 and 4. Digestibility, expressed here as total digestible nutrients (TDN), is the most commonly used term of energy availability. TDN is the sum of digestible protein, carbohydrates, and lipids (Buxton and Mertens, 1995). Percent TDN ranged from 54 percent to 65 percent in the control plots and averaged 58.9 percent (Table 3). Johnstone tall fescue and Garrison creeping foxtail both had 65 percent TDN, the highest in the 16-inch precipitation or greater group. Fleet meadow brome had the least TDN of the control plots at 54 percent. The Plateau treated plots ranged from 65 to 77 percent TDN and averaged 70.8 percent. Regar meadow brome, 'Manchar' smooth brome, and Garrison creeping foxtail contained the most TDN at 77, 76 and 76 percent respectively from the treated plots. Fleet meadow brome and Alkar tall wheatgrass had the least TDN at 65 percent in the treated plots. The greatest increase in TDN was 19 percent between the control and treated plots of Regar meadow brome and Manchar smooth brome. The smallest increase was six percent TDN for both Latar orchardgrass and Alkar tall wheatgrass.

Crude protein (CP) is the sum of non-protein nitrogen and true protein and found by multiplying the percent nitrogen by 6.25 (Buxton and Mertens 1995). Latar orchardgrass and Largo tall wheatgrass had the most CP at seven percent, Fleet meadow brome the least at four percent and the rest of the accessions in this group each had six percent crude protein in the control plots. In the Plateau treated plots, Manchar smooth brome had the greatest CP (13 percent). Latar orchardgrass showed the greatest increase in CP between the control and treated (7 percent).

Table 5 is the quality standards for legume, grass, or legume hay developed by the American Forage and Grassland Council. All accessions in the control plots had CP of less than eight percent putting them in forage quality standard 5, and in the treated plots, Regar meadow brome, Manchar smooth brome and Alkar tall wheatgrass rated in quality standard 3. All other treated plots in this group rated in quality standard 4.

Acid detergent fiber (ADF) is an insoluble residue that does not include all cell wall constituents because hemicellulose is soluble in the acid detergent solution. The ADF percentage includes alkali-soluble lignin, alkali-insoluble lignin, fiber-bound nitrogen, cellulose, and detergent insoluble minerals (Fisher and

[1] Percent change is a relative measure. In this case it is $\%\ \text{change} = \frac{\text{control} - \text{treatment}}{\text{control}} \times (100)$.

A negative percent change means the treated plots produced less than the control plots.

others 1995). ADF is an estimate of digestibility. As the ADF increases the digestibility decreases (Joel Douglas, personal communication). Neutral detergent fiber (NDF) is an excellent estimation of the total cell wall, or structural components (cellulose, hemicellulose, and lignin). NDF is more important because it estimates that fraction of forage that must be degraded by gastrointestinal microorganisms before the animal metabolizes it. The NDF percentage includes all of ADF plus hemicellulose (Fisher and others 1995). Data for ADF and NDF is summarized in Table 4.

In the control plots, Johnstone tall fescue and Garrison creeping foxtail had the least ADF and NDF, and Garrison creeping foxtail the least (30 percent) of the Plateau treated plots; thus, greatest digestibility. Fleet meadow brome had the highest ADF and NDF in the control plot at 41 and 68 percent respectively. Fleet tied with Alkar tall wheatgrass for ADF in the treated plots with 35 percent, and both were among the highest of the group in percent NDF with 59 and 63 percent respectively. The nine control plots averaged 38.0 percent ADF and 64.1 percent NDF. The nine Plateau treated plots averaged 32.4 percent ADF and 56.0 percent NDF (Table 4). All ten accessions of the control plots had ADF percentages that place them in quality standards of 1, 2, and 3, and the treated plots rate prime and 1(Table 5). The control plots ranked 4 - 5 in quality standards based upon NDF and the treated plots ranked 2 - 4. Thus, the Plateau treatment increased the quality standard approximately one to two standards for ADF and NDF. Forage analysis showed the Plateau treated plots had a greater percentage of protoplasm (cell contents) and less cell wall than the grasses not treated (Tables 3 and 4). Protoplasm contains the more easily digestible components of the grasses, and the cell walls require microbial action for digestion.

12 to 16-inch precipitation group

As with the 16-inch or greater precipitation group, each accession that was treated with Plateau was shorter in height than the control plot (Table 1). Average vigor of the Plateau treated plots was less in mid May than the control plots, and the control plots were slightly less uniform in growth. Average height of the control plots on May 14 was 1.5 times taller than the average height of the treated plots. On June 28 average height of the control plots were 1.6 times taller than the treated plots. In the intervening 45 days, growth averaged 1.7 times more for the control than for the treated plots. On June 28, the control plots averaged 36.4 inches tall compared to 22.3 inches tall for the Plateau treated plots.

Plateau affected 'Bromar' mountain brome more than the other accessions, as it was too short to clip. Plateau affected the group as a whole by reducing height an average 41.5 percent at the June 28 evaluation (Table 1). 'Prairieland' altai wildrye, 'Shoshone' beardless wildrye, 'Rosana' western wheatgrass, 'Manska' intermediate wheatgrass, and the three slender wheatgrass accessions ('Pryor,' 'San Luis,' and 'Primar') all were affected greatly having decrease in height of 50 to 57 percent from the herbicide treatment. 'Luna' pubescent wheatgrass, 'Trailhead' and 'Magnar' basin wildrye were affected least with 17, 21, and 7 percent change in height respectively. There was little difference in vigor between the control and treated plots on June 28 (Table 1).

