Upper Colorado Environmental Plant Center
Meeker, Colorado

2008 Annual Technical Report

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2008 Annual Technical Report

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UPPER COLORADO ENVIRONMENTAL PLANT CENTER

Fiscal Year 2008

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Upper Colorado Environmental Plant Center

Established primarily as a means to identify, increase and introduce superior plant materials for identified conservation uses, Upper Colorado Environmental Plant Center (UCEPC) has played a vital role in revegetating disturbances in the inter-mountain west. Owned and operated by the Douglas Creek and White River Conservation Districts, UCEPC has had, since its inception in 1975, the specific charge and primary responsibility for collecting, evaluating, testing, selecting and producing quality plant species for the Upper Colorado River Basin. Superior materials, upon research completion, are then increased, released and made available to the public where they are utilized for a variety of conservation purposes.

UCEPC, at 6500 feet in elevation, is unique in that it is the highest elevation center within the Plant Materials system. A vital need was identified over 25 years ago within NRCS and among many NRCS customers for plant materials and associated technology for high elevation uses.

The Center was also strategically placed near the world's largest deposit of oil-bearing shales, and within an area rich in other mineral deposits. The area is also home to the world's largest concentration of mule deer and elk, which made for considerable interest in providing quality plant materials for revegetation uses related to energy extraction activities.

Much of the research and development of plant materials from agronomic, arable land is provided primarily by the Agricultural Research Service and University Experiments Stations and Extension Services. As a result, the focus of the UCEPC Plant Materials Program is on plant material development for conservation uses on high elevation disturbances, rangeland, wildlife habitat and riparian corridors. There is, however, a certain degree of overlap in the utility a material may provide. For example, many of the grass species developed in the plant materials program for use in rangeland enhancement have been used on thousands of acres of agricultural ground through federal programs such as the Conservation Reserve Program (CRP). Other programs, such as the Buffer Initiative Program, Environmental Quality Incentives Program and Wildlife Habitat Improvement Program may utilize UCEPC developed materials. These programs have been initiated to reduce soil loss and improve water quality while providing concurrent benefits to livestock, wildlife and humans.

Because of the multitudes of existing problems, which can be alleviated, with the use of properly selected plant materials, the direction of the plant materials program and prioritization of projects and materials undertaken by UCEPC is largely provided by the Technical Advisory Committee. This committee is made up of State Conservationists, State Resource Conservationists and other representatives of state and federal agencies, universities and private industry. Key, too, to this process and the operation of UCEPC are local conservation districts, and NRCS Field Office and district employees. From individual districts, plant materials, which can aid in solving conservation problems are identified and collected. These materials are then provided to UCEPC for testing and evaluating against the same or comparable materials prior to seed increase or release. It is within this framework that the best materials are made available for the identified conservation use on the area they were developed for and by the users who will benefit from their inclusion in seedings or plantings.

Presently, there are many plant species and projects at UCEPC, which our Technical Advisory committee has identified as providing substantial benefit for resource conservation. These projects fall into one of five identified High Priority Areas listed below:

- Revegetation of high altitude and disturbed land
- Increased productivity of rangeland and pastures
- Improved water quality
- Wildlife habitat enhancement
- Use of native plants in xeriscape and horticulture

These projects include years of evaluations at numerous testing locations, small seed increase fields, and the production of foundation quality seed of materials released for use by the public. The plant materials, which are developed as a result of the projects encompassed by these priority areas, will provide direct and indirect benefit to the resources of Colorado and to those who call Colorado "Home" for many years to come.

Research projects utilizing plant materials developed by UCEPC have ranged in scope from channel restoration and stabilization to roadside revegetation and from enhancement of mule deer winter range to phytoremediation of heavy metal runoff from mine spoils. Range, water and soil resources have been and will continue to be conserved and improved with UCEPC products. Reclamation and revegetation of utility and transmission corridors and natural and man induced surface disturbances are more successful as a result of research and products developed for those purposes, and livestock and wildlife forage and habitat are improved by the plant materials program and the many entities which assist in and cooperate with our mission.

For information about Upper Colorado Environmental Plant Center or any of its products or services, including specific information about plants, please contact us at (970) 878-5003 or steve.parr@co.nacdnet.net.

Project No. 08A073J
Progress Report – 2008
By: Dr. Gary Noller & Steve Parr

Antelope Bitterbrush for Fire Tolerance

INTRODUCTION

Antelope bitterbrush *Purshia tridentata* is one of the most widely distributed of all western shrubs. It can be found on arid plains, foothills, and mountain slopes in association with pinyon pine, ponderosa pine, and aspen. Antelope bitterbrush is regarded as an important browse species and is especially critical as winter forage for mule deer, elk, and as the name implies, antelope.

Antelope bitterbrush has a high priority for use in revegetation of surface disturbances related to oil and gas well disturbance, pipelines and service roads, wildlife habitat improvement, and rangeland seeding in the Upper Colorado River Basin. The prostrate layering characteristic of certain accessions of antelope bitterbrush is considered beneficial for these purposes.

Some antelope bitterbrush stands are very susceptible to fire. As a result, large areas of antelope bitterbrush have been burned in the Upper Colorado Region and have not naturally regenerated.

OBJECTIVE

The original purpose of the project was to evaluate the performance of accessions of antelope bitterbrush at the Upper Colorado Environmental Plant Center (UCEPC) in Meeker. In 1992, another objective was added, to determine the relative ability of the accessions to sprout after fire. A third objective was identified after the results from the burning. This objective was to increase a seed source from the identified fire tolerant accession.

METHODS

Tubling plants of 17 accessions were grown in the greenhouse and transplanted to a dry land site on June 6, 1983. See Table 1 for the accessions included. Table 2 lists the growth form for the accessions. Plants were planted in rows with 8-foot centers (Figure 1). Each accession was planted in two replications of 15 plants each, except when not enough plants were available. Only one replication was planted for accession 9038520, 9038526, 9030795, and 9038530.

To determine the ability to sprout after fire, 50% of the plants in each accession were burned on September 2 - 3, 1992. Prior to burning, the shrubs were pruned to a size small enough to fit into the burn barrel. The shrubs were burned at maximum intensity (about 400 F) for 2.5 minutes. A total of 139 shrubs were burned. Soil samples and weather records were taken to determine site conditions at the time of burning.

Information on soil moisture was computed in 1998 to update the project report. The procedure is outlined below.

1992

The plants were burned on September 3 (59 plants) and September 4, 1992, (80 plants). A light to heavy rain occurred on September 3 and amounted to 0.19 inch by the time recorded on September 8. Soil samples for soil moisture were taken on September 11, after the burn and rain (figure 2). Three samples were taken; one from the top five inches of soil, another from the five to ten inch layer, and one sample was taken from under a living plant in the center of the entire plot. Soil samples were placed in an oven at 75 degrees F (23 degrees C) for over 50 days to remove moisture. The percent soil moisture was determined on a dry soil basis (Figure 2).

2005

Seed had been collected for many years from both the re-sprouted fire-tolerant accession from this project as well as from a selected class release of bitterbrush from UCEPC, 'Maybell Select'. However, in 2005, a decision was made to remove the 'Maybell Select' shrubs because of the high potential of cross pollination that was likely occurring with it and the fire-tolerant source. Both plantings were also becoming decadent from old growth and were infested with annual weeds and Canada thistle. Additionally, the source of seed for 'Maybell Select' is less than 50 miles from UCEPC, and collections could be obtained from native stands. The fire-tolerant source has been maintained as a seed source.

2007

Herbicide applications were conducted to reduce the annual weedy competition between plants and to control the infestations of Canada thistle. Applications will be conducted as necessary. Pruning of decadent material was also identified as a management activity to improve seed production potential.

2008

Herbicide was again applied to control annual weeds, and pruning of decadent growth was done to improve vigor and appearance of planting. However, no seed was collected according to the seed cleaning records. Hard freezing temperatures were recorded on June 9, 10, 12, 13, and 16 which very likely affected seed set this year.

RESULTS

Accession 9038521 (from Soda Springs, Idaho) was identified as having the best ability to sprout after fire. Both replications (Row 12 and 25) were evaluated on August 16, 1996, (Table 3). In row 12, (north) one of the six plants that were burned was dead on August 16. Three burned plants had abundant regrowth, while the other two had only a small amount of regrowth.

In row 25, (south) three of the burned plants had abundant regrowth, while one had only a small amount of regrowth.

Notes on the plants taken on August 16, 1996, are presented in Table 3.

"On July 18, 2000, 153 grams of *Purshia tridentata* fire tolerant antelope bitterbrush was harvested from field twenty-one. There are twenty-three bitterbrush plants alive in the stand from the original planting of 30 transplants (see historic records). The north row has twelve surviving plants and the south row has eleven. Due to a fire ban within the county, the plot was not burned this year."

Table 1. A listing of bitterbrush accessions with location and number planted.

Row	Accession Number	Collection Location	Planted
1	9031619	Colorado, (NPMC)	15
2			0
3	9038525	Six Mile Lake, OR	15
4	9038523	Celilo, OR	15
5	9007977	Rio Blanco County, CO	15
6			0
7	9024076	Eagle, ID	15
8	9038527	Weber County, UT	12
9			0
10			0
11	9024373	Moffat County, CO	15
12	9038521	Soda Springs, ID	15
13	9009355	Inyo County, CA	15
14	9038522	South Pass, WY	15
15	9038531	Moffat County, CO	15
16	9024377	Moffat County, CO	15
17	9038524	Long Valley Jct, UT	15
18	9030795	Colorado (NPMC)	7
19	9038524	Long Valley Jct, UT	15
20	9031619	Colorado (NPMC)	15
21	9038530	College Farm, NM	14
22	9024377	Moffat County, CO	15
23	9024373	Moffat County, CO	15
24	9007977	Rio Blanco County, CO	15
25	9038521	Soda Springs, ID	15

Row	Accession Number	Collection Location	Planted
26	9009355	Inyo County, CA	15
27	9038527	Weber County, UT	12
28	9038520	St. Anthony, ID	9
29	9038523	Celilo, OR	15
30	9038525	Six Mile Lake, OR	15
31	9038526	Caribou County, ID	15
32	9038522	South Pass, WY	15
33	9024076	Eagle, ID	15
34	9038531	Moffat County, CO	15

Table 2. Growth form for all accession of antelope bitterbrush.

Accession Growth Number	Form
9031619	Prostrate
9038520	″
9038523	″
9007977	″
9038530	″
9024076	″
9038527	″
9038526	″
9024373	″
9038521	″
9038522	″
9038531	″
9024377	″
9038524	″
9038525	Upright
9030795	″
9009355	″

Table 3. A listing of the 1996 evaluation information collected on August 16, for 9038521.

	Row	Planted	Survival	Ht cm.	Wd cm.	Vigor
(North)	12	15	13			
			7 (not burned)	145	230	3
			5 (burned)	55	165	4
(South)	25	15	11			
			7 (not burned)	90	195	3
			4 (burned)	50	130	4

2007

Since the evaluation done in 2000, one plant in the northern plot has died. On September 10, 2007, there were 11 plants that were alive in each the northern plot and the southern plot. There were also three smaller plants in the southern plot, but they did not look like original plants and were not noted in the evaluation from year 2000.

CONCLUSION

Year 2009 will represent 26 years of growth for the bitterbrush plants at UCEPC. It is hoped that seed can be collected from the plots this year, and that more intense management will improve plant performance. Seed will be used for further studies, including the determination of fire tolerance of another generation of plants, site adaptability and comparison to other bitterbrush sources that are commercially available.

Project 08A207
Project Report-2008
By: Manuel Rosales & Steve Parr

Advanced Evaluation of *Koeleria macrantha* Prairie Junegrass

OBJECTIVE

To develop and release an accession of *Koeleria macrantha* for conservation use from a composite selection of superior Northwest Colorado ecotypes.

INTRODUCTION

Koeleria macrantha (prairie Junegrass) is a perennial, cool-season bunchgrass that is widely distributed throughout the United States. According to Hitchcock, 1935, its range extends from Ontario to British Columbia, south to Delaware, Missouri, California, and Mexico. The species is also widely distributed in the temperate regions of the old world. In the Central Rocky Mountains, it is commonly found as a component of prairies, open woods, mountain parks, sagebrush, and mountain brush communities. It is found in elevations ranging from below 4000 feet to over 11,000 feet. The species provides good forage for both livestock and grazing wildlife species, and fair forage for browsing species of wildlife. *Koeleria macrantha* is usually sparsely distributed and is generally not found as the dominant range species in a particular stand. Because of this, its importance as forage to both wildlife and livestock may be more related to its abundance than its preference.

Prairie Junegrass also responds well after fire and studies have found positive effects to plant size and seed head abundance following fire. Other studies show it has increased in abundance after prolonged drought conditions and man induced surface disturbances. Although prairie Junegrass has a number of characteristics that make it an attractive product for inclusion in seed mixtures for revegetation, there is only one released variety, **Barkoel**, which is from the Netherlands. There is no release from the United States. This may be a factor in whether the species is recommended in mixtures. Because of the potential benefit to native ranges, prairie Junegrass has been a product under selection at Upper Colorado Environmental Plant Center (UCEPC) since 1984.

MATERIALS

Forty accessions of *Koeleria macrantha* were planted as a fall seeding, Project 08I115, on August 23, 1985. Due to poor establishment of this planting, a **spring planting**, Project 08I152, was established on June 12, 1986. Because of insufficient seed, only 32 accessions of the original 40 were included in Project 08I152. In addition, 19 International collections were included in Project 08I152, bringing its total number of accessions up to 51. In 1988, Projects 08I115 and 08I152 were combined into a single project designated as 08I115.

In 1991, Dr. Jack Carlson, who was at the time the Northwestern Regional Plant Materials Specialist for the SCS, recommended that a composite of the best strains from the Central Highlands of Turkey (PI-204451, PI-206274, PI-383672, PI-383673, and PI-383674), be made.

In addition, Dr. Carlson recommended that a second composite be put together that consisted of the best performing strains from Northwestern Colorado. At that time, Northwest Colorado accessions 9024197, 9024421, and 9039787 were recommended.

In 1993, Dr. Gary Noller, UCEPC Senior Scientist, determined the top three Northwest Colorado and the top three Turkish Central Highlands accessions for the project. Dr. Noller recommended that accessions PI-383672, PI-383673, and PI-204451 be chosen from the Turkish Ecotypes. In addition, Dr. Noller recommended that accessions 9024197, 9039786, and 9039787 be chosen to represent the Northwest Colorado ecotypes. Accession 9024197 is from Rio Blanco County, while accession 9039786 and 9039787 are from Routt County.

During the summer of 1994, UCEPC established separate crossing nurseries for the Northwest Colorado and Central Turkish Highland accessions in UCEPC. The nurseries were established with vegetative culms transplanted from UCEPC Field 21 onto three-foot centers. Each nursery was laid out in a Randomized Complete Block design and included three replications. Each genotype is represented within a given replication seven times. The Northwest Colorado crossing block represents Project 08A207 while the Turkish Central Highlands crossing block represents Project 08A208. Dr. Tom Jones, ARS, Logan, Utah pointed out that *K. macrantha* cross-pollinates and is self-incompatible. Upon cross-pollination, seed borne on each individual representing one of the three accessions will be considered a half-sib family (one parent known, one parent unknown).

METHODS FOR PRODUCT DEVELOPMENT

The original project methodology was to utilize genotypic recurrent selection only for the establishment of an F1 nursery. The original parental plants, 63 in all, were to provide the seed source for 63 F1 type plants, replicated three times, to produce an F1 nursery with 189 plants.

Each of the F1 plants were to be maintained as a separate line and eventually used to create an F2 nursery. The F1 seed, F2 seed, and parental seed would be compared and a subsequent release be initiated based on the results.

In 1996, seed was collected and harvested by individual plant, but was not identified as to which plant or accession. In 1997-2000, seed was harvested and identified for parental determination. In 2001-2003, the seed from the crossing block was bulk harvested. Because a recurrent selection process would take an additional three to five years to establish and compare seed production results, it was determined by UCEPC to go forward with a release of prairie Junegrass based on results of advanced evaluations.

On July 16, 2002, blended seed from the 2001 harvest was used to seed one acre of prairie Junegrass in Field 11 at UCEPC. Seed density was targeted at 30 seeds per linear foot and the

seeding was completed with a hand pushed Planet Junior. A poor to weak stand was noted until late fall, when a good stand was finally evident.

From 2004 to present, the crossing block has been hand-harvested by accession number.

RESULTS

The following results are summarized by year:

1997-1999

Individual plant harvests were conducted with reference to accession from years 1997-1999. Harvest results from accession 1 (9024197) from Rio Blanco County and accession 2 (9039786) and accession 3 (9039787) from Routt County are provided below.

Year	Accession 1	Accession 2	Accession 3	Total
1997	209	240	225	674
1998	653	710	581	1944
1999	174	237	255	666
Totals	1036	1187	1061	

Analysis of variance statistics were run for the randomized complete block design of this study. Although there is an apparent accessional difference, the difference is not significant at the 5% level. Of the 63 parental plants, there is mortality in ten. Of the remaining 53 plants, 16 are contributing very little to the seed gene pool simply because of the poor stature of the parental plants. Thirty-seven superior plants will be used for cross-pollination with harvested seed being used to test against the blended seed increase field.

Year- 2001

The Hege combine was used to harvest the entire block on July 11. The clean seed amount resulted in 461 grams.

Year- 2002

On July 18, the Hege combine was again used to harvest the entire block, but only 19 grams were harvested.

Year- 2003

The entire plot was hand harvested on July 15 and 2.5 pounds of clean seed resulted.

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Project Report-2008
By: Manuel Rosales & Steve Parr

Year- 2004

Nine inferior plants out of the 44 remaining plants in the crossing block were clipped to prevent crossing with superior desirable parents. Plants were clipped May 17. Plants were monitored throughout the growing season for re-growth but no new heads were formed in the clipped plants. However, about 12 inches of new leaf growth was measured from May 17 to June 15. On July 7, the 35 desirable parent plants in the crossing block were hand harvested and bulked. Three pounds of unclean seed yield 1.7 pounds of cleaned seed.

Year- 2005

On May 13, the nine inferior plants (due to short height and vigor) were clipped to prevent crossing with superior parental plants. All plants were just starting to head out. On June 7, the nine clipped plants were starting to head out again, so they were clipped a second time. The clipped plants were measured for re-growth with an average re-growth of 16 inches. On July 12, the superior plants were hand-harvested by accession. The results are presented in the following table:

Entry No.	Accession No.	No. Plants per Accession	Total Seed Yield per Accession	Collection Site Colorado
1	9024197	10	163 grams	Rio Blanco County
2	9039786	13	181 grams	Routt County
3	9039787	12	187 grams	Routt County

Year- 2006

In 2006, the superior plants of each accession were hand-harvested Inferior plants of each accession were hand clipped on May 18 prior to anthesis to prevent crossing with superior plants. Superior plants were harvested on July 3. Results are presented in the following table:

Entry No.	Accession No.	No. Plants per Accession	Total Seed Yield per Accession	Collection Site Colorado
1	9024197	10	181 grams	Rio Blanco County
2	9039786	13	242 grams	Routt County
3	9039787	12	171 grams	Routt County

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Year-2007

The crossing block was harvested by hand this year as in previous year. The block was harvested by accession number on July 2, 2007. The total seed yield per accession in grams is presented in the following table:

Total Seed Yield per Accession. UCEPC-2007

Accession No.	No. Plants per Accession	Total Seed Yield per Accession	Collection Site Colorado
9024197	10	338 grams	Rio Blanco County
9039786	13	270 grams	Routt County
9039787	12	486 grams	Routt County

Remarks for Growing Season of 2007

A plant materials release from a composite of the three accessions was being planned for the year 2007, however, the release is on hold until a final determination on the species identification is confirmed. The Colorado State Seed Laboratory reported that the *Koeleria macrantha* seed UCEPC submitted for analysis was not *Koeleria* but *Poa* spp. Seed of the accessions has been sent to Steve Larson, with the USDA-Agriculture Research Service, to do a more in-depth investigation to resolve the dilemma of determining if species belongs to the genus *Koeleria* or *Poa*.

Remarks for Growing Season of 2008

As indicated in the remarks for 2007, the release of Prairie Junegrass was on hold until a final determination on the identification of the accessions was secure. On March 17, 2008, Steve Larson from USDA-ARS Forage and Range Research lab, Utah State University reported the followings: "We have determined that eight of eight DNA (AFLP) profiles of 9024197, 9039789, and 9039787 are exactly identical to Sherman and much different from the two *Koelaria* Samples. I am very certain that 9024197, 9039786, and 9039787 are Sherman"

This report came as a surprise, since in the 20 plus years that this species has been in evaluation at UCEPC, nobody ever reported that *Koelaria* was not *Koelaria* but *Poa ampla* (Sherman big bluegrass). The release for Junegrass has been discontinued and the study is now inactive.

Project 08A209
Project Report-2008
By: Steve Parr

Non-Irrigated Production of Three Smooth Brome Grasses

ABSTRACT

Smooth brome grass *Bromus inermis* has been utilized for the conversion of non-irrigated cropland to non-irrigated hayland and improvement of existing non-irrigated hayland throughout the intermountain west. This study was conducted to determine which of three varieties of smooth brome would produce the largest quantity of harvestable biomass for domestic livestock feed in a mountain valley setting of the intermountain west. This study compared the production of 'Manchar', 'Liso', and 'Lincoln' varieties of smooth brome grass under non-irrigated conditions.

INTRODUCTION

During the past several decades many thousands of acres of smooth brome grass have been seeded into non-irrigated situations for hay production in the intermountain west. With the pending release of 'Liso' smooth brome grass, the question arises as to how it will produce in relation to traditional releases of smooth brome grass. The purpose of this study and paper is to review which variety of smooth brome grass will produce the maximum annual harvestable biomass over a realistic stand life of seven to ten years.

MATERIALS AND METHODS

This study was conducted at Upper Colorado Environmental Plant Center (UCEPC), six miles southeast of Meeker, Colorado. Environmental factors at test site are: 16.19″ of annual precipitation, 6500 ft elevation, north facing slope of 3%, growing season of 100 days. This comparison test was conducted on a work loam (fine, montmorillonitic typic argiborolls) which had been fallow for multiple years providing a fine relative weed free seed bed. A total of 18 plots in a random format were developed. Each plot was developed utilizing five 6-ft long rows on 1-ft centers. In return, each plot had border rows consisting of equal parts of each variety on a PLS basis. Planting was conducted utilizing a Planet Junior brand hand planter placing the seed at 1/2″ depth.

The site preparation began on July 1, 1997, and the plots were planted on July 10, 1997. The plots were then irrigated utilizing a “hand” move sprinkle system. The plots were irrigated to field capacity to replicate early spring conditions that are found in the White River Valley. Once field capacity was reached, three weeks later, the sprinkler pipe was removed and no additional irrigation was used during the scope of this study. The results of the 2003 evaluation showed a trend for production by accession to favor those products that spread laterally. Both 'Lincoln' and 'Manchar' had higher plot productivity than the 'Liso' material which was noted to remain more centered along the planted row with much less lateral spread. For evaluations in 2004, ocular assessments were made on the percent spread from the center line of the seeded rows. The three interior rows of each plot were evaluated. A less aggressive, spreading type of smooth

brome may be more productive through time than a vigorous spreading type. In addition, smooth brome has come under some scrutiny as being an aggressive, non-native that has the ability to out-compete native vegetation and spread beyond planted locations. Environmental considerations may strongly favor 'Liso' over more aggressive, spreading selections.

In 2005, productivity was evaluated on a relative scale to help determine the effects of the non-spreading nature of 'Liso' compared to the more aggressively spreading 'Lincoln' and 'Manchar' varieties. Other vegetative characteristics were noted to help identify the unique attributes of each of the selections.

RESULTS

2006 Evaluation

Results are listed in Table 1 for percent cover, number of discernible rows and number of seed heads by plot and product.

Evaluation of
Three Smooth Bromes

Plot #	Percent Cover	Number of Discernible Rows	Number of Seed Heads	Product
1	85	0	0	'Manchar'
2	65	3	4	'Liso'
3	95	0	0	'Lincoln'
4	73	3	2	'Manchar'
5	90	0	0	'Lincoln'
6	80	1	0	'Liso'
7	95	0	0	'Lincoln'
8	70	1 w/parts of 2	1	'Liso'
9	90	0	0	'Manchar'
10	90	0	0	'Manchar'
11	77	3	6	'Liso'
12	95	0	0	'Lincoln'
13	70	3	5	'Liso'
14	80	0	4	'Manchar'
15	95	0	2	'Lincoln'
16	76	3	11	'Liso'
17	85	0	2	'Lincoln'
18	95	0	0	'Manchar'

Table 1

Project 08A209
Project Report-2008
By: Steve Parr

Analysis of variance was conducted for each of the dependent variables; cover, rows, and seed heads. Statistically, there was significant difference in each of these variables by cultivar. However, only the percent cover exhibited normal distribution as 'Liso' displayed the least amount of cover, 'Lincoln', the most cover while 'Manchar' was intermediate. The number of seed heads and the number of rows were also statistically significant among the cultivars, but their distribution is not normal. Rows were either apparent or not visible, so there was not normal distribution. Seed head numbers were a reflection of cover and row visibility. The greater the percent cover, the fewer the number of seed heads.