Forage production in the control plots was slightly less variable than in the 16-inch or greater precipitation group, but was more variable in the Plateau treated plots (Table 2). Four accessions, (Trailhead basin wildrye, 'Newhy' hybrid wheatgrass, 'Reliant' and 'Tegmar' intermediate wheatgrass) each produced more in the treated plots than the corresponding control plots. 'Prairieland' altai wildrye and 'Oahe' intermediate wheatgrass both produced slightly more than 6,800 pounds per acre in the control plots, but produced 3,680 and 4,363 pounds per acre respectively in the Plateau treated plots. 'Shoshone' beardless wildrye also had a large difference between the control (3,597 pounds per acre) and the treated (1,101 pounds per acre) plots. Primar slender wheatgrass and 'Arriba' western wheatgrass were not affected much by Plateau as Arriba retained 97 percent of its production and Primar slender wheatgrass retained 99 percent of its production.

TDN for this group of grasses averaged 1.6 percent less than the 16-inch or greater precipitation group in the control plots, and 6.1 percent less in the Plateau treated plots. Percent TDN was slightly more uniform in this group (Table 3). Rosana western wheatgrass contained the most TDN in the control plot (63 percent), but ranked third (68 percent) in the treated plots behind Shoshone beardless wildrye at 80 percent and 'Paiute' orchardgrass at 73 percent. Pryor slender wheatgrass contained 50 percent TDN in the control

plot then gained 13 percent in the treated plot (63 percent). Arriba western wheatgrass gained only four percent from the control (57 percent) to treated plots (61 percent) and had the least TDN in the treated plots.

Percent nitrogen and percent crude protein for this group averaged less than the 16-inch or greater precipitation group (Table 3). Accessions in the control plots ranged from four to eight percent CP and averaged 5.3 percent. In the treated plots CP ranged from 6 percent to 17 percent and averaged 8.6 percent. Prairieland altai wildrye control sample had 8 percent CP and 10 percent CP in the treated sample to rank in quality standard 4 (Table 5). CP for Shoshone beardless wildrye was 6 and 17 percent in the control and treated plots respectively which puts this grass in the quality standard 5 and 1 respectively (Table 5). Paiute orchardgrass and Pryor slender wheatgrass also had substantial differences between the control and treated plots.

Average ADF for this group was 0.5 percent more for the control plots and 3.2 percent more for the treated plots than the 16-inch or greater precipitation group (Table 4). All accessions contained an average 2.9 percent less ADF in the Plateau treated plots than the control plots. Topar pubescent wheatgrass contained two percent more in the treated plot (39 percent) than the control plot (37 percent). Rosana western wheatgrass was the most digestible at 33 percent ADF in the control plot, and Shoshone beardless wheatgrass was most digestible of the treated plots at 28 percent ADF. Pryor slender wheatgrass was least digestible at 43 percent ADF of the control plots, and 'Topar' pubescent wheatgrass and Pryor slender wheatgrass were least digestible of the treated plots with 39 percent ADF. The control plot of Rosana western wheatgrass rated 1 in quality standard and Shoshone beardless wildrye rated prime quality standard from the treated plot (Table 5).

The three slender wheatgrass accessions contained the most cell wall components as their control NDF ranged from 68 to and 72 percent, and their treated NDF were 63, 64, and 66 percent (Table 4) which places slender wheatgrass in the 4 and 5 quality standards (Table 5). Paiute orchardgrass and Shoshone beardless wildrye had the least NDF at 55 and 54 percent respectively for the treated plots, which places them in the quality standard 3. Overall the average NDF was 65.1 percent for the control plots and 60.5 percent for the Plateau treated plots.

12-inch or less precipitation

Plateau affected this group of grasses in the same way as the other two groups causing the treated plots to be about half as tall as the control plots (Table 1). Grasses in the control plots averaged better vigor on May 14 than did the treated plots. Average vigor rating on June 28 was the same for both control and Plateau treated plots. Vigor was uniform throughout this group with a vigor rating of 3 given to both sets of plots for all accessions except for 'Parkway' and 'Douglas' crested wheatgrass which each received a 4 for both control and treated plots (Table 1).

Height on May 14 was 1.9 times taller for the control plots as compared to the treated plots. On June 28 the grasses in the control plots were twice as tall as the grasses of the treated plots. Average height growth in the 45 days between evaluations was 2.2 times more for the control over the treated plots (Table 1). 'Tetracan' Russian wildrye was tallest of the control plots at 37.4 inches, but grew to only 13.4 inches in the treated plot by the end of June for a –64 percent change. 'Secar' Snake River wheatgrass was the tallest grass of the treated plots and fourth tallest of the control plots. Plateau affected 'Mankota', 'Bozoisky', 'Tetracan', 'Whitmar', 'Goldar' and SL-Hybrid most as these accessions had declines in height greater than 60 percent. Plateau affected the height of 'P-27' Siberian wheatgrass (-17 percent) the least as shown on Table 1.

Forage production within this group averaged 3,035 pounds per acre for the control plots and 2,126 pounds per acre for the treated plots (Table 2) resulting in an overall decline of 30 percent. Goldar bluebunch wheatgrass produced the most forage of the control plots at 4,958 pounds per acre followed by 'Bannock' thickspike wheatgrass at 4,146 pounds per acre. Both of these accessions were affected greatly by Plateau with –41 and –55 percent change respectively; whereas, 'Kirk' crested wheatgrass production

was reduced only 177 pounds per acre for a –5 percent change. 'Ephraim' crested wheatgrass produced the least forage of the control plots (1,927 pounds per acre) and least of the treated plots (790 pounds per acre) for a –59 percent change.