Listed below are the results of the comparisons of each of the variables with the three cultivars in the study. The analysis of variance for cover is presented after the variable comparisons.

Descriptive Statistics for Cultivar = 'Lincoln'

Variable	N	Mean	SD	Minimum	Maximum
Cover	6	92.5000	4.1833	85.0000	95.0000
Heads	6	0.6667	1.0328	0.0000	2.0000
Rows	6	0.0000	0.0000	0.0000	0.0000

Descriptive Statistics for Cultivar = 'Liso'

Variable	N	Mean	SD	Minimum	Maximum
Cover	**6**	73.00000	5.5857	65.0000	80.0000
Heads	**6**	4.5000	3.9370	0.0000	11.0000
Rows	**6**	2.5000	0.8367	1.0000	3.0000

Descriptive Statistics for Cultivar = 'Manchar'

Variable	N	Mean	SD	Minimum	Maximum
Cover	**6**	85.5000	7.9687	73.0000	95.0000
Heads	**6**	1.0000	1.6733	0.0000	4.0000
Rows	**6**	0.5000	1.2247	0.0000	3.0000

Randomized Complete Block AOV Table for Cover

Source	DF	SS	MS	F	P
Rep	5	99.33	19.867		
Cultivar	2	1171.00	585.500	12.68	0.0018
Error	10	461.67	46.167		
Total	17	1732.00			
Grand Mean	83.667	CV 8.12			

Tukey's 1 Degree of Freedom Test for Non-Additivity

Source	DF	SS	MS	F	P
Non-Additivity	1	0.959	0.9590	0.02	0.8941
Remainder	9	460.708	51.1897		
Relative Efficiency, RCB 0.79					

Means of Cover for Cultivar

Cultivar	**Mean**
'Lincoln'	92.500
'Liso'	73.000
'Manchar'	85.500
Observations per Mean	6
Standard Error of a Mean	2.7739
Std Error (Diff of 2 Means)	3.9229

2007 Evaluation

The smooth brome plots were evaluated on September 10, 2007. From the evaluation, five of six plots of 'Liso' were easily identified by discernible, distinct rows. From field notes,

> "Only plot #4 seems to be 'Liso', but is labeled as Manchar. Head abundance is heavier and more numerous in 'Liso' plots, but forage production by plot is not better for 'Liso' plots, but may be better by row. Because there is more bare ground in the 'Liso' plots, (between rows), the overall production is less. This indicates 'Liso' would be more compatible in a mixed planting than either 'Lincoln' or 'Manchar', both of which are sod bound."

It is recommended at this time that the 'Liso' plots be salvaged for seed production, but after ten years, the project is complete and should be closed.

2008

Plots were marked and treated with glyphosate to remove all but 'Liso' plots. However, border rows were not removed and a poor kill of unwanted plots resulted. Because of the perceived value of 'Liso' in off-center testing, it will be a priority to salvage 'Liso' source plants, and if possible, seed from 2009 production. No further activities were conducted on the project in 2008.

CONCLUSIONS

2006

'Lincoln' smooth brome is a very aggressive, rhizomatous sod-forming product. It is suspected that plots were clipped in 2003 at the beginning of lateral movement of 'Lincoln' and 'Manchar' from the planted row. 'Liso', from previous observations, has less lateral spread or movement from its planted row than either 'Manchar' or 'Lincoln'. Because there was "more material to clip" in the 'Manchar' and 'Lincoln' plots from lateral movement of those materials relative to the lack of a spreading tendency exhibited by 'Liso', they produced more forage biomass in 2003 than 'Liso'. Evaluations in 2004 and again in 2005 confirmed the higher biomass production

from the lateral spreading products compared to 'Liso'. In 2006, vigor was higher for 'Liso' based on the number of seed heads, 27 compared to six for 'Manchar' and four for 'Lincoln'.

'Lincoln' may still be the most productive smooth brome, in terms of biomass, while 'Liso', since 2003, has become the least productive, although no data was collected for biomass in 2006. Ocular observations in 2005 also identified six out of six plots of 'Liso' by the vegetative characteristic of "very curly leaves". Four of six plots of each 'Manchar' and 'Lincoln' were also identified by leaf shape morphology. Plots one and four seemed to be a mixture of leaf shapes. No notations were made for leaf shape for plots three and five. In 2006, five of six 'Liso' plots were identified because of the non-spreading nature, or lateral "row migration" as compared to the other two cultivars. Plot six is the most difficult to distinguish as 'Liso'. The southwest portion of the study is also the most heavily vegetated because prevailing winds deposit more snow in this section of the study than elsewhere. The increased moisture has increased the lateral spread of 'Liso', which is not unexpected. This experimental error also shows up as non-additivity in Tukey's Test for seed head numbers especially. There is one 'Liso' plot with 11 seed heads while the next highest number is six. As a result, there is not normal distribution of seed head numbers. There are additional vegetative differences in 'Manchar' and 'Lincoln'. 'Lincoln' has more upright leaf growth while 'Manchar' exhibits less of that characteristic.

The notion that a less aggressively spreading smooth brome may, in the long term, be more compatible with a mixed planting of other grasses and/or legumes in a hay or pasture planting has merit. However, after nine years of data and observations, 'Liso' has never been more productive than 'Lincoln', and has been less productive than 'Manchar' since 2003. Since the source of seed for 'Liso' has been difficult to obtain, efforts to collect seed from the established project will be done so that further studies can be conducted.

2007

On October 31, the plots of 'Lincoln', 'Manchar' and the mixed rows of 'Liso' were sprayed with glyphosate with an ATV mounted sprayer at the recommended label rate of application. Ample fall moisture had allowed green-up of plants, and the herbicide application should have been effective. If necessary, a reapplication will be conducted in the spring of 2008 to kill all 'Lincoln' and 'Manchar' plots. 'Liso' plots will be maintained for seed production.

According to the 1972 publication by USDA-ARS "Grass Varieties in the United States", there are two distinct sources of smooth brome, a non-spreading northern type and an aggressive, sod forming southern type. 'Liso' is definitely behaving as a non-aggressive northern type and does show promise as a dryland or mixed pasture material in the service area of UCEPC.

Project 08A210 (COPMC-T-9801-WL, COPMC-T-9802-WL, COPMC-T-9803-WL)
Maybell Bitterbrush
December – 2008
By: Dr. Gary L. Noller

Maybell Bitterbrush Project with Colorado Division of Wildlife

INTRODUCTION

The project contains three studies: COPMC-T-9801 bitterbrush re-establishment by drilling; COPMC-T-9802 bitterbrush re-establishment, caching vs. live transplants; and COPMC-T-9803 bitterbrush re-establishment with transplants in rows. On October 8, 2008, two of the three bitterbrush studies were evaluated. The evaluation involved examining tubling plants of antelope bitterbrush *Purshia tridentata* in rows and plots. The plants in the one caching plot (Replication 1, plot 7) were dead in 2008. Drilled rows (COPMC-T-9801) were **not examined** in 2008, since live plants have not been found. Additional information on methods of planting can be found in progress reports for 1998 and 1999.

It was a surprise in 2007 to find that a fire had burned almost the entire area inside the exclosure. Only a small part in the Northeast corner of the exclosure had not burned. In some places the fence posts had burned near the soil leaving the posts hanging on the wire fence. Most bitterbrush plants inside the exclosure had been affected by the fire. The effects on the plants ranged from a plant with no green leaves on October 10, 2007, to plants that had abundant green leaves. In 2008, many of the bitterbrush plants that had some green in 2007 were dead.

In 2008, cheatgrass *Bromus tectorum* was abundant with green growth. Needle-and-thread *Stipa comata,* hairy goldenaster *Heterotheca villosa,* and silver sagebrush *Artemisia cana* were present on the site with good growth since the fire. Prickly-pear cacti *Opuntia polycantha* was present and did not appear to be adversely affected by the fire.

Mulch was mostly burned leaving abundant bare soil. The sandy soil was moist to a depth of 16 inches. The exclosure fence is still in need of repair and does not prevent animals from entering the exclosure.

RESULTS

Many of the large bitterbrush stubs that had green leaves in 2007 were dead in 2008. Tubling plants in rows and plots were examined on October 8, 2008. In addition, the one cache (Replication 1, plot 7) that was found each year from 1999 to 2007 was examined in 2008 and was dead. The average height and width (in centimeters) for plants in **rows** was determined by measuring all plants in the first four rows. The average height and width (in centimeters) for plants in **plots** was determined by measuring all plants where herbicide or no herbicide was used. In 2007, the fire effect on bitterbrush plants was categorized as no green leaves (plant may be dead), 1 or 2 green leaves, few green leaves at base, moderate green leaves, or many green leaves.

COPMC-T-9801-WL
Drilled plots – (4.5 and 9.0 ft. row spacing)**:**
This study was **not evaluated** in 2008.

Project 08A210 (COPMC-T-9801-WL, COPMC-T-9802-WL, COPMC-T-9803-WL)
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COPMC-T-9802-WL
Caching:
Plots for caching and tubling (plug) plants had 36 planting sites per plot. The one plant found in 2007 was dead in 2008. Based on this project, caching is **not** a **successfu**l method for re-establishing antelope bitterbrush on this site. Caching plots where plants had not been found in the past were not examined.

Tubling plants in plots:
Height and width measurements from all plots where **herbicide** was used averaged 20.3 cm by 33.3 cm, respectively. The one plant in the plots where **no herbicide** was used was dead. Survival in plots where **herbicide** was used was 34.7% in 1999, 30.6% in 2000, 25.7% in 2001, 25.0% in 2002, 24.3% in 2003 and 2004, 23.6% in 2005 and 2006, 20.8% in 2007, and 4.9% in 2008 (Table 1). Survival in plots where **no herbicide** was used was 13.9% in 1999, 9.0% in 2000, 4.9% in 2001, 1.4% in 2002, and 0.7% in 2003, 2004, 2005, 2006, 2007 and 0.0% in 2008. The loss of bitterbrush from 35 plants in 2006 to only seven plants in 2008 (80 % loss) was primarily due to the fire in 2007 (Table 1). Fire appears to be very harmful to the bitterbrush plants that were planted in rows. However, planting tubling bitterbrush plants in plots when **herbicide** is used is a **successful** method of re-establishing antelope bitterbrush. In 2006 prior to the fire, 50% of the plants were still alive that were found in 1999. **Herbicide** is important in the initial **establishment** of bitterbrush tublings (Table 1). Fifty plants were found in 1999 when herbicide was used while only 20 plants were present when no herbicide was used. Herbicide was also important for **persistence** of tubling bitterbrush plants. The 2006 data shows that 35 of 50 plants (70.0%) were still alive when herbicide was used while only one of the 20 plants (5.0%) were still alive when no herbicide was applied. Survival of bitterbrush tublings in plots appears to be relatively stable three years (1999 - 2002) after planting (Figure 1). This study indicates that if a bitterbrush tubling can survive for three years, its chances of long term survival are good. It would also suggest, methods that improve the chances of survival for the first three years will be important for long term survival. The 2008 data indicates that fire can be very harmful to bitterbrush tublings planted in plots.

COPMC-T-9803-WL
Tubling plants in rows:
Eighteen rows of tubling antelope bitterbrush plants (716 planting sites) were examined for survival on October 8, 2008. Plants in rows averaged a height of 25.4 cm and a width of 38.2 cm. It should be noted that rows were treated with **herbicide** to reduce competition before planting. Survival in rows was 21.1% (151 plants) in 1999, 18.2% (130 plants) in 2000, 17.0% (122 plants) in 2001, 16.5% (118 plants) in 2002, 15.8% (113 plants) in 2003, 16.1% (115 plants) in 2004, and 15.9 % (114 plants) in 2005 and 2006, 13.0% (93 plants) in 2007 and 5.7 % (41 plants) in 2008 (Table 2). The loss of bitterbrush plants from 2006 (114 plants) to 2008 (41 plants), a loss of 64% was primarily due to the fire in 2007. In 2006 over 75% of the plants were found that were present in 1999. This is a **successful** method of re-establishing antelope bitterbrush on this site. Survival of bitterbrush tublings in rows also appears to be relatively stable three years (1999 - 2002) after planting (Figures 2). This study indicates that if a bitterbrush tubling can survive for the first three years, its chances of long term survival are

good. It also suggests that methods that improve the chances for survival for the first three years will be important for long term survival. The 2008 data indicated that fire can be very harmful to bitterbrush plants planted in rows.

OBSERVATIONS AND CONCLUSIONS

1. The project was evaluated on October 8, 2008, for antelope bitterbrush re-establishment.

2. Seeding (both drilling and caching) was done on October 21, 1998.

3. Antelope bitterbrush tublings were planted in plots and rows on May 6, 1999.

4. Seeding (both drilling and caching) were **not successful** methods for re-establishing antelope bitterbrush on this site at this time. Drilled plots were **not examined** in 2007 or 2008.

5. Survival of antelope bitterbrush tublings on October 8, 2008, in **plots** where herbicide was used averaged 4.9%. The one plant that had survived to 2007 when no herbicide was used was dead in 2008. The loss of plants from 2006 to 2008 (80%) in **plots** was primarily due to the fire in 2007.

6. On October 8, 2008, forty-one plants were found in **rows** which represent a survival of 5.7%. The 64% loss of plants in **rows** from 2006 (114) to 2008 (41) was primarily due to the fire in 2007.

7. The 2008 data indicates that fire is very harmful to bitterbrush tublings planted in 1999 in **plots** or **rows.**

8. Planting bitterbrush tublings in **plots** or **rows** are both successful methods of establishing bitterbrush.

9. **Herbicide** was important for the **establishment** of bitterbrush tubling (See Table 1, 1999), and for the **persistence** of the tublings over time (See Table 1, 1999 to 2006).

10. Survival of bitterbrush tublings in **plots** and **rows** did not change substantially after the first three years of the study (1999 - 2002), until the fire of 2007.

11. Methods that will improve survival for the first three years will be important for the long term survival of bitterbrush tublings.

Table 1. A listing of the number of plants found in plots treated with herbicide, no herbicide, and the total of both, from 1999 through 2008. Percent survival is also listed.

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TUBLING PLANTS IN PLOTS

Date		Number of Plants	% Survival
May 9, 1999	(Planted)	288	-
November 10, 1999	(all plants)	70	24.3
	Herbicide	50	34.7
	No herbicide	20	13.9
September 26, 2000	(all plants)	57	19.8
	Herbicide	44	30.6
	No herbicide	13	9.0
November 7, 2001	(all plants)	44	15.3
	Herbicide	37	25.7
	No herbicide	7	4.9
October 4, 2002	(all plants)	38	13.2
	Herbicide	36	25.0
	No herbicide	2	1.4
October 9, 2003	(all plants)	36	12.5
	Herbicide	35	24.3
	No herbicide	1	0.7
October 13, 2004	(all plants)	36	12.5
	Herbicide	35	24.3
	No herbicide	1	0.7
November 2, 2005	(all plants)	35	12.2
	Herbicide	34	23.6
	No Herbicide	1	0.7
November 1, 2006	(all plants)	35	12.2
	Herbicide	34	23.6
	No Herbicide	1	0.7
October 10, 2007	(all plants)	31	10.8
	Herbicide	30	20.8
	No Herbicide	1	0.7
October 8, 2008	(all plants)	7	2.4
	Herbicide	7	4.9
	No Herbicide	0	0

Table 2. A listing of the number of plants found in rows from 1999 to 2008. Percent survival is also listed.

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TUBLING PLANTS IN ROWS

Date	Number of Plants	% Survival
May 6, 1999 (Planted)	716	-
November 10, 1999	151	21.1
September 26, 2000	130	18.2
November 7, 2001	122	17.0
October 4, 2002	118	16.5
October 9, 2003	113	15.8
October 13, 2004	115	16.1
November 2, 2005	114	15.9
November 1, 2006	114	15.9
October 10, 2007	93	13.0
October 8, 2008	41	5.7

Project 08A210 (COPMC-T-9801-WL, COPMC-T-9802-WL, COPMC-T-9803-WL)
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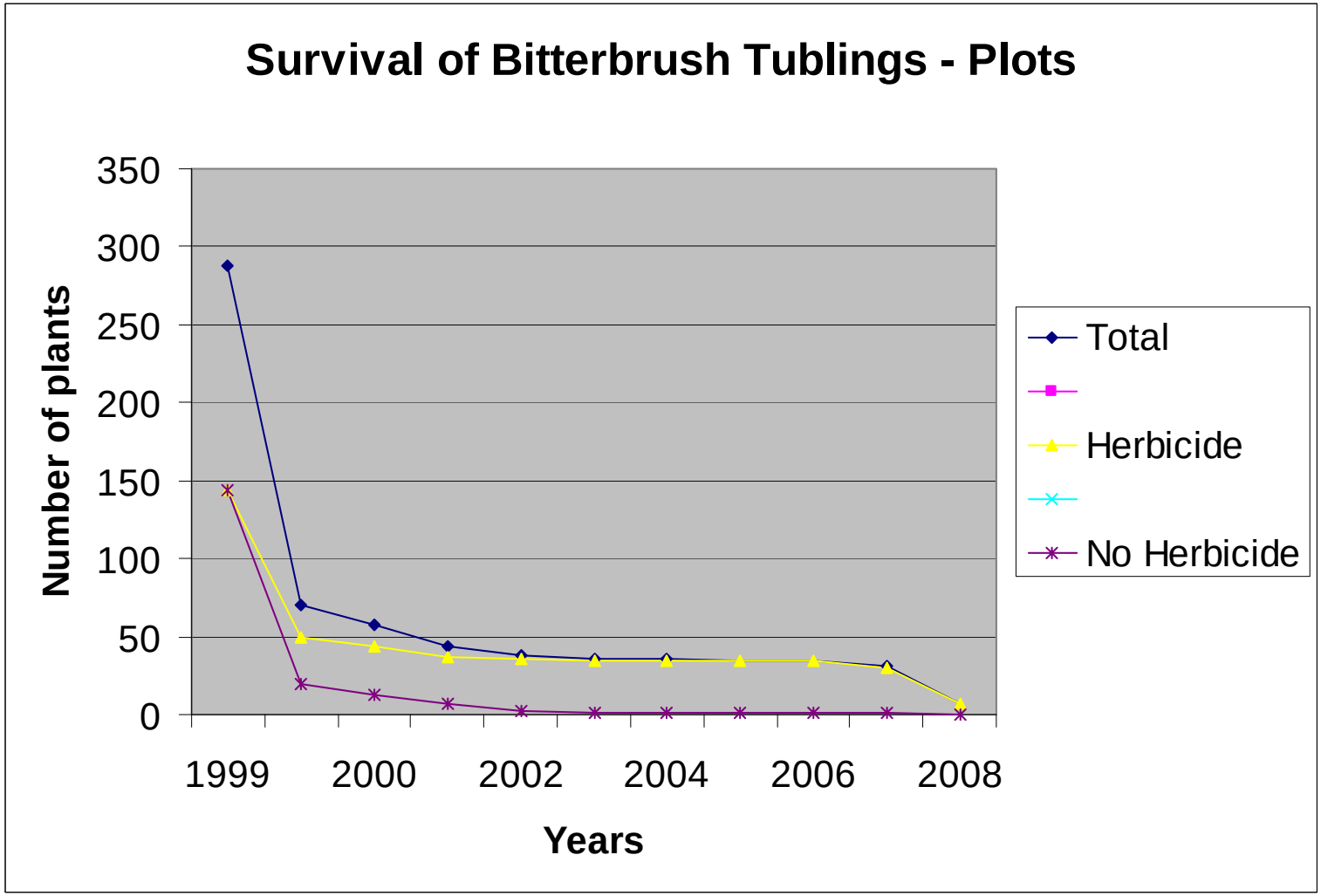

Fig. 1.
Survival of bitterbrush tublings in plots is shown. Bitterbrush tublings are shown as total plants (with and without herbicide), tublings with no herbicide, and tublings that had herbicide (Roundup Ultra at 2 quarts/Ac in a four foot strip prior to planting) to reduce competition. The figure shows that survival, three years after planting (2002), is relatively stable to 2006. A fire in 2007 reduced survival from 2006 to 2008 by 80%.

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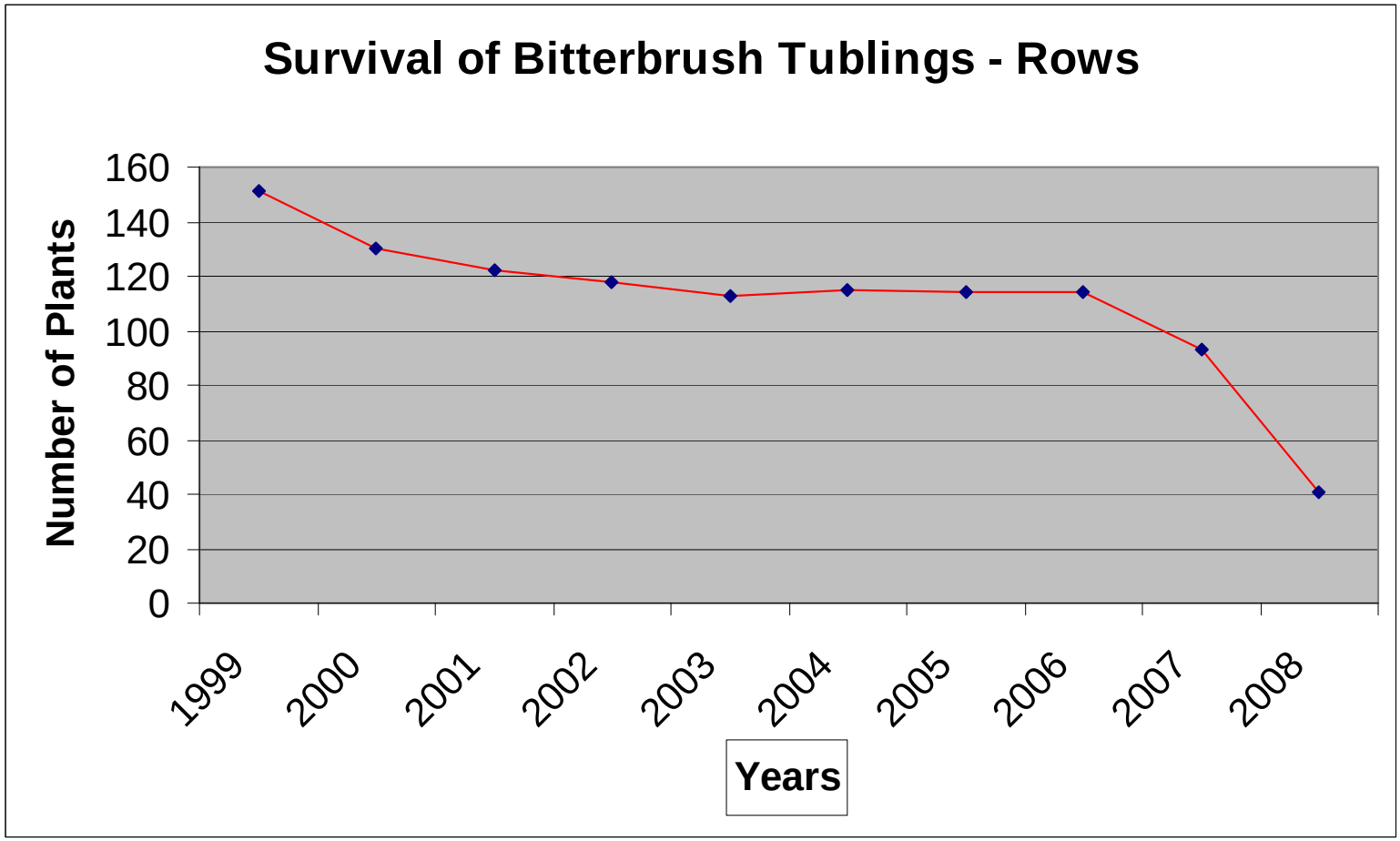

Fig. 2.
Survival of bitterbrush tublings in rows. Herbicide was applied to all rows to reduce competition. Survival three years after planting (2002), has remained relatively stable to 2006. A fire in 2007 reduced survival from 2006 to 2008 by 64%.

PROJECT 08I020J
Project Report - 2008
By: Dr. Gary L. Noller

Transplanted Woody Species - Orchard

INTRODUCTION:

The project contains 179 accessions of mostly woody tubling plant materials that were planted in fields 14 and 15 at Upper Colorado Environmental Plant Center. The plant center is characterized by a growing season of approximately 90 days, an elevation of about 6500 feet and average annual precipitation of slightly more than 16 inches. The original planting was completed on August 8, 1977. An additional planting of some woody species was done in 1981. In 2007 and 2008, certain accessions were removed from the project and those remaining were trimmed to facilitate management and weed control. Accessions remaining in the planting are those that are candidates for release or are important for plant identification purposes. The remaining accessions are listed in Table 1. Each accession is identified as to the field (14 or 15) where they grow, accession numbers (old and new), common and scientific names.

Table 1. A listing of plant accession for materials remaining in fields 14 and 15 on the plant center.

Accession Numbers		Common Name	Scientific Name
Old No.	**New No.**		
Field 14.			
154	9021438 (Released)	Utah serviceberry	*Amelanchier utahensis*
224	9021442	Saskatoon serviceberry	*Amelanchier alnifolia*
229	9024060	Chokecherry	*Prunus virginiana*
174	9024059	Chokecherry	*Prunus virginiana*
476	9008027	Silver buffaloberry	*Shepherdia argentea*
634	9024115	Utah honeysuckle	*Lonicera utahensis* (3)
635	9030476	Utah honeysuckle	*Lonicera utahensis* (15 & 18)
337	9030913	Golden currant	*Ribes aureum*
372	9024288	Wax currant	*Ribes cereum*
529	9024289	Wax currant	*Ribes cereum*
232	9015840	River hawthorn	*Crataegus rivularis*
459	9024181	Hawthorn	*Crataegus spp.*
698	9021435	Rocky Mountain Maple	*Acer glabrum*
615	9024147	Singleleaf ash	*Fraxinus anomala*
155	9024145	Singleleaf ash	*Fraxinus anomala*
?	?	Gooseberry	*Ribes spp.*
398	9024230	Littleleaf mountain mahogany	*Cercocarpus intricatus*
708	9024111	Bearberry honeysuckle	*Lonicera involucrate*
779	9040106	Snowberry	*Symphoricarpos spp.*
287	9030911	Shrubby cinquefoil	*Potentilla fruticosa*
702	9024235	Curl-leaf mountain mahogany	*Cercocarpus ledifolius*

PROJECT 08I020J
Project Report - 2008
By: Dr. Gary L. Noller

Accession Numbers		Common Name	Scientific Name
Old No.	**New No.**		
Field 15.			
1097	9024220	Red barberry	*Berberis haematocarpa*
365	9024219	Barberry	*Berberis fendleri*
701	9024200	Utah juniper	*Juniperus utahensis*
208	9024313	Utah juniper	*Juniperus utahensis*
209	9024314	Utah juniper	*Juniperus utahensis*
275	9024158	Common juniper	*Juniperus communis*
881	9024312	Common juniper	*Juniperus communis*
461	9007948	Squaw-apple	*Peraphyllum ramosissimum*
631	9024285	Squaw-apple	*Peraphyllum ramosissimum*
580	9024141	Apache-plume	*Fallugia paradoxa*
353	9024096	Littleleaf mock orange	*Philadelphus microphyllus*
469	9024308	Buckthorn	*Rhamnus smithii*
376	9007949	Mountain ninebark	*Physocarpus monogynus*
436	9024154	Bush oceanspray	*Holodiscus dumosus*
579	9024155	Bush oceanspray	*Holodiscus dumosus*
456	9024143	Cliff fendlerbush	*Fendlera rupicola*
254	9024222	Creeping barberry	*Berberis repens*
227	9007990	Skunkbush sumac	*Rhus trilobata*
664	9007993	Skunkbush sumac	*Rhus trilobata*

Note: Plant 3, 15, and 18 are identified in Utah honeysuckle for resistance to witches broom aphids.

Project 08S078Z
Report-2008
By: Heather Plumb

Seed Increase of 9021438, Long Ridge Utah Serviceberry

INTRODUCTION

Amelanchier alnifolia is a native shrub found in the Northern Great Plains and Northern Rocky Mountain Regions. It is deciduous with numerous erect stems. The stems and twigs are dark gray to reddish brown. Leaves are ovate with dentate margins and are alternate along the stems. Inflorescences are a showy white and the fruit is a small, red to dark purple pome. The flowers and fruits are in terminal clusters. Each fruit can contain from 4 to 10 seeds, some of which might be infertile. The shrub is a long lived, relatively slow growing and can reproduce by seed or root sprouts. Seeds are dormant and require cold moist stratification to break dormancy. Viability of seeds is good and it has been reported to remain viable for up to 10 years or more. Accession 9021438 was collected in 1975 from Long Ridge near Parachute Creek in Garfield County, Colorado, at an elevation of about 8100 ft. It has good vigor, foliage production, survival, with an upright growth form and almost no root sprouts.

In 2005, plant samples were sent to Colorado State University for identification of accession 9021438 of serviceberry in preparation for its future release. Colorado State University identified the accession as *Amelanchier utahensis* not *Amelanchier alnifolia.* In 2007 plant specimens of accession 9021438 were sent to the Intermountain Herbarium at Utah State University. The Herbarium at Utah State University confirmed Colorado State University's original identification of *Amelanchier utahensis.* This correction was noted by the Upper Colorado Environmental Plant Center and the identification of accession 9021438, *Amelanchier alnifolia* was changed to *Amelanchier utahensis*. The accession 9021438, *Amelanchier utahensis*, was released as "Long Ridge" in 2008 by the UCEPC. *Amelanchier utahensis,* Utah serviceberry, differs from Saskatoon serviceberry in that it generally occupies drier sites and berries persist longer on the bush. The berries provide a food source over a longer period of time, especially when the ground may be covered with snow. Considerable variation occurs when it is found on sites with Saskatoon serviceberry where natural hybrids are sometimes found.

OBJECTIVE

To release accession 9021438, *Amelanchier utahensis*, to the public and to produce seed for additional testing in the future.

MATERIALS & METHODS

Accession 9021438 was a selection from the original nursery planted at the UCEPC on August 8, 1977. The accession was selected as a superior performer from among 14 different accessions of serviceberry.

On May 19, 1984, the accession was planted in field 3 at the UCEPC. Container-grown plants from the greenhouse were transplanted by hand and spaced 15 ft apart in one row. Two of the

plants died and were replaced in 1986. The planting receives no supplemental water. Seed from accession 9021438 has been hand harvested by the UCEPC staff.

RESULTS

The planting was evaluated from 1985 to 1992. Information for these evaluations can be found in the respective reports for those years at the UCEPC. Seed for accession 9021438 has been collected from the project since 1993. In Seed production is listed in the following table:

Seed Collected from Accession 9021438 in field 3, at the UCEPC, during the years of 1993-2008.

Year	Harvested-Acres	Harvest Date	Clean Seed lb
1993	0.25		2.88
1994	0.25		0.88
1995	0.25		1.77
1996	0.25	No harvest	
1997	0.25		0.29
1998	0.25	30-Jul	0.18
1999	0.25	No harvest	
2000	0.25	7/20 – 8/9	0.62
2001	0.25	No harvest	
2002	0.25	No harvest	
2003	0.25	7/10 - 8/13	2.64
2004	0.25	No harvest	
2005	0.25	1/6/2006	0.8
2006	0.25	No harvest	
2007	0.25	7-Aug	1
2008	0.25	August	0.97

The accession 9021438, *Amelanchier utahensis*, was released as “Long Ridge” in 2008 by the UCEPC. Long Ridge has the potential to be use in critical area stabilization, mined land reclamation, range and wildlife habitat improvement plantings, as a living snow fence, and in xeriscape plantings.

PROJECT 08S213
Report - 2008
By: Steve Parr

Seed Increase of 9043501 Salina Wildrye *Leymus salinus*

OBJECTIVE

To increase seed (pre-cultivar with seed increase and technology development) for foundation material as well as field plantings, Off-Center trials, and Inter-Center Strain Trials

INTRODUCTION

Salina wildrye has been identified as one of the most important grasses native to the Upper Colorado Region. It has been rated by the Upper Colorado Environmental Plant Center (UCEPC) Advisory Committee as a high priority for coal mined lands, roadside stabilization, surface disturbed areas, and areas of heavy use.

Harrington, 1954, lists *Leymus ambiguus* (Colorado wildrye) and *Leymus salinus* (Salina wildrye) as occurring 5200 to 8500 feet in elevation primarily in central and northwestern Colorado. Both species are perennial, cool-season bunchgrasses with culms standing between 30 to 50 cm. tall. *Leymus ambiguus* is often found on open slopes, canyons, and rocky hillsides in Colorado, Montana, and Utah. *Leymus salinus* is found on rocky slopes, sagebrush hills, and saline soils in Wyoming, Idaho, Utah, Arizona, and Colorado.

The Soil Conservation Service range site manual lists *Leymus salinus* as a component of shale sites in Utah, often associated with Pinyon-Juniper or mountain brush in 15-inch precipitation zones. Colorado range sites with *Leymus salinus* are described as clayey slopes, clayey salt desert, and semi-desert loams above l2 inches of precipitation.

Leymus salinus was described by Dr. Kay Assay, ARS, Logan, UT, as actively hybridizing with other wildryes. The hybrid from this crossing is sterile. The species is wind pollinated. In general, the species is weak to establish and tends to produce poor quality seed that has some inherent dormancies. However, once established, the species tends to be very persistent and vigorous.

Over a five year period (1987 - 1992), accession 9043501 was consistently evaluated as superior in UCEPC Initial Evaluation 08I114. Project 08I114 consisted of five randomized replications, each of which contained five plants per accession of 31 accessions. 'Prairieland' *Leymus angustus* (altai wildrye) was included in the trial for comparison. In 1994, Project 08I114 was removed from UCEPC.

In addition to the field trial, a germination trial was conducted in 1987 at UCEPC for 38 accessions of *Leymus salinus.* In general, 50% of the seed from filled lots germinated within two days after being removed from a 20-day stratification period and being placed in the germinator.

An Advanced Evaluation for *Leymus salinus,* 08Al58, was installed by UCEPC in 1987. One block of 12 plants per accession was established in Field 25 using 27 accessions. Forage tendencies, as well as general notes concerning vigor, were taken for the planting from 1987 to

1992. Similar to the Initial Evaluation accession 9043501 was judged to be superior. Evaluation 08A158 was removed in 1994 from UCEPC.

As result of its superior performance in the Initial and Advanced Evaluations, a seed and plant increase for accession 9043501 was initiated in 1993 and 1994. In addition, in 1993 vegetative samples for the accession were sent to Utah State University for species confirmation. It was determined that accession 9043501 represents *Leymus salinus.*

METHODS

In 1993, a 0.10 acre increase field for accession 9043501 was established by seed in the UCEPC Headquarters Nursery utilizing seed from the original Kaiser Steel of Price, UT, and a Planet Junior. Although establishment has been slow, the planting has filled in quite nicely from residual germination.

In 1994, culms were lifted from the UCEPC Field 25 08I114 and 08A158 plantings and established in Field 4. Survival for the transplanted culms appears to have been 100%. Plants were established on three-foot centers. Either seed, or perhaps, the plants themselves, will be planted/transplanted from the headquarters nursery to Field 4 in 1995.

In 2004, a new planting was conducted on July 29, 2004. Four rows (or 0.13 acre) were planted with a hand pushed Planet Junior. Additional treatments for 2005 included a spring burn and an herbicide treatment to open up spaces between established plants.

RESULTS

No appreciable seed has been harvested to date from either the breeder or foundation fields. Seed production records are provided in Table 1, from the initiation of the seed increase project to present. Since seed production has been poor for this accession, alternative cultural management practices will be investigated over several years to find out if seed production can be increased.

PROJECT 08S213
Report - 2008
By: Steve Parr

Table 1. Seed Production Records of Two Salina Wildrye Fields at UCEPC. Accession No. 9043501 Project No. 08S213.

Year	Acres	Harvest Date	Field No.	Cleaned Weight	
1996	0.02	7/22	Hqts.	154.00	g
1996	0.10(B)	7/22	4	631.00	g
1996	0.20(F)	Planted	4	No harvest	
1997	0.02	Field plowed	Hqts.	No harvest	
1997	0.10(B)	7/21	4	2.96	lb
1997	0.20(F)	7/21	4	5.32	lb
1998	0.10(B)	8/4	4	4.00	lb
1998	0.20(F)	8/4	4	9.00	lb
1999	0.10(B)	7/15	4	22.00	g
1999	0.20(F)	7/15	4	32.00	g
2000	0.10(B)	No harvest	4	--	
2000	0.20(F)	7/7	4	6.00	g
2001	0.20(F)	7/9	4	174.00	g
2001	0.10(B)	7/9	4	227.00	g
2002	0.10(B)	7/11	4	7.00	g
2002	0.20(F)	7/11	4	23.00	g
2003	0.10(B)	7/9	4	1.69	lb
2003	0.20	7/9	4	0.60	lb
2004	0.10(B)	7/9	4	19.00	g
2004	0.20(F)	7/9	4	146.00	g
2004	0.13	New planting	4	No harvest	
2005	0.13	New planting	4	No harvest	
2005	0.10(B)	7/13	4	1.4	lb
2005	0.20(F)	7/13	4	302	g
2006	0.10 (B)	7/12	4	2	g
2006	0.30 (F)	7/13	4	7	g
2006	0.13(F-2)	7/13	4	76	g
2007	0.10 (B)	7/13	4	296	g
2007	0.30(F-2)	7/11	4	5.5	lb
2008	0.10 (B)	7/28	4	1.17	lb
2008	0.30 (F)	7/28	4	1.27	lb

* B=Breeder field, F = Foundation field, F-2 = Foundation field second planting

In spring of 2005, two sections of the foundation field were chosen to conduct some preliminary testing to enhance seed production. A west section block, approximately 20 x 18 ft, was treated with herbicide-Round-Up, and an east block about 120 x 18 ft was burned with a torch. The purpose of the **herbicide treatment was** to thin out some of the old stand and get spaced plants at about 3 x 3 ft in contrast to an existing crowded solid row of plants. The **burning treatment** was to determine if invigorating the plants by burning and getting rid of old plant material (thatch) might also induce better seed production. The herbicide Round-Up was applied May 9, 2005, at the rate of 1-quart /25 gallons of water (1% solution).

PROJECT 08S213
Report - 2008
By: Steve Parr

Evaluations for 2005: On June 7, 2005, **the herbicide** section was evaluated. Round-up worked very well leaving spaced grass bunches at about 3 x 3 ft as expected, however, no seed set difference was observed between the treated and untreated plants, perhaps because the treatment was done when the plants had already spent a lot of energy in spring growth. The **burned area** showed a more vigorous re-growth after the burning, and also did an excellent job of getting rid of dead plant material. However, no difference in seed set was observed between unburned and burned plants. Burned plants did however, look greener and healthier.

Evaluations for 2006: Breeder and foundation fields were harvested during July 12-13. See Table 1 for amount of seed harvested. The new planting done on July 29, 2004, produced the most seed in 2006, and we hope seed production will be better in 2007, since the planting is new and plants are not crowded yet. The section that was treated with herbicide had more seed heads than the un-sprayed section, however, seed fill was poor. This might indicate that the salina wildrye might need plenty of space to get into the reproductive mode. The same trend was observed in the new planting, plants that had more ground available had more seed heads. The next step is to set up a trial to compare space plants versus solid row planting to determine if lack of space is what has been hindering seed production in this accession of salina wildrye.

Evaluations for 2007: Substantial differences were noted on the "foundation" field plantings. The old planting had very few seed heads, and most of those were again on the most southern row (next to fallow ground), but are very likely the result of snow accumulation from southwest prevailing winds; and hence, much more early spring moisture. The new planting, however, had abundant seed heads. This year represented the second highest seed production for salina wildrye, and only four rows contributed any appreciable seed. In essence, each row produced approximately 1.25 pounds of clean seed. In addition, the field was swathed and picked up by hand. This harvest method very likely resulted in reduced seed capture compared to direct combining.

2008: A disappointing seed harvest was realized with both the Breeder and Foundation portions of the salina wildrye project this year. The low seed yield is preventing the release of an otherwise very much needed conservation plant for the central Rocky Mountains and Colorado Plateau. Because of the unknown yield information on this product, a new spaced planting project, COPMC-T-0802-RA, was initiated this year to determine optimal spacing for seed yield. Plans are to again spray out sections of the foundation field to improve seed yield in 2009 and beyond.

CONCLUSIONS

Unquestionably, the younger seed field with less crowded plants, and possibly greater vigor, produce substantially more seed than the older portion of the field. Whether the improved production is a result of a younger field, less crowding among individual plants and roots, or a combination of both, will be investigated with the design of future salina wildrye studies.

Project COPMC-F-0202-OT
Report-2008
By: Terri Blanke

Inter-Center Planting of Sweetgrass

OBJECTIVE

To compare and evaluate regionally collected *S*weetgrass, *Hierochloe odorata,* as a culturally significant plant.

INTRODUCTION

Four Northern Plains Region Plant Material Centers compared six sources of Sweetgrass: Accession 9039770, 9050243, 9070225, 9063351, 9063128, and South Dakota Radora. The variety 'Radora' was used as the standard variety for comparison. The information obtained was to be used to evaluate genetic variability and recommend potential areas of adaptation for local collections.

EXPERIMENTAL DESIGN

Initial evaluation in rod rows, ten plants per row.

MATERIALS & METHODS

Each PMC exchanged a minimum of ten potted (or cone-tainerized) sweetgrass plants of their local plant material. Bismarck PMC provided ten plants of 'Radora' sweetgrass. Materials were shipped May 15, 2002, (approx.).

Notes on initial establishment at the Colorado PMC are recorded in the 2002 Annual Technical Report.

In June of 2006, five collections of sweetgrass, South Dakota, Montana, North Dakota, Kansas, and Colorado were hand dug, soaked and separated. The individual collections' roots were covered with moist sphagnum moss to prevent drying out, rolled in damp newspaper and finally sealed in a plastic bag. They were then shipped to Vicki L. Bradley, Agronomy Curator at the Western Regional Plant Introduction Station in Pullman, Washington. These accessions were supplied for germplasm storage.

RESULTS

Plot design, initial evaluation, follow-up evaluation and discussion are in the 2003 Annual Technical Report. An evaluation was performed in September of 2007 by Dr. Gary Noller and Terri Blanke. Neither plot has been cultivated for two years. The sweetgrass has competition from several weed varieties, mostly Canada thistle. The sweetgrass receives ditch water that is applied with a sprinkler system about twice per summer. Approximately one gram of seed was harvested and cleaned from the headquarters plot on September 12, 2007. In May of 2008, the Northern plot was watered heavily and hand weeded. The South plot was cut with a lawn mower to test viability for lawn purposes. On June 19, 2008, Heather Plumb dug several plants from the

Project COPMC-F-0202-OT
Report-2008
By: Terri Blanke

North plot between the Kansas and North Dakota rows. Those plants were given to Debbie Clairmont a Soil Conservationist from Brighton, Colorado. Debbie is a Native American hoping to grow and increase the ceremonial material for her own uses. On August 27, 2008, there was 3.0 grams of seed collected from all accessions. Some seed was green, but most was mature. The table below shows the evaluation and results after 5 years.

SWEETGRASS EVALUATION
Five year performance of six regional sources of Sweetgrass *Hierochloe odorata* in headquarters at Upper Colorado Environmental Plant Center

E
N + S
W

September 12, 2007
Block 1

Accession	*Survival*†	*Vigor*†	*Seed Culms*†	*Leaf Height*	*Weed Suppression*†	*Overall Rating*†
South Dakota 'Radora'	1	3	3	24”	3	3
Michigan 9070225	3	1	1	26”	3	3
Montana 9063351	5	3	3	22”	5	5
North Dakota 9063128	5	3	5	20”	5	5
Kansas 9050243	1	1	3	25”	1	1
Colorado 9070988	3	3	7	23”	1	3

†Ratings : 1-excellent, 3-good, 5-fair, 7 poor, 9-none.

Block 2

Accession	*Survival*†	*Vigor*†	*Seed Culms*†	*Leaf Height*	*Lack of Weeds*†	*Overall Rating*†
Michigan 9070225	1	1	1	31”	5	1
Montana 9063351	5	5	5	24”	5	5
Kansas 9050243	5	5	5	24”	1	5
North Dakota 9063128	5	5	3	21”	3	5

Colorado 9070988	7	5	5	21”	5	5
South Dakota 'Radora'	1	1	7	26”	3	3

†Ratings : 1-excellent, 3-good, 5-fair, 7 poor, 9-none.

CONCLUSION

Generally, survival was excellent. The plots did not receive much attention. The East and West sides of the plots have edge effect. Phenotypic characteristics are still not evident. Canada thistle is invading the Michigan sweetgrass along the East edge of block 2, but it continues to survive.

Project COPMC-F-0504-PA
Report 2008
Report by: Heather Plumb

False Quackgrass Performance Trial

INTRODUCTION

Native, perennial, drought adapted, palatable species are high on the list of desirable products for land owners as well as land managers. In 2001, landowner Lynn Bower, from Moffat County, Colorado, brought samples of a grass he said his horses particularly preferred when grazing a specific pasture. He also indicated that his father had noted the same behavior in the same pasture on the same ranch many, many, years before passing along his observation. Mr. Bower wanted to find out what species he had that his horses found so palatable and if the Plant Center was interested in increasing, observing or otherwise working with this plant. He also told Upper Colorado Environmental Plant Center (UCEPC) that his father called it "false quackgrass". Dr. Gary Noller, UCEPC Senior Scientist at the time, and Steve Parr, UCEPC Manager, identified taxonomically that the specimen Lynn brought to us was indeed "false quackgrass". Neither Dr. Noller nor Steve Parr had any familiarity with the species whatsoever, so the project was not initially a high priority. Mr. Bower invited UCEPC staff out to his place to collect some "false quackgrass" specimens. Three years later, in the fall of 2004, UCEPC personnel collected sods from Lynn's place and transplanted individual plugs in a spaced planting and a single row in November 2004.

OBJECTIVE

The objective of the project is to evaluate the potential for the material to be used in pasture renovation, riparian enhancement, and also livestock and wildlife habitat improvement projects through the use of transplants or seed.

METHODS

Individual plugs were separated from sod collected at Lynn Bower's ranch in Moffat County. Plugs were planted approximately one foot apart in rows approximately 15 feet long. A single row on the south end of the plot was plugged without spacing. No supplemental water has been added to the project and plots have been maintained weed free.

In the fall of 2007, harvested seed was sent to Dr. Richard Wang, ARS Logan, Utah, to identify species from root tip chromosome counts. Earlier, we had Dr. Mary Barkworth, Utah State University Herbarium Curator, identify our specimen. Her taxonomic attempts were inconclusive, and suggested we contact Dr. Wang. Dr. Barkworth felt the specimen was possibly a hybrid because it is rhizomatous which, besides *E. pseudorepens,* places it into one of three possible species for consideration; *Elymus repens, E. lanceolatus,* or *Pascopyrum smithii.* She did not feel it was conclusively any of the four. Because the tribe hybridizes readily, she suggested we have the chromosome number identified. *E. repens* is a hexaploid while *E. albicans* is a tetraploid. She also felt *E. pseudorepens* was very likely a tetraploid, but did not confirm that.

Project COPMC-F-0504-PA
Report 2008
Report by: Heather Plumb

2008

The "false quackgrass" seed from the plots at UCEPC was harvested and sent to Dr. Wang for a root tip chromosome count.

> Steve,
>
> I was able to count the chromosome number for your plant, even though the chromosomes were too long and curvy for karyotype analysis. The species is a hexaploid with 42 chromosomes.
>
> Richard Wang, Ph.D.
> Research Geneticist
> USDA-ARS-NPA-FRRL
> 695 N 1100 E
> Logan, UT 84322-6300
> Phone: 435-797-3222
> FAX: 435-797-3075
> e-mail: Richard.Wang@ars.usda.gov

RESULTS

The material sent to Dr. Wang came back as a hexaploid. The material we sent to Dr. Barkworth and to Dr. Wang is not the same material that Dr. Noller and Steve Parr identified. The original specimen of false quackgrass collected by the UCEPC staff had no awns, and the original specimen remains at the center. The plants growing in our plots at the center are awned. Because there were no seed heads at the time to identify the sod that was transplanted, we very likely transplanted a separate species.

CONCLUSION

False quackgrass is a native species in Colorado and has many desirable attributes for plant development. Quackgrass, on the other hand, is an aggressive, non-native weedy grass with undesirable characteristics. According to Dr. Wang and Dr. Barkworth, our products in the plots at UCEPC are not false quackgrass. In 2009, a collection trip will be planned to Lynn Bower's property for further collecting of the "false quackgrass" sod. On this site visit, UCEPC staff will collect only headed out grass specimens. This will help prevent collecting the wrong grass species again. New collection specimens will be sent in for testing to Dr. Barkworth and to Dr. Wang.

Project COPMC-F-0505-PA
Report-2008
By: Manuel Rosales

Boulder County Open Space Demo

OBJECTIVE

To demonstrate to land owners, land managers, and area Field Office employees some of the attributes of various selected plant materials

INTRODUCTION

Boulder County, Colorado, has an area of 753 square miles with 475,000 acres. The terrain in Boulder County is very diverse, including: plains, foothills grasslands, forest montane, and alpine zones. This demonstrational planting was set up in cooperation with Boulder County Parks & Open Space, Longmont USDA-NRCS Field Office, Longmont and Boulder County Conservation Districts, Colorado State University Boulder Extension Service, and the Arkansas Valley, and Pawnee Buttes Seed companies. The purpose of the planting is to demonstrate the potential of a variety of native grasses and some introduced grasses for Pasture and Hayland purposes as well as for other uses such as Prairie restoration, prevention of noxious weeds, xeriscaping, etc., in Boulder County and nearby counties in Colorado. The Planting will also be used for educational purposes.