Average TDN of the control plots (59.8 percent) was greater than the other two groups, but the Plateau treated plots (average 67.0 percent) was between the 16+ and 12 to 16-inch precipitation groups (Table 3). Bozoisky Russian wildrye showed the greatest difference (22 percent) between the control and treated plots. 'Parkway' crested wheatgrass, 'Vavilov' Siberian wheatgrass and P-27 Siberian wheatgrass had the least differences of 1, 2, and 3 percent respectively between the control and treated plots. Douglas crested wheatgrass contained the most TDN in both control (67 percent) and treated (74 percent) plots.

Of the three groups of grasses this group had the least average percent nitrogen at 0.73 percent and crude protein at 4.4 percent (Table 3). Tetracan Russian wildrye and Secar Snake River wheatgrass both had six percent CP in their control plots to lead this group. In the treated plots Goldar bluebunch wheatgrass led the group with 13 percent CP in the Plateau treated plots, but CP dropped to four percent in the control plot. Five accessions contained nine percent CP in their treated plots, but CP dropped to 4, 5, or 6 percent in their control plots. Bannock thickspike wheatgrass had the least CP (3 percent) in its control plot, but CP of 8 percent on its treated plot was above the 7.8 percent average of the group (Table 3). All control plots within in this group ranked in quality standard 5. The CP for the treated plots of seven accessions ranked in the quality standards 3 and 4 (Table 5).

Average ADF in both the control plots (36.6 percent) and Plateau treated plots (32.1 percent) were less than the two other groups (Table 4). Douglas crested wheatgrass was the most digestible of the control plots at 32 percent ADF compared to the least digestible accession, Bozoisky Russian wildrye at 46 percent ADF. The control plots rate in quality standards 1, 2, and 3 except for Bozoiksy, which rated 5 (Table 5). ADF for the treated plots ranged from 28 percent for Douglas crested wheatgrass to 37 percent for Secar Snake River wheatgrass (Table 4) for a range in quality standards from prime to 2 (Table 5).

Bozoisky Russian wildrye contained the most cell wall components at 74 percent NDF in the control plot, and had the greatest change (17 percent) in NDF between the control and treated plots of the group. In fact, 17 percent was the most difference of any accession in these demonstration plots. Douglas crested wheatgrass had the least NDF in both control and treated plots (54 and 53 percent respectively). Both Siberian wheatgrass accessions and SL-Hybrid wheatgrass had the same percent NDF in both control and treated plots. Average NDF was 61.7 percent for the control plots, and 57.8 percent for the treated plots (Table 4). Of the control plots only Bozoisky and Mankota Russian wildrye rated in quality standard 5 based on NDF. Nine accessions rated in quality standard 4, and eight accessions rated in quality standard 3. Of the treated plots one accession had a quality standard of 2, sixteen accessions rated in quality standard 3, and three accessions had a quality standard of 4 (Tables 4 and 5).

The herbicide Plateau affected these grasses by delaying initial spring growth. Growth was delayed differently for each accession. Starting growth later resulted in the treated plots being at an earlier phenological stage than the control plots when clipped. The forage in the treated plots was finer stemmed, softer, and less coarse which corresponded to the higher total digestible nutrients and crude protein and less acid and neutral detergent fiber values.

Four of the accessions in the 12 to 16-inch precipitation group, (Trailhead basin wildrye, Newhy hybrid wheatgrass, Reliant and Tegmar intermediate wheatgrass) had greater forage production in the treated plots than the control plots. This was a definite reversal in the forage production differences between control and treated plots for all other accessions and may be due to sampling error. Even though the difference between the treated and control plots for these four accessions were all substantial, the real difference may be smaller and more in line with the trend of the data.

Literature Cited

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Table 1. Height and vigor of the Aberdeen PMC Grass Display Nursery Plots evaluated 14 May and 28 June 2001.

		Control Plots					Plateau treated Plots					% Change Height 28 June between control & treated
		14 May		28 June		Growth	14 May		28 June		Growth	
Accession	Species	Height inch / cm	Vigor [a]	Height inch / cm	Vigor [a]	in 45 days inch / cm	Height inch / cm	Vigor [a]	Height inch / cm	Vigor [a]	in 45 days inch / cm	
16-inch or greater precipitation												
Paddock	meadow brome	9.8 / 25	2	31.5 / 80	3	21.7 / 55	6.3 / 16	6	11.8 / 30	3	5.5 / 14	-63
Fleet	meadow brome	12.2 / 31	2	33.5 / 85	3	21.3 / 54	4.3 / 11	7	10.6 / 27	3	6.3 / 16	-68
Regar	meadow brome	8.7 / 22	2	30.7 / 78	3	22.0 / 56	2.4 / 6	7	9.8 / 25	3	7.4 / 19	-68
Manchar	smooth brome	7.9 / 20	3	31.5 / 80	3	23.6 / 60	2.4 / 6	7	11.0 / 28	3	8.6 / 22	-65
Latar	orchardgrass	6.7 / 17	3	32.3 / 82	4	25.6 / 65	4.7 / 12	5	15.7 / 40	3	11.0 / 28	-51
Johnstone	tall fescue	6.3 / 16	3	34.3 / 87	3	28.0 / 71	Not measured	9	Not measured	9		
Garrison	creeping foxtail	7.9 / 20	3	31.1 / 79	3	23.2 / 59	5.1 / 13	7	1 / 23	2	4.0 / 10	-71
Largo	tall wheatgrass	11.8 / 30	2	35.0 / 89	3	23.2 / 59	3.9 / 10	8	13.8 / 35	3	9.9 / 25	-61
Jose	tall wheatgrass	11.0 / 28	2	34.3 / 87	3	23.3 / 59	4.7 / 12	8	6.9 / 43	3	12.2 / 31	-51
Alkar	tall wheatgrass	11.0 / 28	2	35.0 / 89	3	24.0 / 61	6.3 / 16	8	15.7 / 40	3	9.4 / 24	-55
Average		9.3 / 23.7	2.4	32.9 / 83.6	3.1	23.6 / 59.9	4.3 / 11.3	7.2	12.7 / 32.3	3.5	8.3 / 21.0	-61.4 [b]
Standard deviation		2.1 / 5.4	0.5	1.7 / 4.3	0.3	2.0 / 5.0	1.4 / 3.6	1.1	2.9 / 7.3	2.0	2.7 / 6.8	--
12 to 16-inch precipitation												
Bromar	mountain brome	11.8 / 30	3	37.4 / 95	2	25.6 / 65	Not measured	9	Not measured	9		
Prairieland	altai wildrye	15.7 / 40	2	43.3 / 110	3	27.6 / 70	7.9 / 20	6	19.7 / 50	3	11.8 / 30	-55
Shoshone	beardless wildrye	9.8 / 25	3	27.2 / 69	4	17.4 / 44	2.0 / 5	8	11.8 / 30	4	9.8 / 25	-57
Trailhead	basin wildrye	15.7 / 40	2	55.1 / 140	3	39.4 / 100	13.8 / 35	3	51.2 / 130	3	37.4 / 95	-7
Magnar	basin wildrye	15.7 / 40	2	53.1 / 135	3	37.4 / 95	13.8 / 35	2	42.1 /107	3	28.3 / 72	-21
Rosana	western wheatgrass	6.7 / 17	3	26.0 / 66	3	19.3 / 49	4.7 / 12	3	13.0 / 33	3	8.3 / 21	-50
Arriba	western wheatgrass	6.3 / 16	3	31.5 / 80	3	25.2 / 64	4.7 / 12	3	17.7 / 45	3	13.0 / 33	-44
Newhy	hybrid wheatgrass	9.8 / 25	4	38.2 / 97	3	28.4 / 72	7.1 / 18	4	29.5 / 75	3	22.4 / 57	-23
Manska	pubescent wheatgrass	9.1 / 23	3	31.5 / 80	3	22.4 / 57	5.9 / 15	4	15.0 / 38	3	9.1 / 23	-53
Reliant	intermediate wheatgrass	7.9 / 20	3	23.6 / 60	3	15.7 / 40	5.9 / 15	4	15.7 / 40	3	9.8 / 25	-33
Topar	pubescent wheatgrass	8.7 / 22	3	31.5 / 80	3	22.8 / 58	7.1 / 18	4	19.7 / 50	3	12.6 / 32	-38
Luna	pubescent wheatgrass1	1.0 / 28	3	37.8 / 96	3	26.8 / 68	7.5 / 19	4	31.5 / 80	3	24.0 / 61	-17
Tegmar	intermediate wheatgrass	5.9 / 15	3	27.6 / 70	3	21.7 / 55	5.1 / 13	3	14.2 / 36	3	9.1 / 23	-49
Oahe	intermediate wheatgrass	11.8 / 30	3	35.4 / 90	3	23.6 / 60	7.5 / 19	3	23.6 / 60	3	16.1 / 41	-33
Greenar	intermediate wheatgrass	11.8 / 30	3	37.4 / 95	3	25.6 / 65	7.5 / 19	3	21.7 / 55	3	14.2 / 36	-42
Rush	intermediate wheatgrass	11.8 / 30	3	42.1 / 107	3	30.3 / 77	7.5 / 19	3	23.6 / 60	3	16.1 / 41	-44
Paiute	orchardgrass	11.0 / 28	3	26.6 / 60	4	15.6 / 32	5.9 / 15	7	15.0 / 38	2	9.1 / 15	-37
Durar	hard fescue	Not evaluated										
Covar	sheep fescue	Not evaluated										

Footnotes at end of table.

Table 1. Height and vigor of the Aberdeen PMC Grass Display Nursery Plots evaluated 14 May and 28 June 2001 continued.