EXPERIMENTAL DESIGN

This is a non replicated planting.

MATERIALS & METHODS

A total of 65 entries were seeded on March 7-9, 2005: Fifty-seven single grass species (41 native & 16 non-native), six grass-mixtures, and one legume (planted at two seeding rates). The seeder was a 16-row FLEX-II Truax. Rows were spaced about 7.5 inches apart. The plot size is 20 x 100 ft with 32 rows per plot (2000 square feet). The rate of seeding was based on the recommended Pure Live Seed rate/acre per species. Small and fluffy seeded grasses were enhanced with number-1 rice hulls to provide a better flow through the drill. The site is located on Boulder County land north of Denver. The planting will be maintained as dry-land.

A list of all the entries is presented in the following table:

Table 1. List of 65 entries for the demonstrational planting

Entry #	Cultivar/Release or Accession #	Common Name	Scientific Name	Seed Source
Single Grass Species				
1	Cheyenne	Indiangrass (ws)**	*Sorghastrum nutans*	Arkansas Valley Seed Co
2	9005439	Switchgrass (ws)	*Panicum virgatum*	Bridger, PMC
3	Dacotah	Switchgrass ((ws)	*Panicum virgatum*	Bismarck, PMC

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Report-2008
By: Manuel Rosales

Entry #	Cultivar/Release or Accession #	Common Name	Scientific Name	Seed Source
4	Kaw	Big Bluestem (ws)	*Andropagon geradii*	Arkansas Valley Seed Co
5	Bonilla	Big Bluestem(ws)	*Andropagon gerardii*	Bismarck, PMC
6	Pawnee	Big Bluestem(ws)	*Andropagon gerardii*	Arkansas Valley Seed Co?
7	Lodorm	Green needlegrass	*Nasella viridula*	Bismarck, PMC
8	Aldous	Little bluestem (ws)	*Schyzachyrium scoparium*	Arkansas Valley Seed Co
9	Camper	Little bluestem (ws)	*Schyzachyrium scoparium*	Arkansas Valley Seed Co
10	Pastura	Little bluestem (ws)	*Schyzachyrium scoparium*	Arkansas Valley Seed Co
11	Niner	Side oats grama (ws)	*Bouteloua curtipendula*	Los Lunas, PMC
12	BSOG-02B	Side oats grama (ws)	*Bouteloua curtipendula*	
13	El Reno	Side oats grama (ws)	*Bouteloua curtipendula*	Manhattan, PMC
14	Hachita	Side oats grama (ws)	*Bouteloua curtipendula*	Los Lunas, PMC
15	Bad river	Side oats grama (ws)	*Bouteloua curtipendula*	Bismarck, PMC
16	Lovington	Side oats grama(ws)	*Bouteloua curtipendula*	Los Lunas, PMC
17	Texoca	Buffalograss (ws)	*Buchloe dactyloides*	Arkansas Valley Seed Co
18	Viva	Galleta grass(ws)	*Peuraphis jamesii*	Los Lunas, PMC
19	9092261	Prairie Junegrass (cs)	*Koelaria macrantha*	Meeker, PMC
20	Covar	Sheep fescue (cs)	*Festuca ovina*	Arkansas Valley Seed Co
21	Redondo	Arizona fescue (cs)	*Festuca arizonica*	Meeker, PMC
22	Sherman	Big bluegrass (ws)	*Poa secunda*	Arkansas Valley Seed Co
23	Rimrock	Indian ricegrass (cs)	*Achnatherum hymenoides*	Bridger, PMC
24	Paloma	Indian ricegrass (cs)	*Achnatherum hymenoides*	Los Lunas, PMC
25	Tusas	Squirretail (cs)	*Elymus elymoides*	Los Lunas, PMC
26	San Luis	Slender wheatgrass (cs)	*Elymus trachycaulus*	Meeker, PMC
27	Pryor	Slender wheatgrass (cs)	*Elymus trachycaulus*	Bridger, PMC
28	Volga	Mammoth wildrye (cs)	*Leymus racemosus*	Meeker, PMC
29	UNIDENTIFIED	Needle & thread (cs)	*Hesperostipa comata*	Arkansas Valley Seed Co
30	Climax	Timothy (cs)	*Phleum pratense*	Arkansas Valley Seed Co
31	Paiute	Orchard grass(cs)	*Dactylis glomerata*	Aberdeen, PMC
32	Renegade	Orchard grass (cs)	*Dactylis glomerata*	Arkansas Valley Seed Co.
33	Salado	Alkali sacaton (ws)	*Sporobolus airoides*	Los Lunas, PMC
34	Fawn	Tall fescue (cs)	*Festuca arundinacea*	Arkansas Valley Seed Co.
35	Trailhead	Basin wildrye (cs)	*Leymus cinerus*	Bridger, PMC
36	Magnar	Basin wildrye (cs)	*Leymus cinerus*	Aberdeen, PMC

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Entry #	Cultivar/Release or Accession #	Common Name	Scientific Name	Seed Source
37	Garnet	Mountain brome (cs)	*Bromus marginatus*	Meeker, PMC
38	UNIDENTIFIED	Nodding brome (cs)	*Bromus anomalus*	Arkansas Valley Seed Co.
39	Regar	Meadow brome cs)	*Bromus erectus*	Aberdeen, PMC
40	Manchar	Smooth brome (cs)	*Bromus inermis*	Arkansas Valley Seed Co.
41	Critana	Streambank wheatgrass (cs)	*Elymus lanceolatus*	Bridger, PMC
42	Bannock	Streambank wheatgrass cs)	*Elymus lanceolatus*	Aberdeen, PMC
43	Goldar	Bluebunch wheatgrass (cs)	*Pseudorogneria spicata*	Aberdeen, PMC
44	Anatone	Bluebunch wheatgrass (cs)	*Pseudorogneria spicata*	Aberdeen, PMC
45	Luna	Pubescent wheatgrass cs)	*Thinopyrum intermedium*	Meeker, PMC
46	Rush	Intermediate wheatgrass(cs)	*Thinopyrum intermedium*	Aberdeen, PMC
47	Arriba	Western wheatgrass(cs)	*Pascopyrum smithii*	Meeker, PMC
48	Rosana	Western wheatgrass(cs)	*Pascopyrum smithii*	Bridger, PMC
49	Sodar	Streambank wheatgras(cs)s	*Elymus lanceolatus*	Aberdeen, PMC
50	UNIDENTIFIED?	Tufted hairgrass (cs)	*Deschampia caespitosa*	Arkansas Valley Seed Co.
51	Jose	Tall wheatgrass cs)	*Thinopyrum ponticum*	Los Lunas, PMC
52	Mandan	Canada wildrye (cs)	*Elymus canadensis*	Bismarck, PMC
53	Bozoisky-select	Russian wildrye cs)	*Psathyrostachys juncea*	Bridger, PMC
54	Newhy	Hybrid wheatgrass cs)	*Elymus hoffmanii*	Aberdeen, PMC
55	Douglas	Crested wheatgrass (cs)	*Agropyron cristatum*	Aberdeen, PMC
56	Hycrest	Crested wheatgrass (cs)	*Agropyron cristatum X desorturum*	Aberdeen, PMC
57	Ephraim	Crested wheatgrass (cs)	*Agropyron cristatum*	Aberdeen, PMC
	Grass-Mixtures			
58	Rocky Mountain. Native mix	Mix-1* See entries below		Arkansas Valley Seed Co.
59	Aggressive dryland mix	Mix-2* See entries below		Pawnee Butte Seed Co.
60	Low grow mix	Mix-3* See entries below		Arkansas Valley Seed Co.
61	Dryland mix	Mix-4*-See entries below		Arkansas Valley Seed Co.
62	Boulder NRCS-mix-Regular	Mix-5*-See entries below		
63	Boulder NRCS-mix-heavy	Mix-6*-See entries below		
	Legume			
64	Medic-@ 14.2 lb/ac	Medic	*Medicago spp.*	CSU Ext. Service
65	Medic @ 29.1 lb/ac	Medic	*Medicago spp*	CSU Ext. Service

Entries for Grass-Mixtures				
Mix-1*	**Mix-2***	**Mix -3***	**Mix-4***	**Mix-5/6***
Slender wheatgrass	Green needle grass	Crested wheatgrass	Crested Wheatgrass-Hycrest	Pubescent wheatgrass
Slender wheatgrass	Slender wheatgrass	Perennial rye grass	Smooth brome-Lincoln	Smooth brome
Thickspike wheatgrass	Slender wheatgrass	Blue fescue	Wild rye-Bozoisky	
Buffalograss	Pubescent wheatgrass	Canada bluegrass	Tetraploid PER	
Blue gramma	Intermediate wheatgrass	Chewing fescue	Orchard grass-Renegade	
Big bluestem			Intermediate wheatgrass-Oahe	
Arizona fescue-Sherman-				

** (ws) = warm season grass; (cs) = cool season grass

RESULTS, ACCOMPLISHMENTS & OBSERVATIONS

Growing Season of 2005

During the summer of 2005, most of the plots were sprayed with herbicide Round-up to control emerging weeds. All plots were mowed to control Kochia weed *Kochia scoparia*. Plant establishment was evaluated during summer-2005. Results are presented in Table-2.

Table 2. Plant stand for 65 entries four month after planting.
Boulder County Open Space Demo-Summer-2005

Entry #	Cultivar/Release or accession #	Common Name	Scientific Name	Plant Stand*
Single Grass Species				
1	UNIDENTIFIED?	Nodding brome	*Bromus anomalus*	5
2	Regar	Meadow brome	*Bromus erectus*	5
3	Garnet	Mountain brome	*Bromus marginatus*	5
4	Paiute	Orchard grass	*Dactylis glomerata*	5
5	Renegade	Orchard grass	*Dactylis glomerata*	5
6	Fawn	Tall fescue	*Festuca arundinacea*	5
7	Paloma	Indian ricegrass	*Achnatherum hymenoides*	4
8	Douglas	Crested wheatgrass	*Agropyron cristatum*	4
9	Hycrest	Crested wheatgrass	*Agropyron cristatum X desorturum*	4
10	Manchar	Smooth brome	*Bromus inermis*	4

Project COPMC-F-0505-PA
Report-2008
By: Manuel Rosales

Entry #	Cultivar/Release or accession #	Common Name	Scientific Name	Plant Stand*
11	Mandan	Canada wildrye	*Elymus canadensis*	4
12	Newhy	Hybrid wheatgrass	*Elymus hoffmanii*	4
13	Critana	Streambank wheatgrass	*Elymus lanceolatus*	4
14	Bannock	Streambank wheatgrass	*Elymus lanceolatus*	4
15	San Luis	Slender wheatgrass	*Elymus trachycaulus*	4
16	Pryor	Slender wheatgrass	*Elymus trachycaulus*	4
17	Lodorm	Green needlegrass	*Nasella viridula*	4
18	Arriba	Western wheatgrass	*Pascopyrum smithii*	4
19	Rosana	Western wheatgrass	*Pascopyrum smithii*	4
20	Goldar	Bluebunch wheatgrass	*Pseudoroegneria spicata*	4
21	Anatone	Bluebunch wheatgrass	*Pseudoroegneria spicata*	4
22	Rush	Intermediate wheatgrass	*Thinopyrum intermedium*	4
23	Luna	Pubescent wheatgrass	*Thinopyrum intermedium*	4
24	Jose	Tall wheatgrass	*Thinopyrum ponticum*	4
25	Ephraim	Crested wheatgrass	*Agropyron cristatum*	3
26	Kaw	Big Bluestem	*Andropagon gerardii*	3
27	Texoca	Buffalograss	*Buchloe dactyloides*	3
28	Tusas	Squirretail	*Elymus elymoides*	3
29	Sodar	Streambank wheatgrass	*Elymus lanceolatus*	3
30	Magnar	Basin wildrye	*Leymus cinereus*	3
31	Dacotah	Switchgrass	*Panicum virgatum*	3
32	Rimrock	Indian ricegrass	*Achnatherum hymenoides*	2
33	Bonilla	Big Bluestem	*Andropogon gerardii*	2
34	Pawnee	Big Bluestem	*Andropogon gerardii*	2
35	Bad river	Side oats grama	*Bouteloua curtipendula*	2
36	Lovington	Side oats grama	*Bouteloua curtipendula*	2
37	Redondo	Arizona fescue	*Festuca arizonica*	2
38	UNIDENTIFIED	Needle & thread	*Hesperostipa comata*	2
39	Trailhead	Basin wildrye	*Leymus cinereus*	2
40	9005439	Switchgrass	*Panicum virgatum*	2
41	Niner	Side oats grama	*Bouteloua curtipendula*	1
42	BSOG-02B	Side oats grama	*Bouteloua curtipendula*	1
43	El Reno	Side oats grama	*Bouteloua curtipendula*	1

Entry #	Cultivar/Release or accession #	Common Name	Scientific Name	Plant Stand*
44	Hachita	Side oats grama	*Bouteloua curtipendula*	1
45	Covar	Sheep fescue	*Festuca ovina*	1
46	9092261	Prairie Junegrass	*Koeleria macrantha*	1
47	Volga	Mammoth wildrye	*Leymus racemosus*	1
48	Climax	Timothy	*Phleum pratense*	1
49	Sherman	Big bluegrass	*Poa secunda*	1
50	Bozoisky-select	Russian wildrye	*Psathyrostachys juncea*	1
51	Aldous	Little bluestem	*Schyzachyrium scoparium*	1
52	Camper	Little bluestem	*Schyzachyrium scoparium*	1
53	Pastura	Little bluestem	*Schyzachyrium scoparium*	1
54	Cheyenne	Indian grass	*Sorghastrum nutans*	1
55	Salado	Alkali sacaton	*Sporobolus airoides*	1
56	UNIDENTIFIED?	Tufted hairgrass	*Deschampsia caespitosa*	0
57	Viva	Galleta grass	*Pleuraphis jamesii*	0
Grass-Mixtures				
58	Dry-land mix.	Mix-4* See entries inTable-1		5
59	Aggressive dry-land mix	Mix-2* See entries inTable-1		4
60	Rocky Mountain Native mix	Mix-1* See entries inTable-1		4
61	Low grow mix	Mix-3*- See entries inTable-1		4
62	Boulder NRCS-mix-Regular	Mix-5*- See entries inTable-1		4
63	Boulder NRCS-mix-heavy	Mix-6*- See entries inTable-1		4
Legume				
64	Medic @ 29.1 lb/ac	Medic	*Medicago* spp.	3
65	Medic-@ 14.2 lb/ac	Medic	*Medicago* spp.	2

* Plant stand: 0 = Poor or no establishment; and 5 = Excellent establishment

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By: Manuel Rosales

Growing Season of 2006

In March of 2006, the plots and surrounding area have caught lots of plastic trash (mainly grocery store type plastic bags) in the weed stems that were mowed last summer. Trash had blown from adjacent businesses west of the plots. The demonstrational plots were located in an accessible and visible area from the road for demonstrational purposes. However, in this occasion the view was not very pleasant and a complaint was placed to the Longmont Conservation District to remove the trash. On April 11, 2006, Patrick Davey, Plant Materials Specialist for Colorado Natural Resources Conservation Service, used an All-Terrain-Vehicle with a chain to pull a gravel pit crusher screen over the 9-acre field to nock down the standing weed stems and release the attached trash. The operation worked and the trash was collected and removed. After removal of the trash the cool-season grass plots were visible. All wheatgrassess and both the Paiute Orchard and Renegade Orchard grasses had about 100 percent stands. No written evaluation was done at this time.

Patrick Davey visited the plots again on April 18, 2007, to check for weed growth and do a visual evaluation of the plots. He found newly kochia rosettes about ½ inch tall and Russian thistle seedlings growing mainly on the warm season grass plots. He also reported that the wheatgrasses (cool season) were growing very well, especially 'Rosana' and 'Arriba' which were spreading out of the planted rows. Both entries of orchard grass showed decline in plant stand, 100 to 25 percent from last summer. 'Texoca' buffalograss was the only visible warm season grass at this time.

On July 26, 2006, Patrick Davey, visited the plots to perform a summer evaluation. He reported that all cool season species were completely dried up and in a dormant stage, perhaps due to lack of precipitation and summer heat. Leaves were brown and crispy, and crumbling when touched. Again, 'Texoca' buffalograss was the only grass showing signs of growth. No formal evaluation of all the plots was done for this summer.

Growing Season of 2007

On April 27, Pat Davey visited the site and sprayed the warm season grass plots that did not establish last year. Plots were sprayed with a 3% Glyphosate (Roundup) to kill cheatgrass and Kochia seedlings.

On June 29, Pat Davey, spot sprayed 2-4 D to control Canada thistle and to prevent it from blooming. The perimeter and all plots were spot sprayed at the rate of 1.5 lbs/acre. In addition, about 20 large spotted knapweeds plants were removed by hand.

Project COPMC-F-0505-PA
Report-2008
By: Manuel Rosales

General observations for growing season of 2007

- Paiute and Renegade orchard grasses have almost died out
- Buffalograss is doing better than last year
- Tufted hairgrass did not establish yet
- Timothy died out
- All varieties of crested wheatgrasses are doing well

The warm season grasses will be replanted during summer of 2008. Also, a tour of the plots is being planned for summer of 2008.

Growing Season of 2008

The plots were not evaluated this year; however, they were maintained by controlling the weeds. Pat Davey sprayed the broadleaved weeds 2,4-D at the rate of 1 ½ pounds per acre. Boulder County Parks & Open Space mowed the weeds in late summer. A site visit is planned for late spring of early summer of 2009 to takes notes on the species that have survived in the last three years.

Project COPMC-F-0506-RA
Project Report – 2008
By: Dr. Joe Brummer and Steve Parr

63 Ranch Conservation Field Trial

INTRODUCTION

The South Park area of Colorado is characterized as a high, cold desert. The harsh growing conditions associated with this environment coupled with drought, historic overgrazing, and the transfer/removal of irrigation water have led to many degraded range sites in the Park. Some of the more productive native grasses, such as Arizona fescue *Festuca arizonica* and prairie Junegrass *Koeleria macrantha* have been displaced. Low growing species, such as blue grama *Bouteloua gracilis* and fringed sage *Artemisia frigida,* have taken the place of these more productive species. With the recent drought conditions, even blue grama has given way to fringed sage. Although fringed sage is a native plant, it has come to dominate many sites throughout the Park. It is particularly troublesome because it is low producing, is unpalatable to livestock, and is very competitive and persistent once established. Upper Colorado Environmental Plant Center, Colorado State University, Natural Resources Conservation Service, Teller and Park County Conservation Districts, and the Colorado Division of Wildlife cooperated to establish two conservation field trials south of Fairplay, Colorado. The study will evaluate various herbicides for controlling or reducing the density of fringed sage; reseeding at three different times – an early summer planting, a mid-summer planting and a dormant fall planting - with both a native grass mixture and an introduced grass mixture on two different sites in South Park.

The two sites differ primarily in the amount of organic matter in the soil profile, but are representative of several thousand acres within South Park (MLRA 48B) with similar site characteristics.

Site Description

63 Ranch east of Highway 285 (Owned by the Colorado Division of Wildlife)

The study area was formerly irrigated. When the water was transferred for municipal uses, most of the irrigated forage species eventually died and were replaced by fringed sage with minor amounts of dryland grasses such as bottlebrush squirreltail. There are many areas within the Park that went through this same successional process and are now dominated by fringed sage. This site has a layer of organic matter on the soil surface that accumulated when it was irrigated. This layer of organic matter does not have good water holding capacity and tends to dry out quickly. The area receives only 12"-14" of annual precipitation and is characterized by high winds, all of which makes establishing new plantings difficult.

OBJECTIVE

The objective of the planting is to compare the most effective methods and products for re-establishing desirable vegetation on altered or degraded range sites in South Park.

Project COPMC-F-0506-RA
Project Report – 2008
By: Dr. Joe Brummer and Steve Parr

METHODS

The methods used in the study include the use of four different herbicides, three seeding dates and two seed mixes. Herbicides were applied at the rates identified below the first week in June 2005.

Treatments:

Herbicide Main Plots: (30 x 112 ft)	**Rate: (per acre)**
Unsprayed control	------
2,4-D ester (4 lb a.i./gal)	4 pt
Curtail	6 pt
Tordon + 2,4-D ester	1 pt + 2 pt
Cimarron Max (2 part herbicide)	1 oz + 4 pt

Seeding Date Split Plot: (32 x 150 ft)
Unseeded control (16ft x 150 ft)
Mid summer (Between July 1 and 15)
Fall (Dormant - Early November)

Seed Mix Split-Split Plot: (16 x 150 ft)
Native (See Table 1)
Introduced (See Table 1)

The plantings were conducted on July 6, 2005, November 2-3, 2005, and July 2006 with the seed mixtures identified in Table 1. Different planting times were selected to attempt to optimize the use of precipitation patterns. In mid to late July, South Park receives monsoonal flows from the southwest. This precipitation pattern generally lasts through early September. In order to capitalize on this monsoonal pattern, the first planting was done before the onset of the monsoon season. The dormant, fall seeding was done in early November 2005 to make use of early spring moisture for establishment prior to the very dry period of mid-May through June and to ensure that seed germination would not occur until spring 2006.

Table 1
Grass Species Planted for Fringed Sage Renovation Project
At 63 Ranch and Ranch of the Rockies in Park County Colorado

Grasses	Variety	% in Mix	Seeding Rate lb/acre	Grams Per Rep	PLS lb/acre
Native Mixture	**Average PLS of Native Mixture is 74%**				
Arizona fescue	Redondo	20	2.5	20	0.5
Bottlebrush squirreltail	Tusas	10	7.0	22	0.7
Indian ricegrass	Paloma	10	6.0	16	0.6
Mountain bromegrass	Garnet	15	12.5	104	2.0
Prairie Junegrass	Northwest CO	10	0.5	5	0.1
Sandberg's bluegrass	High Plains	10	1.0	3	1.0
Western wheatgrass	Rosanna	25	8.0	57	2.0
Total:				**227**	**6.9**
Introduced Mixture	**Average PLS of Introduced Mixture is 86%**				
Crested wheatgrass	Douglas	15	5.0	22	0.8
Crested wheatgrass	Hycrest	15	5.0	24	0.8
Hybrid wheatgrass	Newhy	15	7.0	36	1.1
Intermediate wheatgrass	Rush	15	9.0	38	1.4
Meadow bromegrass	Regar	15	6.5	26	1.0
Pubescent wheatgrass	Luna	15	9.0	52	1.4
Siberian wheatgrass	Vavilov	10	5.5	16	0.6
Total:				**214**	**7.1**

The two grass mixes were compiled in part from results of an earlier trial in South Park. However, a number of new, untested products were also used in each mix.

Experimental Design:

Split-split plot within a randomized complete block with four replications
Total plot area needed per site = 1.68 acres (with a 20 ft alley)

Data Collection:

Evaluations will be initiated in 2006 at both planting sites. Data will be collected on the effects of the treatments for the following:

Density and productivity of fringed sage
Grass establishment as measured by seedling density
Grass productivity by species
Density and productivity of the more abundant forb and shrub species
Economic analysis of treatment costs/benefits

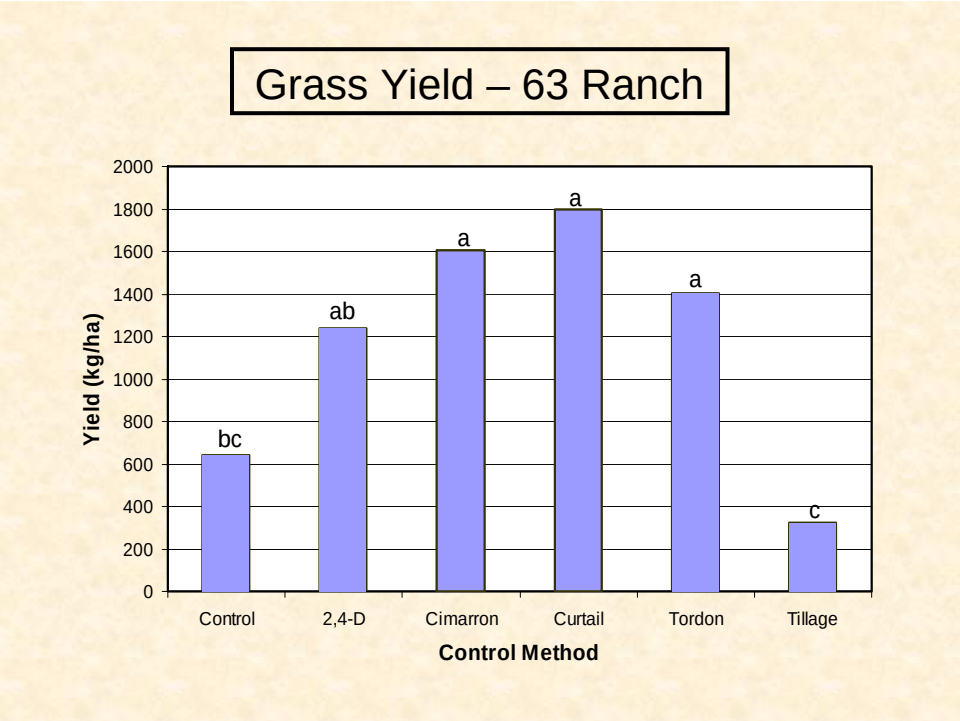
RESULTS

General observations were made on November 2, 2005, about the effectiveness of the treatments conducted in July. The herbicides did not seem to have any significant or glaring differences, but establishment appeared better in the sprayed plots than in the unsprayed control plots. In addition, the introduced seed mixture was more vigorous and had better average stands than the native mixture. Complete evaluations will be conducted in 2006. However, both seed mixtures from the July planting are performing well based on preliminary observations.