		Control Plots					Plateau treated Plots					% Change Height 28 June between control & treated
		14 May		28 June		Growth	14 May		28 June		Growth	
Accession	Species	Height inch / cm	Vigor [a]	Height inch / cm	Vigor [a]	in 45 days inch / cm	Height inch / cm	Vigor [a]	Height inch / cm	Vigor [a]	in 45 days inch / cm	
12 to 16-inch precipitation continued												
Pryor	slender wheatgrass	7.5 / 19	3	40.2 /102	3	32.7 / 83	3.5 / 9	7	19.7 / 50	3	5.6 / 41	-51
San Luis	slender wheatgrass	7.5 / 19	3	47.2 /120	3	39.7 / 101	3.5 / 9	7	21.7 / 55	3	18.2 / 46	-54
Primar	slender wheatgrass	6.7 / 17	2	35.4 / 90	3	28.7 / 73	3.5 / 9	6	17.7 / 45	3	14.2 / 36	-50
Average		10.1 / 25.7	2.9	36.4 / 91.6	3.1	26.3 / 66.4	6.5 / 16.6	4.7	22.3 / 56.7	3.3	15.2 / 39.6	-41.5 [b]
Standard deviation		3.1 / 8.0	0.5	8.7 / 23.4	0.4	7.1 / 18.7	3.1 / 7.8	2.0	10.1 / 25.7	1.4	8.0 / 19.8	
12-inch or less precipitation												
Bozoisky	Russian wildrye	9.8 / 25	3	37.0 / 94	3	27.2 / 69	5.9 / 15	4	11.8 / 30	3	5.9 / 15	-68
Mankota	Russian wildrye	9.8 / 25	3	37.0 / 94	3	27.2 / 69	4.7 / 12	4	10.6 / 27	3	5.9 / 15	-71
Tetracan	Russian wildrye	11.4 / 29	3	37.4 / 95	3	26.0 / 56	4.7 / 12	4	13.4 / 34	3	8.7 / 22	-64
Secar	Snake River wheatgrass	11.8 / 30	3	33.5 / 85	3	21.7 / 55	7.9 / 20	4	20.2 / 52	3	12.3 / 32	-40
Goldar	bluebunch wheatgrass	10.6 / 27	2	27.6 / 70	3	17.0 / 43	4.7 / 12	4	9.8 / 25	3	5.1 / 13	-64
Whitmar	beardless wheatgrass	11.0 / 28	2	27.6 / 70	3	4.7 / 12	4.7 / 12	4	9.4 / 24	3	4.7 / 12	-66
Kirk	crested wheatgrass	11.4 / 29	3	25.6 / 65	3	14.2 / 36	5.9 / 15	3	17.7 / 45	3	11.8 / 30	-31
Parkway	crested wheatgrass	7.9 / 20	3	18.1 / 46	4	10.2 / 26	4.3 / 11	4	7.9 / 20	4	3.6 / 9	-56
Ephraim	crested wheatgrass	5.5 / 14	3	18.9 / 48	3	13.4 / 34	3.9 / 10	3	5.5 / 14	3	1.6 / 4	-71
Fairway	crested wheatgrass	7.9 / 20	3	17.3 / 44	3	9.4 / 24	3.5 / 9	4	7.9 / 20	3	4.4 / 11	-54
Douglas	crested wheatgrass	9.8 / 25	3	21.7 / 55	4	11.9 / 30	3.9 / 10	5	6.3 / 16	4	2.4 / 6	-71
Hycrest	crested wheatgrass	10.2 / 26	3	23.6 / 60	3	13.4 / 34	5.9 / 15	3	15.7 / 40	3	9.8 / 25	-33
Nordan	crested wheatgrass	9.1 / 23	3	24.0 / 61	3	14.9 / 38	5.9 / 15	3	17.7 / 45	3	11.8 / 30	-26
P-27	Siberian wheatgrass	9.8 / 25	3	23.6 / 60	3	13.8 / 35	5.5 / 14	3	19.7 / 50	3	14.2 / 36	-17
Vavilov	Siberian wheatgrass	7.9 / 20	3	23.6 / 60	3	15.7 / 40	5.1 / 13	3	15.7 / 40	3	10.6 / 27	-33
Critana	thickspike wheatgrass	6.7 / 17	3	20.9 / 53	3	14.2 / 36	3.5 / 9	5	11.8 / 30	3	8.3 / 21	-44
Bannock	thickspike wheatgrass	7.9 / 20	3	29.5 / 75	3	21.6 / 55	3.5 / 9	6	19.7 / 50	3	16.2 / 41	-33
Sodar	streambank wheatgrass	4.7 / 12	3	9.8 / 25	3	5.1 / 13	3.1 / 8	5	5.9 / 15	3	2.8 / 7	-40
SL-Hybrid	wheatgrass	6.7 / 17	3	26.0 / 66	3	19.3 / 49	3.9 / 49	5	9.1 / 23	3	5.2 / 13	-65
Canbar	canby bluegrass	Not evaluated										
9040187	bottlebrush squirreltail	Not evaluated										
9024804	Columbia needlegrass	Not evaluated										
Average		8.9 / 22.7	2.9	25.4 / 64.5	3.1	16.5 / 41.8	4.8 / 12.2	4.0	12.4 / 31.6	3.1	7.6 / 19.4	-51.0 [b]
Standard deviation		2.1 / 5.2	0.3	7.3 / 18.5	0.3	6.1 / 15.4	1.2 / 3.0	0.9	5.0 / 12.7	0.3	4.3 / 10.9	

[a] Vigor is a subjective rating of plant health. Rated 1 to 9, 1 is best, 9 is worst.
[b] Percent change of the average heights.

Table 2. Dry matter forage yield of the Aberdeen PMC Grass Display Nursery Plots, 2001 growing season.