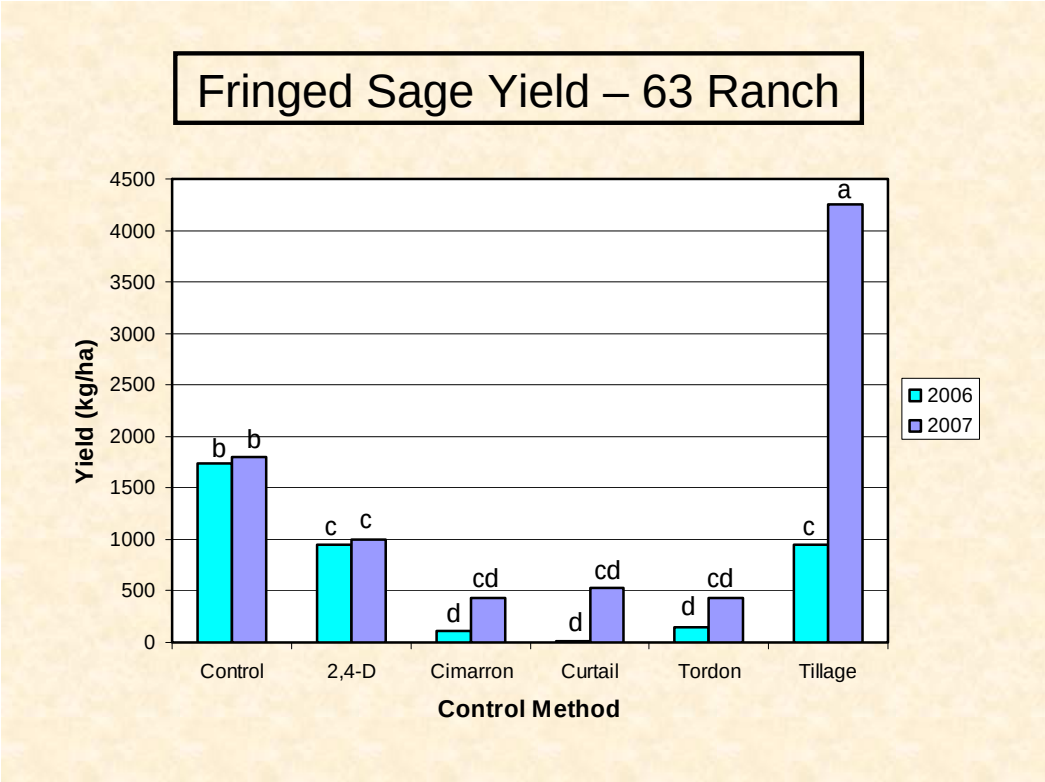
Evaluations conducted in 2006 provided additional insight into fringed sage control and desirable forage enhancement or establishment. Initial results from 2005 were based on density counts of fringed sage and indicated that Cimarron Xtra and 2,4-D alone worked well at the 63 Ranch while Tordon and 2,4-D alone were the treatments of choice at the ROR. Additional data was collected in 2006 which altered these initial conclusions. Fringed sage biomass averaged 1735 and 895 kg/ha in the untreated control plots at the 63 Ranch and ROR, respectively. Although 2,4-D appeared to reduce density of fringed sage in 2005, a number of plants had recovered sufficiently by the 2006 growing season to the point where biomass was reduced by only 45% at both sites. This compares to biomass reductions of 93%, 99%, and 92% for Cimarron, Curtail, and Tordon, respectively, at the 63 Ranch. Tillage was no better than 2,4-D at the 63 Ranch site with only a 45% reduction in fringed sage biomass. The disturbance and lack of competition created by the tillage treatment allowed fringed sage to quickly reestablish from the seed bank. Control was not as good at the ROR with reductions in fringed sage biomass of 70%, 73%, and 81% for Cimarron, Curtail, and Tordon, respectively. Grass biomass averaged 392 kg/ha and 246 kg/ha in the controls at the 63 Ranch and ROR, respectively. Except for the tillage treatment at the 63 Ranch, grass biomass responded positively in all treatments. At the 63 Ranch, grass biomass averaged 1235 kg/ha and 1472 kg/ha for Cimarron and Curtail, respectively, but only 734 kg/ha for Tordon. Baltic rush (included in grass category) was present at the 63 Ranch and Tordon appeared to have detrimental effects on this plant which accounted for most of the reduced grass response in this treatment. At the ROR, grass response was highest for Tordon with an average of 1082 kg/ha. Grass response for 2,4-D, Cimarron, and Curtail averaged 594 kg/ha, 820 kg/ha, and 742 kg/ha, respectively, at this site.

2007

The Curtail and Cimarron herbicide applications reduced the fringed sage component substantially while increasing the grass component by more than two times over the control. In fact, all herbicide applications increased the grass yield by nearly two times, including 2,4-D. Only tillage provided for an increase in forb (fringed sage) production when compared to the other treatment methods. In addition, the Tordon plots produced the lowest total biomass in 2006, but the highest in 2007 for all treatments except tillage, which suggests that the grass component may have been affected negatively by the application one year later, but that there was a positive response two years later.



Cover values mimicked those for biomass. Seeding success was evaluated by ranking each plot from 0 (no seeded plants) to 5 (all drill rows well defined by seeded plants). Establishment was generally minimal at the 63 Ranch, regardless of seed mix or time of seeding. The best establishment at this site was in the tillage treatment (2.4) due to reduced competition and seeding into a prepared seedbed. Establishment was better in both summer plantings (average of 1.4) compared to the fall (1.0) with the native seed mix doing slightly better (1.6) compared to the introduced mix (1.3) at this site. The fall and summer 2006 plantings ranked less than 1.0 for both native and introduced seed mixes while the summer 2005 planting ranked at 3.7 and 2.9 for the introduced and native mixes, respectively.



2008

The plots were not evaluated in 2008.

CONCLUSION

Fringed sage can be effectively controlled with several types of herbicides (Cimarron Xtra, Curtail, and Tordon) thereby allowing established grasses to increase productivity. Although Curtail performed well, it was higher priced at $35.63/acre compared to $17.11 and $19.98/acre for Tordon and Cimarron, respectively. Seeding success is often minimal in high-elevation, harsh environments such as the South Park area of Colorado. Mid-summer plantings appear to be the best approach for improving establishment of seeded grasses in areas that typically receive monsoonal (July and August) precipitation. Performance of the introduced grass mix was not consistently better than the native mix. Although native grasses are slower to establish, they may be the better choice for long-term productivity. There are thousands of acres in the South Park area alone that could benefit from control of fringed sage including over 40,000 acres that have experienced increases in sage due to the sale of irrigation water.

Overall, tillage as a disturbance produced the greatest biomass response of the treatments compared to the control. However, almost 80% of the total biomass yield of the tilled plots is attributed to fringed sage, while less than 17% of the total biomass for the Tordon treated plots is comprised of fringed sage. Curtail and Cimarron had similar results.

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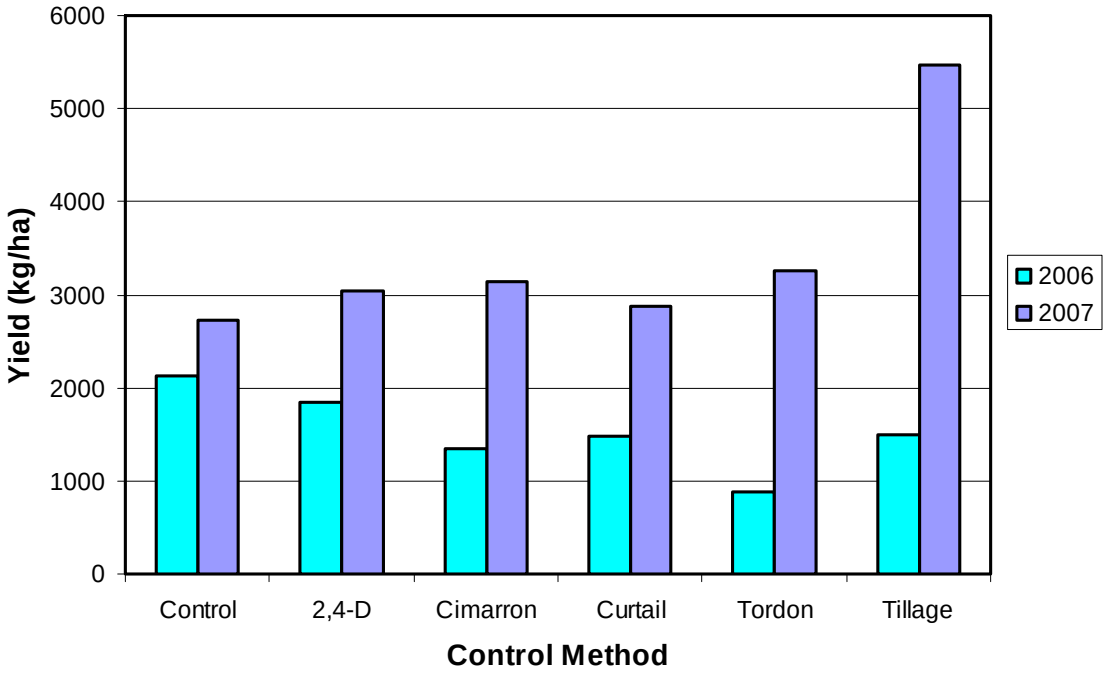
By: Dr. Joe Brummer and Steve Parr

The application of one of three herbicides at this site appears to be the most effective treatment at reducing fringed sage biomass and increasing native, perennial grasses when compared to a control. In addition, tilling and planting desired grasses at this site without controlling the fringed sage with herbicides prior to planting, does not result in desirable grass establishment. Therefore, if tillage is used to convert these historic irrigated hay meadows to desirable dryland grasses, competition must be substantially reduced and off-type products must be controlled prior to planting desired materials.



Project COPMC-F-0507-RA
Project Report – 2008
By: Dr. Joe Brummer and Steve Parr

Ranch of the Rockies Conservation Field Trial

INTRODUCTION

The South Park area of Colorado is characterized as a high, cold desert. The harsh growing conditions associated with this environment coupled with drought, historic overgrazing, and the transfer/removal of irrigation water have led to many degraded range sites in the Park. Some of the more productive native grasses, such as Arizona fescue *Festuca arizonica* and prairie Junegrass *Koeleria macrantha* have been displaced. Low growing species, such as blue grama *Bouteloua gracilis*, and fringed sage *Artemisia frigida*, have taken the place of these more productive species. With the recent drought conditions, even blue grama has given way to fringed sage. Although fringed sage is a native plant, it has come to dominate many sites throughout the Park. It is particularly troublesome because it is low producing, is unpalatable to livestock, and is very competitive and persistent once established. Upper Colorado Environmental Plant Center, Colorado State University, Natural Resources Conservation Service, Teller and Park County Conservation Districts, and the Colorado Division of Wildlife cooperated to establish two conservation field trials south of Fairplay, Colorado. The study will evaluate various herbicides for controlling or reducing the density of fringed sage; reseeding at three different times – an early summer planting, a mid summer planting, and a dormant fall planting - with both a native grass mixture and an introduced grass mixture on two different sites in South Park.

The two sites differ primarily in the amount of organic matter in the soil profile, but are representative of several thousand acres within South Park (MLRA 48B) with similar site characteristics.

Site Description

Ranch of the Rockies south of Highway 24

This is an upland site that has experienced an increase in fringed sage due to the drought and past grazing practices. Although many of the native grasses are present at the site, their density and vigor have been significantly reduced which has allowed fringed sage to increase to the point where it dominates large areas.

OBJECTIVE

The objective of the planting is to compare the most effective methods and products for re-establishing desirable vegetation on altered or degraded range sites in South Park.

METHODS

The methods used in the study include the use of four different herbicides, three seeding dates and two seed mixes. Herbicides were applied at the rates identified below the first week in June 2005.

Project COPMC-F-0507-RA
Project Report – 2008
By: Dr. Joe Brummer and Steve Parr

Treatments:

Herbicide Main Plots: (30 x 112 ft)	**Rate: (per acre)**
Unsprayed control	------
2,4-D ester (4 lb a.i./gal)	4 pt
Curtail	6 pt
Tordon + 2,4-D ester	1 pt + 2 pt
Cimarron Max (2 part herbicide)	1 oz + 4 pt

Seeding Date Split Plot: (32 x 150 ft)
Unseeded control (16 x 150 ft)
Mid summer (Between July 1 and 15)
Fall (Dormant - Early November)

Seed Mix Split-Split Plot: (16 x 150 ft)
Native (See Table 1)
Introduced (See Table 1)

The plantings were conducted on July 6, 2005, November 2-3, 2005, and again in July 2006, with the seed mixtures identified in Table 1. Two planting times were selected to attempt to optimize the use of precipitation patterns. In mid to late July, South Park receives monsoonal flows from the southwest. This precipitation pattern generally lasts through early September. In order to capitalize on this monsoonal pattern, the first planting was done before the onset of the monsoon season. The dormant, fall seeding was done in early November 2005 to make use of early spring moisture for establishment prior to the very dry period of mid-May through June and to ensure that seed germination would not occur until spring 2006.

Table 1
Grass Species Planted for Fringed Sage Renovation Project
at 63 Ranch and Ranch of the Rockies in Park County, Colorado

Native Mixture	**Average PLS of Native Mixture is 74%**				
Grasses	Variety	% in Mix	Seeding Rate lb/acre	Grams Per Rep	PLS lb/acre
Arizona fescue	Redondo	20	2.5	20	0.5
Bottlebrush squirreltail	Tusas	10	7.0	22	0.7
Indian ricegrass	Paloma	10	6.0	16	0.6
Mountain bromegrass	Garnet	15	12.5	104	2.0
Prairie Junegrass	Northwest CO	10	0.5	5	0.1
Sandberg's bluegrass	High Plains	10	1.0	3	1.0
Western wheatgrass	Rosanna	25	8.0	57	2.0
Total:				**227**	**6.9**

Table 2

Introduced Mixture	**Average PLS of Introduced Mixture is 86%**				
Grasses	Variety	% in Mix	Seeding Rate lb/acre	Grams Per Rep	PLS lb/acre
Crested wheatgrass	Douglas	15	5.0	22	0.8
Crested wheatgrass	Hycrest	15	5.0	24	0.8
Hybrid wheatgrass	Newhy	15	7.0	36	1.1
Intermediate wheatgrass	Rush	15	9.0	38	1.4
Meadow bromegrass	Regar	15	6.5	26	1.0
Pubescent wheatgrass	Luna	15	9.0	52	1.4
Siberian wheatgrass	Vavilov	10	5.5	16	0.6
Total:				**214**	**7.1**

The two grass mixes were compiled in part from results of an earlier trial in South Park. However, a number of new, untested products were also used in each mix.

Experimental Design:

Split-split plot within a randomized complete block with 4 replications
Total plot area needed per site = 1.68 acres (with a 20 ft alley)

Data Collection:
Evaluations will be initiated in 2006 at both planting sites. Data will be collected on the effects of the treatments for the following:

Density and productivity of fringed sage
Grass establishment as measured by seedling density
Grass productivity by species
Density and productivity of the more abundant forb and shrub species
Economic analysis of treatment costs/benefits

RESULTS

General observations were made on November 2, 2005, about the effectiveness of the treatments conducted in July. The herbicides did not seem to have any significant or glaring differences, but establishment appeared better in the sprayed plots than in the unsprayed control plots. In addition, the introduced seed mixture was more vigorous and had better average stands than the native mixture. However, both seed mixtures from the July planting are performing well based on preliminary observations.

Evaluations conducted in 2006 provided additional insight into fringed sage control and desirable forage enhancement or establishment. Initial results from 2005 were based on density counts of fringed sage and indicated that Tordon and 2,4-D alone were the treatments of choice at the Ranch of the Rockies. Additional data was collected in 2006 which altered these initial conclusions. Fringed sage biomass averaged 895 kg/ha in the untreated control plots at ROR.

Although 2,4-D appeared to reduce density of fringed sage in 2005, a number of plants had recovered sufficiently by the 2006 growing season to the point where biomass was reduced by only 45% at both sites. Control was not as good at the ROR with reductions in fringed sage biomass of 70, 73, and 81% for Cimarron, Curtail, and Tordon, respectively. Grass biomass averaged 246 kg/ha in the controls at ROR. Grass biomass responded positively in all treatments. At the ROR, grass response was highest for Tordon with an average of 1082 kg/ha. Grass response for 2,4-D, Cimarron, and Curtail averaged 594, 820, and 742 kg/ha, respectively, at this site.

2007

All treatments were significantly different for controlling fringed sage than the control treatment in 2007. Tordon treated plots had over four times less fringed sage than the control plots and four times more grass yield than the control plots.

Yield – ROR

Control Trt	Sage	Grass	Forbs	Shrubs	Total
	----------(kg/ha)----------				
Control	800 a	320 d	60 a	40 a	1220 a
2,4-D	520 b	650 c	40 a	80 a	1290 a
Cimarron	250 c	940 b	20 a	100 a	1310 a
Curtail	320 bc	880 b	50 a	70 a	1320 a
Tordon	190 c	1280 a	40 a	10 a	1520 a

It is interesting to note that the use of Curtail, while not the most effective at controlling fringed sage, released the most forb production. Curtail also ended up producing the least amount of plot biomass overall in 2006, but responded to have the second highest total production in 2007. Tordon was the most effective herbicide for controlling fringed sage on this site and was also the best choice for improving grass production and overall plot biomass production.

Cover values mimicked those for biomass. Seeding success was evaluated by ranking each plot from 0 (no seeded plants) to 5 (all drill rows well defined by seeded plants). At the ROR, establishment was generally low with rankings of 1.9, 1.7, 1.5, and 1.2 for Tordon, Curtail, Cimarron, and 2,4-D, respectively. The fall and summer 2006 plantings ranked less than 1.0 for both native and introduced seed mixes while the summer 2005 planting ranked at 3.7 and 2.9 for the introduced and native mixes, respectively.

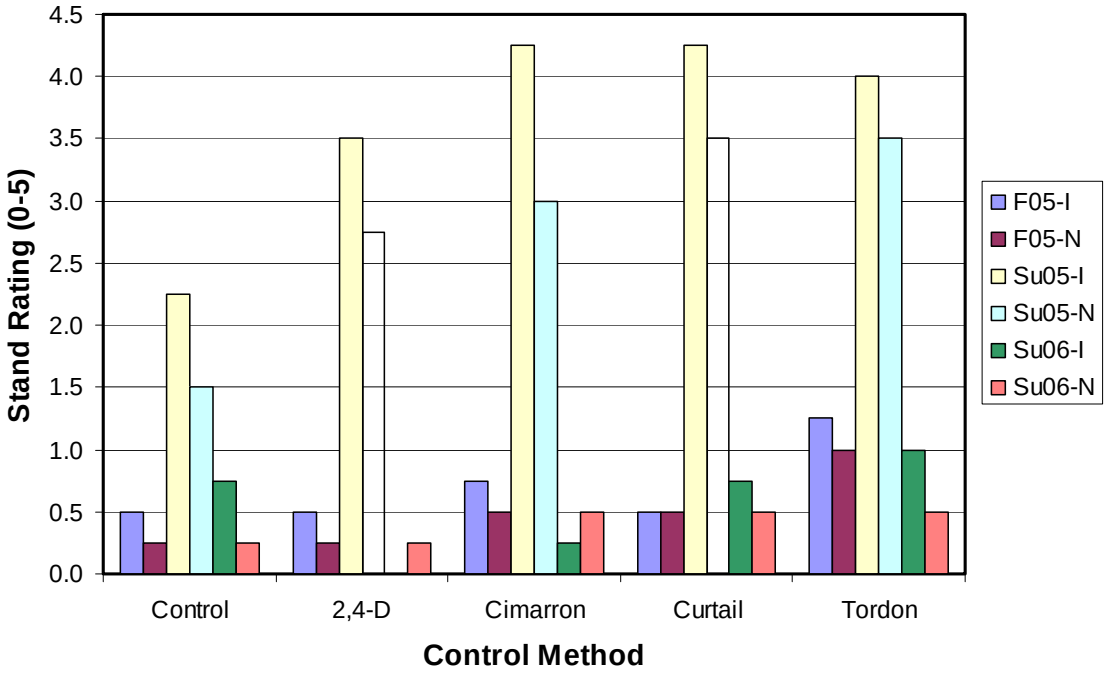
Table 3. Cover of fringed sage, grasses, forbs, and shrubs as affected by herbicide treatments on the Ranch of the Rockies, South Park, Colorado. Samples were taken on September 1, 2006.

Herbicide Treatment	Sage	Grass	Forb	Shrub
	----------%----------			
2,4-D	19.4	34.5	2.3	3.1
Cimarron	10.1	40.2	0.7	2.0
Control	34.8	15.1	1.6	0.4
Curtail	14.0	40.6	3.5	3.3
Tordon	7.9	44.3	1.9	0.3

Table 4. Effect of herbicide treatments, time of seeding, and seed mix on grass establishment at 2 sites in South Park, Colorado. Samples were taken on August 16, 2006 at the 63 Ranch and September 1, 2006 at the Ranch of the Rockies.

Herbicide Treatment	63 Ranch	Ranch of the Rockies
2,4-D	0.9	1.2
Cimarron	1.0	1.5
Control	0.4	0.9
Curtail	1.1	1.7
Tillage	2.4	----
Tordon	1.6	1.9
Seed Treatment		
Fall-Introduced	1.0	0.7
Fall-Native	1.0	0.5
Spring-Introduced	1.2	0.6
Spring-Native	1.6	0.4
Summer-Introduced	1.3	3.7
Summer-Native	1.5	2.9

Ratings were based on a scale of 0 (no seeded plants) to 5 (all drill rows well defined by seeded plants).



2008

The plots were not evaluated in 2008.

CONCLUSION

Fringed sage can be effectively controlled with several types of herbicides (Cimarron Xtra, Curtail, and Tordon) thereby allowing established grasses to increase productivity. Although Curtail performed well, it was higher priced at $35.63/acre compared to $17.11 and $19.98/acre for Tordon and Cimarron, respectively. Seeding success is often minimal in high-elevation, harsh environments such as the South Park area of Colorado. Mid-summer plantings appear to be the best approach for improving establishment of seeded grasses in areas that typically receive monsoonal (July and August) precipitation. Performance of the introduced grass mix was not consistently better than the native mix. Although native grasses are slower to establish, they may be the better choice for long-term productivity. There are thousands of acres in the South Park area alone that could benefit from control of fringed sage including over 40,000 acres that have experienced increases in sage due to the sale of irrigation water.

Project COPMC-F-0601-CR
Report-2008
By: Manuel Rosales

South Park Field Evaluation Planting

OBJECTIVE

To determine which selected materials will establish and persist in peat-rich soils once irrigated and now dryland.

INTRODUCTION

Historically, ranchers and developers have been interested in the peatlands (also referred to as fens) of South Park, Colorado. Peatlands were ditched and drained to grow crops for livestock grazing and to prevent cattle from becoming bogged down in their soft soils. Peatland is a generic term for any wetland that accumulates decayed plant material. In Colorado, peatlands are classified as fens. This type of peatland is only found in high-elevation sites above 8000 feet. These peatlands form in places where a constant supply of ground water maintains the soil saturation. This field evaluation planting was designed to help select plant materials, especially native grasses, that will grow in peatlands that were previously drained and irrigated, and no longer will be irrigated.