		Control Plots		Plateau treated Plots		
		Pounds		Pounds		Percent
Accession	Species	per acre	kg/ ha	per acre	kg/ ha	Change
		16-inch or greater precipitation				
Paddock	meadow brome	8,415	9,434	2,838	3,182	-66
Fleet	meadow brome	7,800	8,744	3,586	4,020	-54
Regar	meadow brome	6,147	6,891	1,615	1,811	-74
Manchar	smooth brome	4,314	4,836	2,453	2,750	-43
Latar	orchardgrass	4,019	4,506	3,069	3,441	-24
Johnstone	tall fescue	4,952[a]	5,552[a]	Not clipped		
Garrison	creeping foxtail	3,097	3,472	1,433	1,606	-54
Largo	tall wheatgrass	7,310	8,195	1,540	1,726	-79
Jose	tall wheatgrass	5,684	6,372	2,093	2,347	-63
Alkar	tall wheatgrass	4,222	4,733	2,708	3,035	-36
Average		5,668	6,354	2,371	2,658	-58 [b]
Standard deviation		1,880	2,107	752	843	
		12 to 16-inch precipitation				
Bromar	mountain brome	2,424 [c]	2,717 [c]	Not clipped		
Prairieland	altai wildrye	6,812	7,636	3,680	4,126	-46
Shoshone	beardless wildrye	3,597	4,032	1,101	1,234	-69
Trailhead	basin wildrye	3,977	4,458	4,854	5,442	+22
Magnar	basin wildrye	3,756	4,211	3,188	3,574	-15
Rosana	western wheatgrass	4,885	5,476	3,313	3,714	-32
Arriba	western wheatgrass	3,735	4,187	3,615	4,052	- 3
Newhy	hybrid wheatgrass	3,387	3,797	3,902	4,375	+15
Manska	pubescent wheatgrass	5,236	5,869	4,505	5,050	-14
Reliant	intermediate wheatgrass	3,582	4,016	4,161	4,665	+16
Topar	pubescent wheatgrass	3,528	3,955	2,917	3,270	-17
Luna	pubescent wheatgrass	5,556	6,229	4,815	5,398	-13
Tegmar	intermediate wheatgrass	2,915	3,268	3,466	3,886	+19
Oahe	intermediate wheatgrass	6,814	7,639	4,363	4,891	-36
Greenar	intermediate wheatgrass	5,884	6,597	3,387	3,797	-42
Rush	intermediate wheatgrass	4,944	5,542	3,048	3,417	-38
Paiute	orchardgrass	2,360	2,646	1,356	1,520	-43
Durar	hard fescue		Not clipped			
Covar	sheep fescue		Not clipped			
Pryor	slender wheatgrass	2,515	2,819	1,032	1,157	-59
San Luis	slender wheatgrass	3,097	3,471	1,003	1,125	-68
Primar	slender wheatgrass	3,679	4,125	3,642	4,083	- 1
Average		4,134	4,634	3,141	3,521	-30 [b]
Standard deviation		1,360	1,525	1,220	1,368	

Footnotes at end of table.

Table 2. Dry matter forage yield of the Aberdeen PMC Grass Display Nursery Plots, 2001 growing season continued.

		Control Plots		Plateau treated Plots		
Accession	Species	Pounds per acre	kg/ ha	Pounds per acre	kg/ ha	Percent Change
		12-inch or less precipitation				
Bozoisky	Russian wildrye	3,173	3,557	2,607	2,923	-18
Mankota	Russian wildrye	3,512	3,937	2,230	2,500	-37
Tetracan	Russian wildrye	2,595	2,909	2,170	2,433	-16
Secar	Snake River wheatgrass	3,985	4,467	1,907	2,138	-52
Goldar	bluebunch wheatgrass	4,958	5,558	2,927	3,282	-41
Whitmar	beardless wheatgrass	3,465	3,885	2,740	3,071	-21
Kirk	crested wheatgrass	3,299	3,698	3,122	3,500	- 5
Parkway	crested wheatgrass	2,230	2,500	1,756	1,969	-21
Ephraim	crested wheatgrass	1,927	2,161	790	886	-59
Fairway	crested wheatgrass	2,211	2,479	1,612	1,807	-27
Douglas	crested wheatgrass	2,268	2,543	1,834	2,057	-19
Hycrest	crested wheatgrass	2,527	2,833	2,072	2,323	-18
Nordan	crested wheatgrass	2,961	3,320	2,022	2,267	-32
P-27	Siberian wheatgrass	3,122	3,500	2,562	2,872	-18
Vavilov	Siberian wheatgrass	3,362	3,769	2,136	2,395	-36
Critana	thickspike wheatgrass	2,853	3,199	2,153	2,413	-25
Bannock	thickspike wheatgrass	4,146	4,648	1,868	2,094	-55
Sodar	streambank wheatgrass	2,372	2,659	2,077	2,329	-12
SL-Hybrid	wheatgrass	2,705	3,032	1,805	2,024	-33
Canbar	canby bluegrass	Not clipped		Not clipped		
9040187	bottlebrush squirreltail	Not clipped		Not clipped		
9024804	Columbia needlegrass	Not clipped		Not clipped		
Average		3,035	3,403	2,126	2,383	-30 [b]
Standard deviation		769	861	524	588	

[a] Not included in averages. When included in averages for the control plots percentages for pounds per acre and kilograms per hectare are 5,596 and 6,274 respectively.

[b] Percent change of the average of control and treated yields rather than average of percents change.

[c] Not included in averages. When included in averages for the control plots percentages for pounds per acre and kilograms per hectare are 4,395 and 4,927 respectively.

Table 3. Percent total digestible nutrients, nitrogen, crude protein, and the difference between the control and Plateau treated plots.