EXPERIMENTAL DESIGN

The statistical design for the study is a randomized complete block with four replications

MATERIALS & METHODS

The planting site was prepared by rototilling, letting stand, spraying with Roundup, and then rolling to firm up the soil prior to seeding. Seventeen native grass species and 11 introduced or manipulated grass species were planted November 2-3, 2005. The planting was done with a four-row plot cone-seeder. The rate of seeding was 60 pure live seeds per linear foot of row (30 x 2 for critical area planting). The plot size is 4 x 20 ft with four rows per plot. Table-1 lists the 28 entries for the study:

Table 1. South Park Field Evaluation Planting. UCEPC

Common Name	Scientific Name	Release Name or Accession No.
Natives		
Arizona fescue	*Festuca arizonica*	Redondo
Bluebunch wheatgrass	*Pseudoroegneria spicata spp.spicata*	Anatone
Bluebunch wheatgrass	*Pseudoroegneria spicata spp.spicata*	Goldar
Blue grama	*Bouteloua gracilis*	Bad River
Bottlebrush squirreltail	*Elymus elymoides spp. brevifolius*	Pueblo
Bottlebrush squirreltail	*Elymus elymoides*	Tusas
Bottlebrush squirreltail	*Elymus elymoides spp.brevifolius*	Wapiti
Columbia needlegrass	*Achnatherum nelsonii*	9024804

Common Name	Scientific Name	Release Name or Accession No.
Columbia needlegrass	*Achnatherum nelsonii*	9040137
Indian ricegrass	*Achnatherum hymenoides*	Paloma
Indian ricegrass	*Achnatherum hymenoides*	Rimrock
Mountain brome	*Bromus marginatus*	Garnet
Prairie Junegrass	*Koeleria macrantha*	9092261
Sandberg's bluegrass	*Poa secunda*	High plains
Streambank wheatgrass	*Elymus lanceolatus*	Sodar
Western wheatgrass	*Pascopyrum smithii*	Arriba
Western wheatgrass	*Pascopyrum smithii*	Rosana
Introduced or Manipulated		
Basin wildrye-hybrid	*Leymus cinerus*	Continental
Crested wheatgrass	*Agropyrum cristatum*	Douglas
Crested wheatgrass	*Agropyrum cristatum*	Nordan
Crested-desertorum hybrid	*Agropyrum cristatum x A. desertorum*	Hycrest
Intermediate wheatgrass	*Thinopyrum intermedia*	Rush
Meadow brome	*Bromus biebersteinii*	Regar
Pubescent wheatgrass	*Thinopyrum intermedia*	Luna
Russian wildrye	*Psathyrostachys juncea*	Bozoisky
Siberian wheatgrass	*Agropyrum fragile spp. sibiricum*	Vavilov
Smooth brome	*Bromus inermis*	Liso
Wheatgrass-hybrid	*Elymus hoffmanni*	Newhy

The site is located 15 miles south of the city Fairplay, Park County, Colorado, on U.S. Highway 285. Elevation at the site is 9000 feet, and the annual precipitation is 10 inches. The planting site is on 63-Ranch State Wildlife Area. A six-foot tall game-fence enclosed the planting area. Plots will be evaluated for stand establishment and performance.

RESULTS

Results for Year-2006

Table 2 presents percent plant stand (establishment) and plant vigor for the growing season of year 2006. The over-all average for plant establishment was 8.2 percent, which is low. Bad River-blue grama performed best for the native grasses and Liso-smooth brome performed best for the introduced grasses. By mid-summer the plots had been over run by a flush of fringed sagebrush seedlings and in some areas were covered with dense four foot circles of cutleaf nightshade. The cutlef nightshade were all pulled by hand and the fringed sage was sprayed with a mix of 2,4-D and Tordon. Also, the native western wheatgrass was encroaching from the perimeter and this was sprayed with glyphosate.

Table 2. Plant Stand & Vigor for 28 entries. South Park FEP-2006

Natives			
Common Name	**Release Name or Accession No.**	**% Plant Stand Average[1]**	**Plant Vigor Average[1]**
Blue grama	**Bad River**	32.0	3.5
Bluebunch wheatgrass	**Anatone**	18.2	3.5
Indian ricegrass	**Rimrock**	14.5	3.5
Western wheatgrass	Rosana	12.5	3.2
Bluebunch wheatgrass	Goldar	10.5	3.7
Indian ricegrass	Paloma	7.2	3.5
Western wheatgrass	Arriba	5.5	2.7
Bottlebrush squirreltail	Pueblo	2.7	2.2
Columbia needlegrass	9024804	2.5	2.3
Mountain brome	Garnet	2.0	3.2
Columbia needlegrass	9040137	1.7	2.3
Sandberg's bluegrass	High plains	1.2	2.0
Prairie Junegrass	9092261	1.0	2.6
Streambank wheatgrass	Sodar	0.7	2.5
Bottlebrush squirreltail	Wapiti	0.5	2.0
Arizona fescue	Redondo	0.25	2.0
Bottlebrush squirreltail	Tusas	0.25	2.0
Introduced or Manipulated			
Smooth brome	**Liso**	23.0	2.7
Meadow brome	**Regar**	17.7	3.2
Russian wildrye	**Bozoisky**	14.5	3.7
Basin wildrye-hybrid	Continental	12.5	3.7
Crested wheatgrass	Nordan	11.5	3.7
Intermediate wheatgrass	Rush	8.7	3.7
Crested-desertorum hybrid	Hycrest	7.7	3.2
Pubescent wheatgrass	Luna	7.5	3.2
Siberian wheatgrass	Vavilov	7.2	3.2
Crested wheatgrass	Douglas	5.0	2.5
Wheatgrass-hybrid	Newhy	1.5	2.6

1. Average of four replications. Plant stand & vigor were statistically significantly different at the 5% level of probability. The ratings for Vigor are: 2 = poor, 3 = fair, 4 = Good and 5 = Excellent. Plant stand is a visual estimate per plot basis; four-row/ plot germinated are equal 100 percent establishment.

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By: Manuel Rosales

Results forYear-2007

The plots were evaluated on July 31, 2007. Plant stand and vigor for the 28 entries are presented in the table 3.

Table 3. Plant Stand & Vigor for 28 entries. South Park FEP-2007

Natives			
Common Name	**Release Name or Accession No.**	**% Plant Stand[1] Average**	**Plant Vigor[2] Average**
Western wheatgrass	Rosana	35.2	2.5
Bluebunch wheatgrass	**Anatone**	33.7	2.5
Blue grama	**Bad River**	20.0	3.0
Bluebunch wheatgrass	Goldar	14.7	2.2
Indian ricegrass	**Rimrock**	10.7	2.0
Western wheatgrass	Arriba	9.0	2.7
Sandberg's bluegrass	High Plains	6.0	2.5
Bottlebrush squirreltail	Pueblo	5.0	1.5
Columbia needlegrass	9040137	3.7	2.7
Arizona fescue	Redondo	3.2	3.2
Mountain brome	Garnet	2.7	3.0
Prairie Junegrass	9092261	2.5	1.5
Columbia needlegrass	9024804	2.0	3.2
Streambank wheatgrass	Sodar	1.3	4.2
Bottlebrush squirreltail	Tusas	1.0	3.0
Indian ricegrass	Paloma	0.5	1.5
Bottlebrush squirreltail	Wapiti	0.5	1.75
Introduced or Manipulated			
Crested wheatgrass	Nordan	41.2	1.7
Crested wheatgrass	Douglas	32.7	2.7
Meadow brome	**Regar**	31.0	2.2
Russian wildrye	**Bozoisky**	30.2	2.0
Siberian wheatgrass	Vavilov	29.0	1.7
Crested-desertorum hybrid	Hycrest	26.2	2.0
Smooth brome	**Liso**	20.0	3.0
Wheatgrass-hybrid	Newhy	12.2	3.2
Intermediate wheatgrass	Rush	11.2	3.0
Pubescent wheatgrass	Luna	11.2	3.2
Basin wildrye-hybrid	Continental	11.0	2.5

1. Plant stand was statistically significantly different at the 5% level of probability, vigor was not significant. Plant stand is a visual estimate per plot basis; four complete rows within the plot are equal to 100 percent establishment.
2. Plant Vigor is a visual estimate per plot basis. 1 = Excellent; 2 = Good; 3 = Fair; 4 = Poor; 5 = very poor

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Report-2008
By: Manuel Rosales

Results for Year 2008

The plots were evaluated in July 8, 2008, for the third year of establishment. Most of the species are performing well. Table 4 & 5 present a summary for the establishment and plant vigor for the three years**.**

Table 4. Plant Establishment for South Park Field Evaluation Planting.

Native Species					
Common Name	**Release or Accession No.**	**Percent Plant Stand[1]**			**Average**
		2006	**2007**	**2008**	
Western wheatgrass	Rosana	12.5	**35.2**	**65.0**	37.6
Blue grama	Bad River	**32.0**	20.0	39.0	30.3
Bluebunch wheatgrass	Anatone	18.2	33.7	37.5	29.8
Western wheatgrass	Arriba	5.5	9.0	34.0	16.2
Bluebunch wheatgrass	Goldar	10.5	14.7	16.8	14.0
Indian ricegrass	Rimrock	14.5	10.7	2.5	9.2
Arizona fescue	Redondo	0.25	3.2	14.8	6.1
Sandberg's bluegrass	High Plains	1.2	6.0	8.5	5.2
Columbia needlegrass	9040137	1.7	3.7	7.5	4.3
Columbia needlegrass	9024804	2.5	2.0	5.5	3.3
Bottle brush squirretail	Pueblo	2.7	5.0	1.8	3.2
Indian ricegrass	Paloma	7.2	0.5	0.5	2.7
Mountain brome	Garnet	2	2.7	2.8	2.5
Prairie junegrass	9092261	1	2.5	3.7	2.4
Streambank wheatgrass	Sodar	0.7	1.3	2.0	1.3
Bottle brush squirretail	Tusas	0.25	1.0	1.0	0.8
Bottle brush squirretail	Wapiti	0.5	0.5	0.3	0.4

Introduced or Manipulated Species					
Common Name	**Release or Accession No**	**Percent Plant Stand**			**Average**
		2006	**2007**	**2008**	
Crested wheatgrass	Nordan	11.5	**41.2**	40.0	30.9
Siberian wheatgrass	Vavilov	7.2	29.0	**47.0**	27.7
Russian wildrye	Bozoisky	14.5	30.2	37.0	27.2
Meadow brome	Regar	17.7	31.0	27.0	25.2
Crested wheatgrass	Douglas	5	32.7	35.8	24.5
Crested-desertorum hybrid	Hycrest	7.7	26.2	27.3	20.4
Basin wildrye-hybrid	Continental	12.5	11.0	37.0	20.2
Smooth brome	Liso	**23.0**	20.0	6.5	16.5
Intermediate wheatgrass	Rush	8.7	11.2	10.3	10.1
Pubescent wheatgrass	Luna	7.5	11.2	10.0	9.6
Wheatgrass-hybrid	Newhy	1.5	12.2	7.5	7.1
LSD (0.05)[2]		10.1	16.9	19.6	

1. Percent plant stand is a visual estimate per plot basis; four complete rows within the plot are equal to 100 percent establishment.
2. Least Significant Difference (LSD) at $P<0.05$.

Table 5. Plant Vigor for South Park Field Evaluation Planting

Native Species				
Common Name	**Release or Accession No.**	**Plant Vigor[1] 2007**	**2008**	**Average**
Bottle brush squirretail	Wapiti	1.8	1.0	1.4
Prairie junegrass	9092261	1.5	1.5	1.5
Indian ricegrass	Paloma	1.5	2.0	1.8
Sandberg's bluegrass	High Plains	2.5	1.5	2.0
Western wheatgrass	Rosana	2.5	1.8	2.1
Indian ricegrass	Rimrock	2.0	2.3	2.2
Bottle brush squirretail	Pueblo	1.5	3.0	2.3
Bottle brush squirretail	Tusas	3.0	1.5	2.3
Bluebunch wheatgrass	Anatone	2.5	2.3	2.4
Bluebunch wheatgrass	Goldar	2.2	2.5	2.4
Blue grama	Bad River	3.0	2.0	2.5
Arizona fescue	Redondo	3.2	2.0	2.6
Columbia needlegrass	9040137	2.7	2.5	2.6
Western wheatgrass	Arriba	2.7	2.8	2.8
Mountain brome	Garnet	3.0	3.0	3.0
Columbia needlegrass	9024804	3.2	3.0	3.1
Streambank wheatgrass	Sodar	4.2	2.5	3.4

Introduced or Manipulated Species				
Common Name	**Release or Accession No**	**Plant Vigor[1] 2007**	**2008**	**Average**
Russian wildrye	Bozoisky	2.0	1.5	1.8
Crested wheatgrass	Nordan	1.7	2.0	1.9
Siberian wheatgrass	Vavilov	1.7	2.3	2.0
Meadow brome	Regar	2.2	2.3	2.3
Basin wildrye-hybrid	Continental	2.5	2.0	2.3
Crested-desertorum hybrid	Hycrest	2.0	2.8	2.4
Intermediate wheatgrass	Rush	3.0	2.3	2.7
Crested wheatgrass	Douglas	2.7	2.8	2.8
Smooth brome	Liso	3.0	3.5	3.3
Pubescent wheatgrass	Luna	3.2	3.3	3.3
Wheatgrass-hybrid	Newhy	3.2	3.3	3.3

1. Plant Vigor is a visual estimate per plot basis. 1 = Excellent; 2 = Good; 3 = Fair; 4 = Poor; 5 = very poor.
Note: 2006 was not included because a different rating rank was used.

Project COPMC-F-0602-WI
Report-2008
By: Manuel Rosales

Windbreak Demonstration Planting

OBJECTIVE

To demonstrate the use of different woody species for windbreak purposes and to provide a source for plant release materials at Upper Colorado Environmental Plant Center (UCEPC).

INTRODUCTION

UCEPC is located in an area that experiences strong winds throughout the year. To protect the Center from prevailing winds, a windbreak is being planted with multipurpose benefits in mind. In addition to providing protection from the wind, the windbreak will serve for educational and demonstrational purposes, as well as aesthetic purposes.

EXPERIMENTAL DESIGN

This is a non-replicated planting.

MATERIALS & METHODS

A multiple-row windbreak with five to eight rows of woody plant materials will be planted along the west side perimeter of the Center. Three rows of evergreen trees, two rows of deciduous trees and two to three rows of shrubs will be planted during 2006-2009. Native woody species will be planted where possible, following the Natural Resources Conservation Services guidelines for establishing a windbreak/shelterbelt. The planting will be irrigated as needed until the plants get well establish. Plant materials for the windbreak will be acquired through Colorado State Forest Service tree program and/or UCEPC's own woody collections.

RESULTS/ACCOMPLISHMENTS

On May 25, 2006, sixty potted Colorado blue spruce *Picea pungens* seedlings were transplanted by hand. Tree seedlings were about 6-12 inches in height. The trees were purchased at the Local NRCS field office through the State Forest Program. Trees were planted in a single row (north-south) that runs parallel to the UCEPC-west fence at 16 feet spacing within the row Adjacent rows will be set at 20 feet between rows. Trees were watered by hand immediately after planting. Trees were irrigated during the summer with a hand-moved 2 inch-line sprinkler set. Trees were also mulched with a 2-3 inch layer of wood chips around each tree with a 2-feet diameter. The mulch kept soil moist and prevented weeds from competing with the trees.

On July 10, 2006, the trees were evaluated for survivability. All 60 trees were alive and growing well. More trees will be planted during 2007 growing season.

Project COPMC-F-0602-WI
Report-2008
By: Manuel Rosales

Growing Season of 2007

On May 10, 2007, sixty more potted Colorado blue spruce were transplanted into the existing row of spruce bringing the total to 120 trees (row- length = 1920 feet). Holes for the transplants were dug with a hand post-hole digger. Seedlings were then placed in the holes, backfilled and packed lightly. A basin of soil was made around each tree and watered immediately with a water tank carried in the pick-up truck.

On August 20, 2007, twenty-one honey suckle plants *Lonicera utahensis* propagated by cuttings at UCEPC were added to the windbreak to start a row of shrubs. These plants were also hand transplanted.

On September 12, 2007, the plants in the windbreak were evaluated for survivability. All transplants done during growing season of 2007 were alive. The planting will be evaluated during the Spring-2008 to determine survivability over the winter.

Growing Season of 2008

The windbreak demonstrational planting continues to grow in height as well as in number of plants. Ten more spruce trees were added to the spruce row bringing the total to 124 Colorado spruce trees. In addition, four shrubs species (with five plants each) received from Bismarck plant material for an inter-center observational planting were added to the shrub-row. The four shrubs are: American black currant *Ribes americanum*, black chokecherry *Photinia melanocarpa*, fireberry hawthorn *Crataegus chysocarpa*, and plum *Prunus*. This update the total of shrubs to 40 (including the honeysuckles planted in 2007).

A drip system was installed in the windbreak on August 8, 2008. The emitters put out about a half a gallon of water per hour. All trees and shrubs will be irrigated with the system as needed.

Project COPMC-F-0603-RA
Report-2008
By: Manuel Rosales

Grass and Forb Observational Planting

OBJECTIVE

To establish grasses and forbs of Plant Materials releases and experimental species for training, educational, and demonstration purposes.

INTRODUCTION

Upper Colorado Environmental Plant Center (UCEPC) usually holds tours, field days, training and other events for the general public and other guests. In the past the Center has shown the array of production fields and experimental studies being conducted. However, guests are often times interested in other species besides the ones being studied at the Center. This planting was initiated to fill this need and provide a better service to our customers.

EXPERIMENTAL DESIGN

None: this is a non-replicated planting.

MATERIALS & METHODS

On August 2, 2006, a total of 60 entries; 40 grasses and 20 forbs species were seeded at the UCEPC. The species planted are UCEPC plant releases and experimental species, as well as plant releases from other Plant Materials Centers within the region (See Table 1). The planting was done in raised beds prepared with a bed former pulled with a tractor.

Each species was planted with a hand-push belt seeder, in plots 20 feet long and six feet wide, with two rows per plot. The distance between the rows is about three feet. The planting was then irrigated with a hand moved sprinkler system to ensure germination.

Table 1. Grass and Forbs Observational Planting. UCEPC

Entry #	Release Name/Accession	Common Name	Scientific Name	Seed Source
Cool Season Grass Species				
1	Arriba	Western wheatgrass	*Pascopyrum smithii*	UCEPC
2	Luna	Intermediate wheatgrass	*Thinopyrum intermedium*	UCEPC
3	San Luis	Slender wheatgrass	*Elymus trachycaulus*	UCEPC
4	Pueblo Germplasm	Squirreltail	*Elymus elymoides* spp. *brevifolius*	UCEPC
5	Wapiti Germplasm	Squirreltail	*Elymus elymoides* spp. *brevifolius*	UCEPC
6	Garnet Germplasm	Mountain brome	*Bromus marginatus*	
7	Redondo	Arizona fescue	*Festuca arizonica*	UCEPC

Entry #	Release Name/Accession	Common Name	Scientific Name	Seed Source
8	Hycrest	Crested wheatgrass	*Agropyrum cristatum x A. desertorum*	UCEPC
9	Peru Creek	Tufted hairgrass	*Deschampsia cespitosa*	UCEPC
10	Volga	Mammoth wildrye	*Leymus racemosus*	UCEPC
11	9092261	Poa	*Poa* spp.	UCEPC
12	9040137	Columbia needlegrass	*Achnatherum nelsoni*	UCEPC
13	9092282	Sandberg bluegrass	*Poa secunda*	UCEPC
14	9092272	Mutton grass	*Poa fendleriana*	UCEPC
15	9070976	Thurber's fescue	*Festuca thurberi*	UCEPC
16	9092284	Mountain muhly	*Muhlenbergia montana*	UCEPC
17	9024739	Indian ricegrass	*Achnatherum hymenoides*	
18	9070952	Bluebunch	*Pseudoroegneria spicata* spp. *spicata*	UCEPC
19	9043501	Salina wildrye	*Leymus salinus*	UCEPC
20	L-45	Basin wildrye Cross	*Leymus cinereus*	ARS-Logan, UT/UCEPC
Forbs Species				
21	ARS-2678	Kura clover	*Trifolium ambiguum*	UCEPC
22	Timp	Utah sweetvetch	*Hedysarum boreale*	UCEPC
23	Summit	Louisiana sage	*Artemisia ludoviciana*	UCEPC
24	Bandera	Rocky Mountain penstemon	*Penstemon strictus*	UCEPC
25	9024993	Rydberg's penstemon	*Penstemon rydbergii*	UCEPC
26	9070934	Sticky cinquefoil	*Potentilla glandulosa*	UCEPC
27	9092283	Utah sweetvetch	*Hedysarum boreale*	UCEPC
28	9070972	Senecio	*Senecio biglovii*	UCEPC
29	9024921	Sulphur buckwheat	*Eriogonum umbellatum*	UCEPC
30	9021471	Fringed sage	*Artemisia frigida*	UCEPC
Other PMCs Cool Season Grass Species				
31	Sodar	Streambank wheatgrass	*Elymus lanceolatus*	Aberdeen , PMC
32	Critana	Thick spike wheatgrass	*Elymus lanceolatus*	Bridger, PMC
33	Rosana	Western wheatgrass	*Pascopyrum smithii*	Bridger, PMC
34	Newhy	Hybrid wheatgrass	*Elymus hoffmanni*	Aberdeen, PMC
35	Rush	Intermediate wheatgrass	*Elytrigia intermedia*	Aberdeen , PMC
36	Trailhead	Basin wildrye	Leymus cinereus	Bridger, PMC
37	Anatone	Blue Bunch wheatgrass	*Pseudoroegneria spicata*	Aberdeen, PMC
38	Vavilov	Siberian wheatgrass	*Agropyron fragile*	Aberdeen, PMC
39	Whitmar	Beardless Wheatgrass	*Pseudoroegneria spicata*	Pullman, PMC
40	Covar	Sheep Fescue	*Festuca ovina*	Pullman, PMC
Other PMCs Warm Season Grass Species				
41	9005439	Switchgrass	*Panicum virgatum*	Bridger, PMC

Entry #	Release Name/Accession	Common Name	Scientific Name	Seed Source
42	Dacotah	Switchgrass	*Panicum virgatum*	Bismarck, PMC
43	Bison	Big bluestem	*Andropogon gerardii*	Bismarck, PMC
44	Bad river	Blue grama	*Bouteloua gracilis*	Bismarck, PMC
45	Salado	Alkali sacaton	*Sporobolus airoides*	Los Lunas, PMC
46	Pierre	Sideoats grama	*Bouteloua curtipendula*	Bismarck, PMC
47	Vaughn	Sideoats grama	*Bouteloua curtipendula*	Los Lunas, PMC
48	Badlands	Little bluestem	*Schizachyrium scoparium*	Bismarck, PMC
49	Alma	Blue grama	*Bouteloua gracilis*	Los Lunas, PMC
50	Viva	Galleta grass	*Pleuraphis jamesii*	Los Lunas, PMC
Other PMCs Forb species				
51	Great Northern Germplasm	Common yarrow	*Achillea millefolium*	Bridger, PMC
52	San Juan Germplasm	Penstemon	*Penstemon angustifolius*	Los Lunas, PMC
53	Richfield Germplasm	Eaton's penstemon	*Penstemon eatonii*	Bridger, PMC
54	Maple Grove Germplasm	Prairie flax	*Linum lewisii*	Aberdeen, PMC
55	Appar	Prairie flax	*Linum lewisii*	Aberdeen, PMC
56	Bismarck Germplasm	Violet prairie clover	*Dalea purpurea*	Bismarck, PMC
57	Antelope Germplasm	White prairie clover	*Dalea candida*	Bridger, PMC
58	Stillwater Germplasm	Prairie coneflower	*Ratibida columnifera*	Bridger, PMC
59	Bismarck Germplasm	Narrow-leaved purple coneflower	*Echinacea angustifoli*a	Bismarck, PMC
60	Medicine Creek Germplasm	Maximilian sunflower	*Helianthus maximilian*i	Bismarck, PMC
61		Canada milkvetch*	*Astragalus canadensis*	Pullman, PMC

*Added on Nov-20, 2007

RESULTS/ACCOMPLISHMENTS

On August 15, 2006, about two weeks after planting, the first evaluation was performed since some species had already emerged. Eighty percent of the grass species (including warm season grasses) had germinated, however, the forbs had only a few entries that showed emergence at this date

On September 29, 2006, since all warm season grass species (except 'Galleta') had germinated, the plots were mulched with grass-hay to protect them from frost heaving damage during the winter months.

On April 30, 2007, the plots were evaluated to determine survivability over the winter, and also to make note of the species that germinated in the spring of 2007. Most of the forbs that did not germinate during the fall of 2006 were showing about 50 percent germination. Also, the Indian ricegrass that had no germination during the fall-2006 had now 90 percent germination. Out of the ten entries of warm season grasses that germinated during the fall, only the blue grama

species and alkali sacaton could be found. Most of the other species suffered winter damage and only a few plants were visible.

On May 24, 2007, all warm season grasses were replanted including the ones that had a few plants to insure a full stand. By July 5, 2007, the warm season grasses had all germinated and were progressing well. The entire demonstrational planting was showing excellent plant vigor and stand. Observations will continue during growing season of 2008.

Growing Season of 2008

The demonstrational planting was evaluated in September 4, 2008, for plant establishment. Most of all species are doing well, including the warm season grasses.

Table 2. Percent Plant Stand for 61 Native species of Grasses and Forbs. UCEPC-2008

Entry #	Release Name/Accession	Common Name	Plant Stand[1]	Seed Source
UCEPC Cool Season Grass Species				
1	Arriba	Western wheatgrass	100	UCEPC
2	Luna	Intermediate wheatgrass	100	UCEPC
3	San Luis	Slender wheatgrass	95	UCEPC
4	Pueblo Germplasm	Squirreltail	100	UCEPC
5	Wapiti Germplasm	Squirreltail	45	UCEPC
6	Garnet Germplasm	Mountain brome	100	UCEPC
7	Redondo	Arizona fescue	85	UCEPC
8	Hycrest	Crested wheatgrass	100	UCEPC
9	Peru Creek	Tufted hairgrass	40	UCEPC
10	Volga	Mammoth wildrye	100	UCEPC
11	9092261	Poa	100	UCEPC
12	9040137	Columbia needlegrass	100	UCEPC
13	9092282	Sandberg bluegrass	100	UCEPC
14	9092272	Mutton grass	100	UCEPC
15	9070976	Thurber's fescue	25	UCEPC
16	9092284	Mountain muhly	95	UCEPC
17	9024739	Indian ricegrass	100	UCEPC
18	9070952	Bluebunch	100	UCEPC
19	9043501	Salina wildrye	100	UCEPC
20	L-45	Basin wildrye Cross	100	ARS-Logan, UT/UCEPC
UCEPC Forbs Species				
21	ARS-2678	Kura clover	100	UCEPC
22	Timp	Utah sweetvetch	95	UCEPC
23	Summit	Louisiana sage	95	UCEPC
24	Bandera	Rocky Mountain penstemon	100	UCEPC
25	9024993	Rydberg's penstemon	95	UCEPC
26	9070934	Sticky cinquefoil	100	UCEPC

Entry #	Release Name/Accession	Common Name	Plant Stand[1]	Seed Source
27	9092283	Utah sweetvetch	70	UCEPC
28	9070972	Senecio	70	UCEPC
29	9024921	Sulphur buckwheat	5	UCEPC
30	9021471	Fringed sage	95	UCEPC
Other PMC's Cool Season Grass Species				
31	Sodar	Streambank wheatgrass	100	Aberdeen , PMC
32	Critana	Thick spike wheatgrass	100	Bridger, PMC
33	Rosana	Western wheatgrass	100	Bridger, PMC
34	Newhy	Hybrid wheatgrass	100	Aberdeen, PMC
35	Rush	Intermediate wheatgrass	100	Aberdeen , PMC
36	Trailhead	Basin wildrye	100	Bridger, PMC
37	Anatone	Blue Bunch wheatgrass	100	Aberdeen, PMC
38	Vavilov	Siberian wheatgrass	100	Aberdeen, PMC
39	Whitmar	Beardless Wheatgrass	100	Pullman, PMC
40	Covar	Sheep Fescue	100	Pullman, PMC
Other PMC's Warm Season Grass Species				
41	9005439	Switchgrass	70	Bridger, PMC
42	Dacotah	Switchgrass	65	Bismarck, PMC
43	Bison	Big bluestem	80	Bismarck, PMC
44	Bad river	Blue grama	100	Bismarck, PMC
45	Salado	Alkali sacaton	80	Los Lunas, PMC
46	Pierre	Sideoats grama	95	Bismarck, PMC
47	Vaughn	Sideoats grama	95	Los Lunas, PMC
48	Badlands	Little bluestem	50	Bismarck, PMC
49	Alma	Blue grama	95	Los Lunas, PMC
50	Viva	Galleta grass	0	Los Lunas, PMC
Other PMC's Forb species				
51	Great Northern Germplasm	Common yarrow	100	Bridger, PMC
52	San Juan Germplasm	Penstemon	80	Los Lunas, PMC
53	Richfield Germplasm	Eaton's penstemon	95	Bridger, PMC
54	Maple Grove Germplasm	Prairie flax	70	Aberdeen, PMC
55	Appar	Prairie flax	75	Aberdeen, PMC
56	Bismarck Germplasm	Violet prairie clover	50	Bismarck, PMC
57	Antelope Germplasm	White prairie clover	60	Bridger, PMC
58	Stillwater Germplasm	Prairie coneflower	95	Bridger, PMC
59	Bismarck Germplasm	Narrow-leaved purple coneflower	80	Bismarck, PMC
60	Medicine Creek Germplasm	Maximilian sunflower	95	Bismarck, PMC
61		Canada milkvetch*	35	Pullman, PMC

1. Visual estimate; two complete rows per plot = 100 percent plant stand

Project COPMC-F-0604-RA
Report-2008
By: Manuel Rosales

Harvey Gap Demonstrational Planting

OBJECTIVE

To determine adaptability of 20 cool and warm season perennial grasses and forbs for educational, demonstrational, and training purposes.

INTRODUCTION

This demonstrational planting was set up as a request from the Glenwood Springs Field Office and the Conservation Districts in Garfield and Pitkin Counties in Colorado. At present, the Glenwood field office has a limited list of plant materials that can be recommended in the area. There is a need to increase the number of adapted perennial native grasses and forbs that can be recommended in the area. This technology development study was set up to fill this need.

EXPERIMENTAL DESIGN

This is a non-replicated planting.

MATERIALS & METHODS

The site was prepared with a fall application of herbicide on October 25, 2005, to eliminate existing brush, cheatgrass, native forbs, and grasses. The site received another application of herbicide on May 10, 2006, to kill some remaining brush, weeds, and perennial native grasses. The site was then plowed and disked. On November 1, 2006, a dormant planting was completed (see table 1.). Seventeen perennial cool season grasses and three warm season grasses were seeded with an old 10-foot-wide grain drill, except for Pastura-little blue stem which was hand broadcast. The plot size is 10 feet wide by 50 feet long; a total of 500 square feet per plot. All plots were dragged with a chain pulled with 2-ATVs (All terrain vehicles) after drilling to insure seed coverage and soil contact. The soil at the site is Vail silt loam. The entire site was then fenced to protect it from grazing of cattle and big game wildlife.

The site is located in the property of Cooperator and District board member, Larry Sweeney, near Rifle, Colorado. The average yearly precipitation for the site is 14-16 inches. The elevation is about 5600 feet. This is a dryland field planting with no irrigation.

Table 1. Sweeney's Demonstrational Planting.

Plot # (south-north)	**Release/Accession**	**Common Name**	**Scientific Name**
1	Arriba	Western wheatgrass	*Pascopyrum smithii*
2	Sodar	Streambank wheatgrass	*Elymus lanceolatus*
3	Douglas	Crested wheatgrass	*Agropyron cristatum*
4	Goldar	Bluebunch wheatgrass	*Pseudoroegneria spicata*
5	San Luis	Slender wheatgrass	*Elymus trachycaulus*
6	Luna	Pubescent wheatgrass	*Thinopyrum intermedium*
7	Ephraim	Crested wheatgrass	*Agropyron cristatum*
8	Newhy	Hybrid wheatgrass	*Elymus hoffmannii*
9	Lodorm	Green needlegrass	*Nassella viridula*
10	Covar	Sheep fescue	*Festuca ovina*
11	NW Colorado	Prairie Junegrass?	*Poa spp.*
12	Pueblo	Squirreltail	*Elymus elymoides*
13	Paloma	Indian ricegrass	*Achnatherum hymenoides*
14	Paiute	Orchard grass	*Dactylis glomerata*
15	Bozoisky	Russian wildrye	*Psathyrostachys juncea*
16	Trailhead	Basin wildrye	*Leymus cinereus*
17	Mandan	Canada wildrye	*Elymus canadensis*
18	Bad River	Blue grama	*Bouteloua gracilis*
19	Niner	Sideoats grama	*Bouteloua curtipendula*
20	Pastura	Little bluestem	*Schizachyrium scoparium*

RESULTS/ACCOMPLISHMENTS

2007-Results: On April 26, 2007, the plots were inspected to determine which species were germinating. Unfortunately, the entire area was covered with cheatgrass *Bromus tectorum* and it was very difficult to distinguish our seeded grasses. Application of herbicide was not an option since it would also kill the new grass seedlings. An attempt to get rid of cheat grass by hand-hoeing was made; however, the task was impossible since it was hard to see the rows of seedling grasses. As an alternative to hand-hoeing, the entire plot area was mowed with a hand-pushed mower to a height of about three-inches to control the growth of cheatgrass and prevent it from going to seed. The area was mowed four times until the cheat grass started to die back due to mowing and hot weather. The mowing was effective in controlling cheat grass and preventing it from forming seed heads.

On August 22, 2007, Larry Sweeney, reported on the status of the plots as follows:

1. Arriba – Western wheatgrass – Very sparse (3" - 4" growth)
2. Sodar Streambank wheatgrass – Virtually no growth
3. Douglas Crested wheatgrass - Virtually no growth

4. Goldar Bluebunch wheatgrass - Virtually no growth
5. San Luis Slender wheatgrass - Virtually no growth
6. Luna Pubescent wheatgrass - Virtually no growth
7. Ephraim Crested wheatgrass - Virtually no growth
8. Newhy Hybrid wheatgrass - Virtually no growth
9. Lodorm Green needlegrass – Almost nothing (4" – 5" growth)
10. Covar Sheep fescue – Good, but not full (2" – 3" growth)
11. NW Colorado Prairie Junegrass(Poa) – Full (5" – 10" growth)
    a. Although still much green, some browning has occurred
    b. Very few weeds in this section – Some Thistle
12. Pueblo squirreltail – Sparse (6" – 7" growth)
13. Paloma Indian ricegrass – Very sparse (5" – 6" growth)
14. Pauite Orchard grass – Sparse (3" – 4" growth)
15. Bozoisky Russian wildrye – Very sparse (4" – 5" growth)
16. Trailhead Basin wildrye – Sparse (4" growth)
17. Mandan Canada wildrye – Almost nothing (2-1/2" growth)
18. Bad River Blue grama – Nothing
19. Niner Sideoats – Nothing
20. Pastura Little blue stem – Nothing

Larry also reported that no measurable precipitation occurred during the months of May, June and July. Some Monsoonal rains occurred in late July and early August, however, they were not recorded

On September 25, 2007, the plots were visited again to make a determination on re-seeding the plots. At this date it appeared that Covar-Sheep fescue, NW Colorado –Poa (Prairie Junegrass), Paloma-Indian ricegrass and Bozoisky-Russian Wildrye were the plots that had a good plant stand (35% - 40% for all of them except NW-Colorado that had 90% plant stand). A decision was made to re-seed in order to have a better demonstrational planting. **On October 26, 2007,** the plots were re-seeded except for NW Colorado Prairie Junegrass (Poa). The plots were re-planted with hand -Planet Jr. - seeders. The warm season plots were replaced with native perennial forbs as follow:
Plot-18- Appar-Prairie flax *Linum lewisii*
Plot-19- Timp-Utah sweetvetch *Hedysarum boreale*
Plot-20 Bandera-Rocky Mountain penstemon *Penstemon strictus*
Also plot -12 Pueblo-squirreltail was replace with Wapiti-squirreltail.

After finishing the re-seeding, all the plots with no signs of germination were sprayed with a 3% solution of glyphosate (Round-up) to kill the existing cheatgrass and other indigenous grass plants.

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By: Manuel Rosales

2008-Results: On May 28, 2008, the plots were visited by Terri Blanke and Heather Plumb from the UCEPC. The plots were weeded at this time and field notes were taken to record the plots that were showing signs of establishment. On July 18, Terri Blanke and Manuel Rosales visited the plots to weed and make an evaluation for the season. The results are presented in the following table.

Table 2. Sweeney's Demonstrational Planting.
Results for Growing Season-2008.

Release/Accession	Common Name	Percent Plant Stand[1]
Wapiti	Squirreltail	95
Paiute	Orchard Grass	95
Mandan	Canada Wildrye	95
Timp (forb)	Utah Sweet-Vetch	95
Bandera (forb)	Rocky Mountain Penstemon	95
Covar	Sheep Fescue	90
NW Colorado	Prairie Junegrass?	90
Bozoisky	Russian Wildrye	90
Trailhead	Basin Wildrye	85
Paloma	Indian Ricegrass	65
Goldar	Bluebunch Wheatgrass	5
San Luis	Slender Wheatgrass	5
Luna	Pubescent Wheatgrass	5
Ephraim	Crested Wheatgrass	5
Appar (forb)	PrairieFlax	5
Arriba	Western Wheatgrass	3
Sodar	Streambank Wheatgrass	3
Douglas	Crested Wheatgrass	3
Lodorm	Green Needlegrass	3
Newhy	Hybrid Wheatgrass	2

1. Visual estimate per plot basis.

As shown in table 2, the performance of the wheatgrasses was very low as compared to the other grass species. It is interesting to mention here that western wheatgrass is one of the naturally occurring grasses in this site; however, we have not been successfully in establishing any of the improved wheatgrasses yet. Persistence, perspiration and patience are good teachers, therefore, we decided to re-seed the wheatgrasses again and give them another chance. The re-seeding took place on November 19, 2008. Ten entries were re-seeded as shown in table 3.

Table 3. Sweeney's Demonstrational Planting

Plot #	Variety/Accession	Species	Status* Re-seeded on November 19-08
1	Arriba	Western Wheatgrass	Re-seeded
2	Sodar	Streambank Wheatgrass	Re-seeded
3	Douglas	Crested Wheatgrass	Re-seeded with Hycrest
4	Goldar	Blue Bunch Wheatgrass	Re-seeded with Whitmar
5	San Luis	Slender Wheatgrass	Re-seeded
6	Luna*	Pubescent Wheatgrass	Re-seeded
7	Ephraim	Crested Wheatgrass	Re-seeded with Pueblo-Squirreltail
8	Newhy*	Hybrid Wheatgrass	Re-seeded
9	Lodorm*	Green Needle Grass	Re-seeded
10	Covar	Sheep Fescue	Not re-seeded
11	Poa (not reseeded)	Poa ampla	Not re-seeded
12	Wapiti	Squirreltail	Not re-seeded
13	Paloma	Indian Rice Grass	Not re-seeded
14	Paiute	Orchard Grass	Not re-seeded
15	Bozoisky	Russian Wild Rye	Not re-seeded
16	Trailhead	Basin Wild Rye	Not re-seeded
17	Mandan	Canada Wild Rye	Not re-seeded
18	Appar (Forb)*	Lewis Flax	Re-seeded
19	Timp (Forb)	Utah Sweetvetch	Not re-seeded
20	Bandera (Forb)	Penstemon	Not re-seeded

- *** Note** : In addition to re-seeding, some of the entries were replaced with another release of the same specie, except Ephraim-Crested wheatgrass that was replaced with Pueblo-Bottlebrush Squirreltail.
- **Original Planting:** November 1, 2006, (Drill: 10-foot wide grain drill)
- **Reseeding Dates:** October 26, 2007, & Nov19, 2008, (drill: hand pushed Planet Jr.)

We will continue to monitor the plots, and use whatever results we get for educational and demonstrational purposes.

Project COPMC-F-0605-RA
Report-2008
By: Manuel Rosales

Bluebell Field Evaluation Planting

OBJECTIVE

To determine adaptability of most applicable plant materials for use in low precipitation sandy sites to support Field Office Technical Guide (FOTG) and PM-releases. The top rated species will be recommended to be listed in the FOTG to be used by local NRCS field offices in Utah. These plant materials can then be recommended to solve rangeland resource concerns and natural resource concerns where plant materials are applicable. The off-center plots will also be used for educational, demonstrational, and training purposes.

INTRODUCTION

This off-center planting was requested by the NRCS Area Range Conservationist in Roosevelt, Utah, to further test the cool season grass species that did well on the Coyote Draw trial. The Coyote Draw site had very similar climatic conditions except the soils were clayey at Coyote Draw and the soils on this site are sandy soils. Currently, the local NRCS Field Office have very few native and introduced grass species to recommend to producers to plant under these conditions in order to solve the resource concerns. There is a need to increase the number of adapted perennial native grasses that can be recommended in the area. This technology development study was set up to fill this need.

EXPERIMENTAL DESIGN

The statistical design for this study is a randomized complete block with four replications

MATERIALS & METHODS

Fifty accessions (plant material releases and experimentals) were planted on November 7, 2006, (See Table 1). The planting was done with a four-row plot cone-seeder. The rate of seeding was 30 pure live seeds per linear foot of row. The plot size is 4 x 20 feet with four rows per plot spaced about one foot apart. No seed bed preparation was done before planting. The average annual precipitation for the site is 8-12 inches. The soil texture for the site is sandy loam. The site is located about 15 miles west from the Roosevelt, Utah Service Center, at an elevation of about 6200 feet. Site was fenced to protect it from grazing cattle, big game wildlife, and rabbits. This is a dryland off-center planting with no irrigation.

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By: Manuel Rosales

Table 1. Fifty Entries of Perennial Grasses for Bluebell, Utah, Off-Center Evaluation.

Entry No.	Release/ Accession	Common Name	Scientific Name	Seed Source
1	Nezpar	Indian ricegrass	*Achnatherum hymenoides*	Aberdeen, ID
2	Anatone	Bluebunch wheatgrass	*Pseudoroegnaria spicata*	Aberdeen, ID
3	Goldar	Bluebunch wheatgrass	*Pseudoroegnaria spicata*	Aberdeen, ID
4	Bannock	Thickspike wheatgrass	*Elymus lanceolatus*	Aberdeen, ID
5	Sodar	Streambank wheatgrass	*Elymus lanceolatus*	Aberdeen, ID
6	Magnar	Basin wildrye	*Leymus cinereus*	Aberdeen, ID
7	Ephraim	Crested wheatgrass	*Agropyrum cristatum*	Aberdeen, ID
8	Rush	Intermediate wheatgrass	*Elytrigia intermedia*	Aberdeen, ID
9	Rimrock	Indian ricegrass	*Achnatherum hymenoides*	Bridger. MT
10	Critana	Thickspike wheatgrass	*Elymus lanceolatus*	Bridger. MT
11	Trailhead	Basin wildrye	*Leymus cinereus*	Bridger. MT
12	Goshen	Prairie sandreed	*Calamovilfa longifolia*	Bridger. MT
13	Paloma	Indian ricegrass	*Achnatherum hymenoides*	Los Lunas, NM
14	Tusas	Bottlebrush squirreltail	*Elymus elymoides*	Los Lunas, NM
15	Alma	Blue grama	*Bouteloa gracilis*	Los Lunas, NM
16	Hachita	Blue grama	*Bouteloa gracilis*	Los Lunas, NM
17	Niner	Sideoats	*Bouteloa curtipendula*	Los Lunas, NM
18	Vaughn	Sideoats	*Bouteloa curtipendula*	Los Lunas, NM
19	Aldous	Little bluestem	*Schyzachyrium scoparium*	Los Lunas, NM
20	Bad river	Blue grama	*Bouteloa gracilis*	Bismark, ND
21	Pierre	Sideoats	*Bouteloa curtipendula*	Bismark, ND
22	Badlands	Little bluestem	*Schyzachyrium scoparium*	Bismark, ND
23	Nordan	Crested wheatgrass	*Agropyrum cristatum*	Bismark, ND
24	739	Indian ricegrass	*Achnatherum hymenoides*	Meeker, CO
25	Pueblo	Bottlebrush squirreltail	*Elymus elymoides*	Meeker, CO
26	Wapiti	Bottlebrush squirreltail	*Elymus elymoides*	Meeker, CO
27	State Bridge	Bottlebrush squirreltail	*Elymus elymoides*	Meeker, CO
28	Colorado	Bluebunch wheatgrass	*Pseudoroegnaria spicata*	Meeker, CO
29	Graystone	Needle & thread	*Hesperostipa comata*	Meeker, CO
30	Maybell	Needle & thread	*Hesperostipa comata*	Meeker, CO
31	Simms	Needle & thread	*Hesperostipa comata*	Meeker, CO
32	Yampa	Prairie Junegrass	*Koeleria comata*	Meeker, CO
33	Price	Salina wildrye	*Leymus salinus*	Meeker, CO
34	Luna	Intermediate wheatgrass	*Elytrigia intermedia*	Meeker, CO
35	Volga	Mammoth wildrye	*Leymus racemosu*	Meeker, CO
36	Arriba	Western wheatgrass	*Pascopyrum smithii*	Meeker, CO
37	Fish Creek	Bottlebrush squirreltail	*Elymus elymoides*	ARS-Logan, UT
38	Sand Hollow	Bottlebrush squirreltail	*Elymus elymoides*	ARS-Logan, UT
39	Toe Jam Creek	Bottlebrush squirreltail	*Elymus elymoides*	ARS-Logan, UT
40	P-24	Bluebunch wheatgrass	*Pseudoroegnaria spicata*	ARS-Logan, UT
41	P-7	Bluebunch wheatgrass	*Pseudoroegnaria spicata*	ARS-Logan, UT
42	Continental	Basin wildrye	*Leymus cinereus*	ARS-Logan, UT
43	L-46	Basin wildrye	*Leymus cinereus*	ARS-Logan, UT

Entry No.	Release/ Accession	Common Name	Scientific Name	Seed Source
44	Douglas	Crested wheatgrass	*Agropyron cristatum*	ARS-Logan, UT
45	Hycrest-II	Crested wheatgrass	*Agropyron cristatum*	ARS-Logan, UT
46	Vavilov	Siberian wheatgrass	*Agropyrum fragila*	ARS-Logan, UT
47	Bozoisky II	Russian wildrye	*Psathyrostachys juncea*	ARS-Logan, UT
48	P-22	Bluebunch wheatgrass	*Pseudoroegnaria spicata*	ARS-Logan, UT
49	White River	Indian ricegrass	*Achnatherum hymenoides*	ARS-Logan, UT
50	Star Lake	Indian ricegrass	*Achnatherum hymenoides*	ARS-Logan, UT

RESULTS

On May 11, 2007, the plots were sprayed with herbicide Buctryl and 2,4-D at recommended rates to eliminate some of the broadleaved weeds.

On July 24, 2007, the plots were evaluated. A visual estimate of plant stand per plot was recorded and analyzed statistically (See table 2). Rabbits had gained access to the plots and had done considerable damage to most plots. Plant vigor was not taken due to the damaged performed by rabbits, making it impossible to truly assess plant vigor. The plots will continue to be evaluated in subsequent years until sufficient data is collected to make confident recommendations.

Table 2. Percent Plant Stand per Plot for 50 Perennial Grasses. Bluebell, Utah. 2007

Rank	Release/Accession	Common Name	% Plant Stand*
1	Luna	Intermediate wheatgrass	38.75
2	Continental	Basin wildrye	28.25
3	Trailhead	Basin wildrye	26.25
4	Fish Creek	Bottlebrush squirreltail	23.00
5	P-7	Bluebunch wheatgrass	20.25
6	Vavilov	Siberian wheatgrass	19.50
7	Volga	Mammoth wildrye	19.25
8	P-24	Bluebunch wheatgrass	19.00
9	Rush	Intermediate wheatgrass	17.25
10	Douglas	Crested wheatgrass	16.75
11	Toe Jam Creek	Bottlebrush squirreltail	14.75
12	P-22	Bluebunch wheatgrass	14.50
13	Paloma	Indian ricegrass	13.25
14	Goldar	Bluebunch wheatgrass	11.25
15	Nordan	Crested wheatgrass	10.5
16	Sand Hollow	Bottlebrush squirreltail	7.75
17	Anatone	Bluebunch wheatgrass	7.00
18	Sodar	Streambank wheatgrass	5.75
19	Magnar	Basin wildrye	5.75
20	Bozoisky II	Russian wildrye	4.25
21	Hycrest-II	Crested wheatgrass	3.50

Rank	Release/Accession	Common Name	% Plant Stand*
22	Rimrock	Indian ricegrass	3.00
23	State Bridge	Bottlebrush squirreltail	3.00
24	Arriba	Western wheatgrass	3.00
25	Critana	Thickspike wheatgrass	2.75
26	L-46	Basin wildrye	2.75
27	Star Lake	Indian ricegrass	2.75
28	Bannock	Thickspike wheatgrass	2.00
29	Nezpar	Indian ricegrass	1.75
30	Graystone	Needle & thread	1.75
31	White River	Indian ricegrass	1.75
32	Maybell	Needle & thread	1.50
33	Ephraim	Crested wheatgrass	0.75
34	Alma	Blue grama	0.75
35	739	Indian ricegrass	0.75
36	Pueblo	Bottlebrush squirreltail	0.75
37	Colorado	Bluebunch wheatgrass	0.75
38	Simms	Needle & thread	0.75
39	Hachita	Blue grama	0.50
40	Aldous	Little bluestem	0.50
41	Yampa	Prairie Junegrass	0.50
42	Price	Salina wildrye	0.50
43	Goshen	Prairie sandreed	0.25
44	Tusas	Bottlebrush squirreltail	0.25
45	Niner	Sideoats	0.25
46	Vaughn	Sideoats	0.25
47	Bad river	Blue grama	0.25
48	Pierre	Sideoats	0.25
49	Badlands	Little bluestem	0.25
50	Wapiti	Bottlebrush squirreltail	0.25
LSD (0.05)[1]			13.5

*****Percent plant stand is the average of four observations. Plant stand was measured by making a visual estimate per plot; if entire four rows/plot germinated the entry was recorded as 100 percent establishment.

1. LSD = Least Significant Difference at P<0.05. Results were significantly different at the 5% level of probability.

Results for 2008

The plots were evaluated for the second growing season in May 25, 2008. From the time the plots were planted to May 15, 2008, the plots received about 10 inches of precipitation for a period of 18.5 months. This is a good indication that the species that are performing well are very drought tolerant. Table 3 presents the results of the evaluation for 2008.