Accession	Species	Percent TDN			Percent nitrogen			Percent crude protein [a]		
		Control	Plateau	Difference	Control	Plateau	Difference	Control	Plateau	Difference
16-inch or greater precipitation										
Paddock	meadow brome	58	73	15	0.9	1.6	0.7	6	10	4
Fleet	meadow brome	54	65	11	0.7	1.1	0.4	4	7	3
Regar	meadow brome	58	77	19	1.0	1.9	0.9	6	12	6
Manchar	smooth brome	57	76	19	1.0	2.0	1.0	6	13	7
Latar	orchardgrass	63	69	6	1.1	1.4	0.3	7	9	2
Johnstone	tall fescue	65 [b]	--	--	0.9 [b]	--	--	6 [b]	--	--
Garrison	creeping foxtail	65	76	11	1.0	1.6	0.6	6	10	4
Largo	tall wheatgrass	58	70	12	1.1	1.9	0.8	7	12	5
Jose	tall wheatgrass	58	66	8	1.0	1.5	0.5	6	9	3
Alkar	tall wheatgrass	59	65	6	1.0	1.7	0.7	6	11	5
Average		58.9	70.8	11.9	0.98	1.63	0.66	6.0	10.3	4.3
Standard deviation		3.3	4.9	5.0	0.12	0.28	0.23	0.9	1.9	1.6
12 to 16-inch precipitation										
Bromar	mountain brome	60 [c]	--	--	0.9 [c]	--	--	6 [c]	--	--
Prairieland	altai wildrye	58	66	8	1.2	1.6	0.4	8	10	2
Shoshone	beardless wildrye	60	80	20	0.9	2.7	1.8	6	17	11
Trailhead	basin wildrye	56	62	6	0.7	0.9	0.2	4	6	2
Magnar	basin wildrye	55	62	7	0.9	1.1	0.2	6	6	0
Rosana	western wheatgrass	63	68	5	0.8	1.3	0.5	5	8	3
Arriba	western wheatgrass	57	61	4	0.9	1.2	0.3	6	8	2
Newhy	hybrid wheatgrass	60	66	6	0.7	1.1	0.4	4	7	3
Manska	pubescent wheatgrass	60	64	4	0.9	1.2	0.3	6	8	2
Reliant	intermediate wheatgrass	61	65	4	0.9	1.2	0.3	6	8	2
Topar	pubescent wheatgrass	60	62	2	0.8	0.9	0.1	5	6	1
Luna	pubescent wheatgrass	55	62	7	0.7	0.9	0.2	4	6	2
Tegmar	intermediate wheatgrass	59	62	3	1.0	1.1	0.1	6	7	1
Oahe	intermediate wheatgrass	58	63	5	0.7	1.2	0.5	4	8	4
Greenar	intermediate wheatgrass	58	62	4	0.9	1.2	0.3	6	8	2
Rush	intermediate wheatgrass	55	63	8	0.8	1.3	0.5	5	8	3
Paiute	orchardgrass	57	73	16	0.9	2.0	1.1	6	13	7
Durar	hard fescue	Not sampled								
Covar	sheep fescue	Not sampled								
Pryor	slender wheatgrass	50	63	13	0.6	1.8	1.2	4	11	7
San Luis	slender wheatgrass	54	62	8	0.8	1.4	0.6	5	9	4
Primar	slender wheatgrass	52	64	12	0.8	1.5	0.7	5	9	4
Average		57.3	64.7	7.5	0.84	1.35	0.51	5.3	8.6	3.3
Standard deviation		3.2	4.7	4.7	0.13	0.44	0.43	1.1	2.7	2.6

Footnotes at end of table.

Table 3. Percent total digestible nutrients, nitrogen, crude protein, and the difference between the control and Plateau treated plots, continued.

Accession	Species	Percent TDN			Percent nitrogen			Percent crude protein [a]		
		Control	Plateau	Difference	Control	Plateau	Difference	Control	Plateau	Difference
		12-inch or less precipitation								
Bozoisky	Russian wildrye	47	69	22	0.6	1.5	0.9	4	9	5
Mankota	Russian wildrye	56	68	12	0.7	1.5	0.8	4	9	5
Tetracan	Russian wildrye	63	69	6	1.0	1.5	0.5	6	9	3
Secar	Snake River wheatgrass	57	64	7	0.9	1.3	0.4	6	8	2
Goldar	bluebunch wheatgrass	58	72	14	0.7	2.1	1.4	4	13	9
Whitmar	beardless wheatgrass	56	65	9	0.7	1.4	0.7	4	9	5
Kirk	crested wheatgrass	61	67	6	0.7	0.9	0.2	4	6	2
Parkway	crested wheatgrass	62	63	1	0.7	0.7	0.0	4	4	0
Ephraim	crested wheatgrass	61	67	6	0.8	1.1	0.3	5	7	3
Fairway	crested wheatgrass	62	67	5	0.7	0.9	0.2	4	6	2
Douglas	crested wheatgrass	67	74	7	0.8	1.5	0.7	5	9	4
Hycrest	crested wheatgrass	63	68	5	0.6	0.9	0.3	4	6	2
Nordan	crested wheatgrass	63	67	5	0.7	1.0	0.3	4	6	2
P-27	Siberian wheatgrass	61	64	3	0.7	1.1	0.4	4	7	3
Vavilov	Siberian wheatgrass	63	65	2	0.7	0.9	0.2	4	6	2
Critana	thickspike wheatgrass	58	66	8	0.7	1.3	0.6	4	8	4
Bannock	thickspike wheatgrass	56	64	8	0.5	1.3	0.8	3	8	5
Sodar	streambank wheatgrass	61	66	5	0.8	1.3	0.5	5	8	3
SL-Hybrid	wheatgrass	62	68	6	0.8	1.6	0.8	5	10	5
Canbar	canby bluegrass	Not sampled								
9040187	bottlebrush squirreltail	Not sampled								
9024804	Columbia needlegrass	Not sampled								
Average		59.8	67.0	7.2	0.73	1.25	0.53	4.4	7.8	3.5
Standard deviation		4.3	2.8	4.7	0.11	0.34	0.33	0.8	2.0	2.0

[a] Percent crude protein is the percent nitrogen times 6.25 and rounded to the nearest integer, personal communication Joel Douglas of the Jamie L. Whitten PMC at Coffeeville, Mississippi.

[b] Not included in averages. When included in averages for the control plots percentages for TDN, N, and crude protein are 59.5, 0.97, and 6 respectively.

[c] Not included in averages. When included in averages for the control plots percentages for TDN, N, and crude protein are 57.4, 0.84, and 5.4 respectively.

Table 4. Percent acid detergent fiber and percent neutral detergent fiber and the difference between the control and Plateau treated plots, 28 June 2001.

		Percent ADF			Percent NDF		
Accession	Species	Control	Plateau	Difference	Control	Plateau	Difference
		16-inch or greater precipitation					
Paddock	meadow brome	37	31	6	65	53	12
Fleet	meadow brome	41	35	6	68	59	9
Regar	meadow brome	40	30	10	65	51	14
Manchar	smooth brome	39	31	8	66	52	14
Latar	orchardgrass	37	33	4	60	56	4
Johnstone	tall fescue	33 [a]	--	--	57 [a]	--	--
Garrison	creeping foxtail	33	30	3	58	50	8
Largo	tall wheatgrass	39	33	6	66	59	7
Jose	tall wheatgrass	39	34	5	65	61	4
Alkar	tall wheatgrass	37	35	2	64	63	1
Average		38.0	32.4	5.6	64.1	56.0	8.1
Standard deviation		2.3	2.0	2.5	3.1	4.7	4.6
		12 to 16-inch precipitation					
Bromar	mountain brome	37 [b]	--	--	62 [b]	--	--
Prairieland	altai wildrye	40	36	4	66	61	5
Shoshone	beardless wildrye	35	28	7	64	54	10
Trailhead	basin wildrye	39	37	2	66	60	6
Magnar	basin wildrye	42	36	6	67	62	5
Rosana	western wheatgrass	33	32	1	60	57	3
Arriba	western wheatgrass	37	35	2	67	64	3
Newhy	hybrid wheatgrass	37	34	3	61	57	4
Manska	pubescent wheatgrass	36	35	1	62	61	1
Reliant	intermediate wheatgrass	36	34	2	61	60	1
Topar	pubescent wheatgrass	37	39	-2	62	59	3
Luna	pubescent wheatgrass	41	38	3	66	60	6
Tegmar	intermediate wheatgrass	39	38	1	64	61	3
Oahe	intermediate wheatgrass	37	36	1	63	61	2
Greenar	intermediate wheatgrass	39	36	3	64	62	2
Rush	intermediate wheatgrass	39	36	3	67	62	5
Paiute	orchardgrass	38	33	5	65	55	10
Durar	hard fescue	Not sampled					
Covar	sheep fescue	Not sampled					
Pryor	slender wheatgrass	43	39	4	72	66	6
San Luis	slender wheatgrass	42	38	4	68	64	4
Primar	slender wheatgrass	41	36	5	71	63	8
Average		38.5	35.6	2.9	65.1	60.5	4.6
Standard deviation		2.6	2.7	2.1	3.3	3.1	2.7
		12-inch or less precipitation					
Bozoisky	Russian wildrye	46	34	12	74	57	17
Mankota	Russian wildrye	42	34	8	68	57	11
Tetracan	Russian wildrye	36	34	2	60	56	6
Secar	Snake River wheatgrass	41	37	4	65	61	4
Goldar	bluebunch wheatgrass	38	32	6	64	58	6
Whitmar	beardless wheatgrass	40	36	4	65	61	4
Kirk	crested wheatgrass	35	30	5	61	56	5
Parkway	crested wheatgrass	33	32	1	61	59	2
Ephraim	crested wheatgrass	35	32	3	61	57	4

Footnotes at end of table.

Table 4. Percent acid detergent fiber and percent neutral detergent fiber and the difference between the control and Plateau treated plots, 28 June 2001 continued.

		Percent ADF			Percent NDF		
Accession	Species	Control	Plateau	Difference	Control	Plateau	Difference
Fairway	crested wheatgrass	33	29	4	60	56	4
Douglas	crested wheatgrass	32	28	4	54	53	1
Hycrest	crested wheatgrass	33	30	3	58	55	3
Nordan	crested wheatgrass	33	20	3	58	57	1
P-27	Siberian wheatgrass	35	33	2	60	60	0
Vavilov	Siberian wheatgrass	34	32	2	58	58	0
Critana	thickspike wheatgrass	38	34	4	63	59	4
Bannock	thickspike wheatgrass	39	35	4	64	61	3
Sodar	streambank wheatgrass	36	34	2	60	59	1
SL-Hybrid	wheatgrass	36	34	2	59	59	0
Canbar	bottlebrush squirreltail	Not sampled					
9024804	Columbia needlegrass	Not sampled					
Average		36.6	32.1	3.9	61.7	57.8	4.0
Standard deviation		3.7	3.7	2.5	4.4	2.2	4.1

[a] Not included in averages. When included in averages for the control plots percentages for ADF and NDF are 37.5 and 63.4 respectively.

[b] Not included in averages. When included in averages for the control plots percentages for ADF and NDF are 38.4 and 64.9 respectively.

Table 5. Quality standards for legume, grass, or grass-legume hay.[a]

Quality Standard	CP	ADF	NDF	DDM	DMI	RFV
			Percent			
Prime	>19	<31	<40	>65	>3.0	>151
1	17-19	31-35	40-46	62-65	3.0-2.6	151-125
2	14-16	36-40	47-53	58-61	2.5-2.3	124-103
3	11-13	41-42	54-60	56-57	2.2-2.0	102-87
4	8-10	43-45	61-65	53-55	1.9-1.8	86-75
5	<8	>45	>65	<53	<1.8	<75

CP = crude protein, ADF = acid detergent fiber, NDF = neutral detergent fiber.

Digestible dry matter (DDM%) = 88.9-0.779 ADF (% of dry matter).

Dry matter intake (DMI) = 120/forage NDF (% of DM).

Relative feed value (RFV) calculated from (DDM x DMI)/1.29.

Reference hay of 100 RFV contains 41% ADF and 53% NDF.

[a] Hay Market Task Force, American Forage and Grassland Council, from D.M. Ball and others 1991.