Table 2. Percent Plant Stand and Vigor for 50 Perennial Grasses. Bluebell - Utah. 2008

Rank.	Release/Accession	Common Name	% Plant Stand[1]*	Plant Vigor[2]
1	Luna	Intermediate wheatgrass	43.7	1.3
2	Rush	Intermediate wheatgrass	25.3	2.3
3	Fish Creek	Bottlebrush squirreltail	23.8	2.0
4	Paloma	Indian ricegrass	23.8	
5	Vavilov	Siberian wheatgrass	20.8	1.5
6	Continental	Basin wildrye	20.0	2.3
7	Volga	Mammoth wildrye	17.8	1.3
8	Nordan	Crested wheatgrass	15.5	1.8
9	P-7	Bluebunch wheatgrass	13.5	1.5
10	P-24	Bluebunch wheatgrass	13.5	1.8
11	Trailhead	Basin wildrye	11.8	3.0
12	Douglas	Crested wheatgrass	11.8	2.5
13	Graystone	Needle & thread	9.5	1.8
14	Nezpar	Indian ricegrass	8.8	1.3
15	Toe Jam Creek	Bottlebrush squirreltail	8.5	2.3
16	Rimrock	Indian ricegrass	7.3	1.5
17	White River	Indian ricegrass	6.5	2.3
18	Sodar	Streambank wheatgrass	5.5	2.0
19	P-22	Bluebunch wheatgrass	4.0	1.0
20	Arriba	Western wheatgrass	4.0	1.8
21	Maybell	Needle & thread	3.8	1.8
22	Sand Hollow	Bottlebrush squirreltail	3.5	1.5
23	Anatone	Bluebunch wheatgrass	3.5	1.8
24	739	Indian ricegrass	3.5	1.8
25	Goldar	Bluebunch wheatgrass	3.3	2.5
26	Bozoisky_II	Russian wildrye	2.8	1.5
27	Bannock	Thickspike wheatgrass	2.3	1.8
28	Critana	Thickspike wheatgrass	2.0	1.8
29	L-46	Basin wildrye	1.8	2.3
30	Magnar	Basin wildrye	1.5	2.3
31	State Bridge	Bottlebrush squirreltail	1.5	1.8
32	Colorado	Bluebunch wheatgrass	1.5	2.3
33	Simms	Needle & thread	1.5	1.0
34	Star Lake	Indian ricegrass	1.3	2.0
35	Hycrest-II	Crested wheatgrass	1.0	2.3
36	Ephraim	Crested wheatgrass	0.8	2.3
37	Pueblo	Bottlebrush squirreltail	0.5	1.0
38	Price	Salina wildrye	0.5	1.8
39	Wapiti	Bottlebrush squirreltail	0.5	1.5
40	Tusas	Bottlebrush squirreltail	0.3	1.0
41	Alma	Blue grama	0	
42	Hachita	Blue grama	0	
43	Aldous	Little bluestem	0	
44	Yampa	Prairie Junegrass	0	

Rank.	Release/Accession	Common Name	% Plant Stand[1]*	Plant Vigor[2]
45	Goshen	Prairie sandreed	0	
46	Niner	Sideoats	0	
47	Vaughn	Sideoats	0	
48	Bad river	Blue grama	0	
49	Pierre	Sideoats	0	
50	Badlands	Little bluestem	0	
LSD(0.05)[3]			13.8	1.31

1. Plant stand: Visual estimate per plot: Four complete rows = 100 percent
2. Plant vigor: Visual estimate per plot: 1 = Excellent; 2 = Good, 3 = Fair ; 4 = Poor; 5 = Very poor
3. LSD =Least Significant Difference at P<0.05.

Project COPMC-F-0801-RA
Report-2008
By: Manuel Rosales

Snowmass Field Evaluation Planting

OBJECTIVE

To determine suitability of grasses for high altitude revegetation

INTRODUCTION

There is limited information on the performance of perennial native grasses and forbs at altitudes near 8000 feet or above. With this in mind, Upper Colorado Environmental Plant Center in cooperation with Mount Sopris Conservation District, and St. Benedict's Monastery installed a high altitude planting to evaluate the performance of different species. The site is located on the Monastery at 7800 feet.

EXPERIMENTAL DESIGN

The statistical design for the study is a randomized complete block with four replications

MATERIALS & METHODS

The planting site was prepared in the fall of 2006 and spring of 2007. Existing vegetation was removed by chemical and mechanical means. The site was seeded on October 4-5, 2007. Thirty eight species were seeded with a four-row cone-seeder. The rate of seeding was 30 pure live seeds per linear foot of row. The plot size is 4 x 20 ft with four rows. The site was also fenced to protect the planting from livestock use. Plots will be evaluated for establishment, vigor and performance for at least five years. Table-1 lists the 38 entries for the study:

Table1. 38 Grass Species Planted at Snowmass

Common Name	Release Name or Accession No.	Scientific Name
Arizona fescue	Florrisant	*Festuca arizonica*
Arizona fescue	Redondo	*Festuca arizonica*
Big bluegrass	Yampa	*Poa secunda*
Big bluegrass	Sherman	*Poa secunda*
Bluebunch	Anatone	*Pseudoroegnaria spicata*
Bluebunch	Colorado BLM	*Pseudoroegnaria spicata*
Bluebunch	Goldar	*Pseudoroegnaria spicata*
Bluebunch	P7	*Pseudoroegnaria spicata*
Blue wildrye	California Park	*Elymus glaucus*
Blue wildrye	Flat Tops	*Elymus glaucus*
Blue wildrye	Marvine	*Elymus glaucus*
Blue wildrye	Park Range	*Elymus glaucus*
Blue wildrye	Rabbit Ears	*Elymus glaucus*

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Common Name	Release Name or Accession No.	Scientific Name
Blue wildrye	Uncompahgre	*Elymus glaucus*
Bottlebrush	State Bridge BLM	*Elymus elymoides*
Bottlebrush	Tusas	*Elymus elymoides*
Bottlebrush	Wapiti	*Elymus elymoides*
Columbia needlegrass	2A	*Achnatherum nelsonii*
Columbia needlegrass	12A	*Achnatherum nelsonii*
Indian ricegrass	715	*Achnatherum hymenoides*
Indian ricegrass	739	*Achnatherum hymenoides*
Indian ricegrass	741	*Achnatherum hymenoides*
Indian ricegrass	Rimrock*	*Achnatherum hymenoides*
Meadow brome	Regar	*Bromus biebersteinii*
Mountain brome	Garnet	*Bromus marginatus*
Mountain brome	Elk Creek	*Bromus marginatus*
Mountain muhly	Florrisant	*Muhlenbergia montana*
Salina wildrye	Price	*Leymus salinus*
Sandberg's bluegrass	Gypsum	*Poa secunda*
Sandberg's bluegrass	High Plains	*Poa secunda*
Slender wheatgrass	Pryor	*Elymus trachycaulus*
Slender wheatgrass	San Luis	*Elymus trachycaulus*
Slender wheatgrass	Summitville	*Elymus trachycaulus*
Spike trisetum	Summitville	*Trisetum spicatum*
Thurber's fescue	Hiner Spring	*Festuca thurbery*
Western wheatgrass	Arriba	*Pascopyrum smithii*
Western wheatgrass	Irish Canyon BLM	*Pascopyrum smithii*
Western wheatgrass	Rosana	*Pascopyrum smithii*

RESULTS

On July 17, 2008, the plots were weeded by hand and evaluated. Most species established very well for the first year after planting. The evaluation results for the 2008 growing season are presented in table 2.

Table 2. Plant Stand and Vigor
Snow Mass Field Evaluation Planting-2008. UCEPC

Common Name	Release Name or Accession No.	Plant Stand[1]	Vigor [2]
Mountain brome	Elk Creek	93.8	1.0
Slender wheatgrass	Pryor	85.0	1.0
Mountain brome	Garnet	82.5	1.0
Slender wheatgrass	San Luis	82.5	1.0
Bottlebrush	Wapiti	78.8	1.3
Blue wildrye	California Park	77.5	1.8
Bluebunch	P7	75.0	1.5

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Common Name	Release Name or Accession No.	Plant Stand[1]	Vigor [2]
Meadow brome	Regar	71.3	2.3
Bluebunch	Goldar	70.0	1.5
Blue wildrye	Flat Tops	68.8	1.8
Bottlebrush	State Bridge BLM	66.3	1.3
Western wheatgrass	Rosana	65.0	2.0
Slender wheatgrass	Summitville	63.8	2.5
Blue wildrye	Marvine	59.5	1.8
Blue wildrye	Park Range	58.8	2.3
Blue wildrye	Rabbit Ears	56.3	2.3
Blue wildrye	Uncompahgre	55.0	2.0
Western wheatgrass	Arriba	53.8	2.5
Indian ricegrass	715	47.5	2.5
Indian ricegrass	741	47.5	2.3
Western wheatgrass	Irish Canyon BLM	46.3	3.0
Bluebunch	Anatone	43.8	1.0
Bluebunch	Colorado BLM	38.8	2.5
Indian ricegrass	739	35.0	2.8
Columbia needlegrass	12A	25.0	2.0
Indian ricegrass	Rimrock*	20.0	3.0
Columbia needlegrass	2A	17.0	2.5
Big bluegrass	Yampa	10.8	3.3
Big bluegrass	Sherman	10.0	3.5
Salina wildrye	Price	9.0	3.5
Arizona fescue	Florrisant	4.8	4.0
Arizona fescue	Redondo	3.3	4.0
Thurber's fescue	Hiner Spring	3.0	3.0
Bottlebrush	Tusas	1.3	1.3
Mountain muhly	Florrisant	1.3	1.3
Sandberg's bluegrass	Gypsum	0.3	1.0
Sandberg's bluegrass	High Plains	0.3	1.0
Spike trisetum	Summitville	0.0	0.0
LSD (0.05)[3]		17.2	1.3

1. Plant stand: Visual estimate per plot: Four complete rows = 100 percent
2. Plant vigor: Visual estimate per plot: 1 = Excellent; 2 = Good, 3 = Fair ; 4 = Poor; 5 = Very poor
3. Least Significant Difference at $P<0.05$.

Project: COPMC-F-0802-IN
Report- 2008
By: Terri Blanke and Heather Plumb

Tamarisk Replacement Planting

OBJECTIVE

To determine what native woody species are suitable and effective in replacing post treated tamarisk infested sites.

INTRODUCTION

Riparian ecosystems are ideal ecosystems for invasive plant specie infestations. There is an ever constant demand to use native plants for revegetating infested ecosystems. Upper Colorado Environmental Plant Center (UCEPC), United States Department of Agriculture (USDA), The Tamarisk Coalition and the Young Ranch are working cooperatively to rehabilitate a known riparian ecosystem where tamarisk *Tamarix* spp. has rigorously invaded and taken over the area.

MATERIALS AND METHODS

In February 2008, the UCEPC staff collected one hundred willow whips *Salix* spp. from Horsethief Canyon near Grand Junction Colorado. Willow whips were placed in cold storage for the winter and were kept in cold storage till spring planting. Most of the willow whips had begun developing roots and sprouts while in cold storage. Nine silver buffaloberry *Shepherdia argentea* were grown over a period of several years in the UCEPC greenhouse.

Planting of the willow whips and silver buffaloberries began May 29, 2008, at Salt Creek. Sites for willows were chosen according to erosion patterns along the creek bank. Approximately ten willows were planted in each site. Willows were planted as deeply as possible directly into the sand bank or in the creek itself. Of the 100 original willow whips, 50 were cut in half to make 50 additional whips to be inserted into the sand banks. A total of 150 willow whips were planted at the site. August 13, 2008, five more willows were planted at the site.

Two different sites were chosen for the silver buffaloberries. The first site was located 100 yards from Salt Creek in an old washed out area. The area was sprayed with glyphosate, Round-up, for weed control. Holes for the plants were hand dug and filled with water from the creek. One 4-year old plant and 3 two-year old plants were planted and watered. The second site was 1000 yards away from Salt Creek below an old terrace. The area was sprayed with Round-up for weed control. Holes were hand dug again and filled with creek water. One 4-year old, 3 two-year old plants and one 1-year old plant were planted and additionally watered.

Project: COPMC-F-0802-IN
Report- 2008
By: Terri Blanke and Heather Plumb

RESULTS

USDA office in Grand Junction observed deer browsing on the silver buffaloberries. August 13, 2008, UCEPC staff evaluated willows and silver buffaloberries. Tamarisk was sprouting and coming back within the treatment areas. A 20% survival rate for the willow whips was observed, majority of willow whips were washed away or died. Surviving willows ranged in size and location along Salt Creek. Eight wire pens were made and placed around the silver buffaloberries to prevent further deer damage. One silver buffaloberry plant at the first site by the creek was not found, and only three plants were observed. All plants at the second site were found. Silver buffaloberries that were observed were alive and trimmed to help promote growth.

CONCLUSION

Further evaluations must be performed in the future on the Salt Creek site for both silver buffaloberries and willows. Additional willow whips should be established to replace those lost in the previous year.

Project COPMC-F-0803-RI
Project Report-2008
By: Terri Blanke

Beefsteak Riparian Planting

OBJECTIVE

To determine adaptation of buffaloberry selection for riparian restoration plantings.

INTRODUCTION

With ongoing efforts to repair our riparian ecosystems from the damage done by invasion of Russian olive *Elaeagnus angustifolia L*. and tamarisk *Tamarix spp*. the need for restoration material is greater than ever. Upper Colorado Environmental Plant Center (UCEPC) and the Meeker Bureau of Land Management (BLM) have recognized this need and are working together to collect, propagate, increase, study, and implement the best suitable materials for these riparian restoration/enhancement projects. The Silver buffaloberry *Shepherdia argentea* is a hearty shrub native to Colorado with many conservation attributes. UCEPC has recognized silver buffaloberry as a possible native woody riparian replacement material.

EXPERIMENTAL DESIGN

This is a non-replicated planting.

MATERIALS & METHODS

On June 9, 2008, fifteen silver buffaloberry plants of various sizes were planted in the BLM Beefsteak pasture between the White River and County Road 64, Meeker, Colorado. The location hosted a variety of riparian species including willow, alder, juniper, hackberry, skunk brush, gamble oak, and volunteer buffaloberry. The soil was mostly sand /silt with plenty of moisture. The public access is also a holding field for cattle that are being relocated. Melissa Kendall and Mary Taylor of the Meeker BLM office, along with Heather Plumb and Terri Blanke of UCEPC, used a portable 8" auger for digging holes to place the shrubs in. The holes were filled with water and then backfilled as necessary. Planting locations varied to study survivability. Material was placed directly into the high water, on the shoreline, higher up on the bank and out into the field. UCEPC employees watered the shrubs periodically through the summer, and that fall, the shrubs were fenced for protection from wildlife browsing and cattle.
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RESULTS

UCEPC employees visited the site to water and evaluate the shrubs. Several head of cattle had spent the summer in the pasture and severely trampled and browsed the plants that were at water line. Eight of the nine shrubs originally planted had survived. UCEPC hosted a material training seminar and utilized the site for a group tour.

CONCLUSION

Silver buffaloberry plants are proving to be very hearty. They have survived heavy browsing and drought conditions. UCEPC will continue to monitor the shrubs for a possible release to the general public for conservation practices.

Project: COPMC-F-0804-RI
Report- 2008
By: Heather Plumb

Silver Buffaloberry Field Planting

OBJECTIVE

To determine adaptability of silver buffaloberry *Shepherdia argentea* selection for riparian plantings at high elevations in Colorado.

INTRODUCTION

Riparian ecosystems are extremely sensitive areas that are used by both humans and wildlife. Riparian areas are well known for major soil erosion problems because of natural and man induced practices, as a result, habitat can be severely degraded. Native plants are in constant demand to be used as soil and stream bank stabilizers to help eliminate or reduce soil erosion effects. Upper Colorado Environmental Plant Center (UCEPC) and the Gunnison Field Office are working cooperatively to rehabilitate known riparian ecosystems where soil erosion at high elevations has occurred and depleted riparian habitat. The plant specie chosen to be used in this field planting is Silver buffaloberry *Shepherdia argentea*. Silver buffaloberries are a deciduous, thorny shrub/tree that is well adapted to high elevations. Plants at maturity can reach heights of 6 to 20 feet. Roots are shallow and are readily sprouting making them excellent at stabilizing eroding soils. Silver buffaloberries are very common along streams and on exposed moist hillsides.

MATERIALS AND METHODS

June 26, 2008, forty live silver buffaloberries were picked up and delivered to Jason Turner at the Gunnison Field Office in Gunnison Colorado. Silver buffaloberry plants ranged in size and age. Plants delivered were as follows; one 1-gallon pot, one 3-gallon pot, two-6”x 16” tree pots, seven-2”x 12” cones, eighteen-2”x 2”x 11” tree pots and eleven-4”x 4”x 14” tree pots.

RESULTS

The buffaloberries were all planted the day after the Gunnison field office received them. They were planted in a reclaimed reservoir site. The site presented a great opportunity to test the plants in various soils (clayey to sandy loam) and at various depths to the water table. The landowner working with the Gunnison field office reported that in late summer 2008, many of the silver buffaloberries were looking good and he was optimistic.

CONCLUSION

The plan for further follow-up is to go back and visit the site in the summer of 2009. UCEPC staff and members from the Gunnison field office will visit the reclaimed reservoir site to evaluate how the buffaloberries survived over the winter and how they are doing at the high elevation site.

Project COPMC-F-0805-CR
Project Report - 2008
By: Steve Parr

Piceance Basin Evaluation Planting

INTRODUCTION

Successful revegetation of well pads, pipelines, roadsides, and other surface disturbances related to natural resource extraction is a critical aspect of long-term land stewardship. Energy extraction in Western Colorado and the associated activities has increased substantially since 2004. According to the U.S. Energy Information Administration, the nation's use of natural gas will increase by more than 50 percent by 2025. This is echoed by Joe Jaggers, vice president of exploration and production of Williams Energy Company, who said, "In a national sense, the Rocky Mountains have the most undeveloped potential that we can access".

This project addresses some of the most pressing natural resource conservation concerns that surface disturbing activities related to natural gas exploration, extraction, and transmission create. The construction of well pads, roads and pipeline transmission corridors are all activities that, if left unchecked, result in loss of topsoil and invasion by annual or noxious weeds. Additionally, if revegetation activities utilize improper methods or materials that are not suited to the site, failure is the most common result. In order to reduce or minimize the ecological negative affects of natural gas extraction, soil surface disturbances must be successfully revegetated with products that are well suited to the site and that have long term environmental benefits.

Private landowners, conservation district members, and public land managers are directly and indirectly affected by pipeline and well pad disturbances. Annual and invasive weed spread, soil loss, reduced grazing opportunities, water quality degradation and loss of wildlife habitat, including critical mule deer and sage grouse habitat, are some of the conservation challenges that landowners and land managers will be facing if surface disturbances occur without successful revegetation.

OBJECTIVE

The goal of this project is to identify practices and products that result in successful well pad revegetation. The principle objective is to identify which conservation plant materials will establish and persist on abandoned well pads, and secondarily, to compare how new releases and experimental products compare to current seed mix and source recommendations by NRCS and BLM field offices.

BACKGROUND

The Bureau of Land Management (BLM), White River Field Office, Riata Energy Company, and Upper Colorado Environmental Plant Center (UCEPC) were original partners on the project. Likely additional partners included the Natural Resources Conservation Service, Colorado State University, and Colorado Division of Wildlife. However, no additional partners have contributed time or resources as of the date of this report. Riata had agreed to allow UCEPC to conduct this

research on two well pads they had abandoned, and were to have fenced both sites to exclude livestock. In exchange, BLM was to release Riata's reclamation bond.

The two sites are typical of much of the Piceance Basin where extraction activities are being conducted. In addition, one site was identified as important sage grouse habitat and both sites are important mule deer habitat components. This project specifically addresses which plant material product(s), out of 52 entries, replicated four times, shows promise for long-term revegetation success on well pads that are plugged and recontoured. Successful revegetation ensures conservation of topsoil, reduction of weed invasion, improved wildlife habitat, and livestock grazing opportunities, reduced fire hazards, and enhanced water quality. Additionally, it will help to demonstrate that successful revegetation is an expected outcome of surface disturbing activities in the Piceance Basin.

In order to simulate actual well pad revegetation activities, a well pad that had been constructed, and then abandoned and recontoured prior to revegetation, was necessary. This effort required the coordination of the White River Field Office of the Bureau of Land Management, and resource specialists for many of the major oil and gas companies operating in the Piceance Basin. After several site evaluation trips, one was selected that was permitted to Riata Energy Company. Riata Energy Company, who was an initial partner on the project, provided the site location, did the recontour work on the well pad, and was in the process of signing a long-term agreement that would allow the research to be done on the site. They were also agreeable to pay for the fencing of the site. However, they sold to Sand Ridge Energy before the agreement was signed, and ceased all operations in the area. An agreement could not be reached with Sand Ridge, so the BLM identified the site as a public research location which is off limits to any future permitting for oil and gas activities. This permit is presently owned by Williams. Both the frequency of permit sales and the length of commitment by a given energy company to a research site were concerns of Upper Colorado Environmental Plant Center and BLM.

METHODS

Once the site was chosen, BLM acquired the necessary National Environmental Policy Act (NEPA) documentation to allow research on public lands. This permit allowed the use of herbicide and the construction of an exclosure fence around the research site. BLM sprayed herbicide (glyphosate) in the spring and fall of 2007 and 2008 to help control annual weeds. UCEPC personnel tilled the site with a vertical axis tiller prior to the last herbicide application. This was done to prepare a suitable seed bed and to germinate annual weeds before applying herbicide and installing the research project.

A draft species list was circulated within the local BLM office, the Meeker NRCS Field Office, NRCS State Plant Materials Specialist, and EnCana Oil and Gas (USA) Inc. (EnCana) field specialists. A final entry list was selected, and the materials were obtained. The project utilizes a randomized, complete block research design (included) for statistical analysis, and this, too, was circulated for input. The materials were assembled by UCEPC personnel, and the project was installed on September 26, 29, and 30, 2008. On October 31, the site was sprayed with

glyphosate to suppress or kill winter annual weeds that had germinated since the tilling operation on August 27.

The original NEPA permit, which allowed the construction of a livestock exclosure fence, was also determined to be acceptable to allow for the construction of a wildlife exclosure fence for the project. However, the correspondence confirming permission to construct a "wildlife exclosure" fence was not received until December 8, 2008. As a result, the fence was not constructed by the end of the calendar year, but the project was bid and a construction company has been selected to install the fence. EnCana had initially agreed to pay for the entire fencing project.

A written project description and two oral presentations were made to members of the Rio Blanco County Users Group. This group is an assembly of energy companies conducting oil and gas extraction activities in Rio Blanco and Garfield Counties. The interest in the project expressed by this group resulted in a tour of UCEPC facilities on September 10, prior to the monthly meeting.

A Matching Grant was provided by the Colorado State Conservation Board as the primary funding source for the project. This grant was a $25,000 cash award. The BLM provided coordination for the involvement of a cooperating energy company, and site selection that encompassed location and stage of development. The BLM also obtained the necessary NEPA documentation that allows for the establishment of a research site on public lands and the associated activities related to the research. The BLM has applied herbicide four times to the site and has agreed to assist with the monitoring of the project. This has all been provided as In-Kind contributions.

UCEPC provided tillage and seeding equipment and all staff time, travel, meetings, and coordination activities not covered by the CSCB Matching Grant as In-Kind contributions.

The NRCS provided species recommendations for the specific Major Land Resource Areas and soil types, seed of certain native species that were planted in the project, and assistance in entry selection and project installation. These services were all In-Kind contributions. The Board of Directors for White River and Douglas Creek Conservation Districts encouraged the development of the project and agreed to allow the use of UCEPC staffing and resources to initiate, coordinate, and establish the project, and to commit to long term monitoring and educational outreach.

The individual plots will be evaluated on at least three parameters; percent cover, vigor, and biomass production. If there is not adequate biomass to acquire from clipping plots, height, and width will be used for measurements instead.

The project will be monitored and results assessed, presented, and published. As described above, one or more commercially released plants may result from the project. These releases will have substantial site documentation to show the attributes that they exhibit for use on similar

sites in the Piceance Basin. Site tours for energy companies, public land management agencies, and private landowners will be conducted for educational purposes.

RESULTS

Over 50 native and introduced plant materials were planted in replicated plots and will be evaluated for five years to identify the products that are most successful at establishing and persisting on one of the abandoned well pad sites. This project represents one of the most comprehensive studies of released, experimental, and locally collected native plant materials assembled for performance comparison in the Piceance Basin. Because of the scope of the study and the long-term benefits, this project will be monitored annually through 2013. Data will be collected, analyzed, and summarized in annual reports to determine the most successful revegetation products for this site. Because the project utilizes the materials presently recommended for revegetation seed mixes on these ecological sites, and compares them to newly released commercial products, experimental products and locally collected Piceance Basin source products, the most successful products for revegetating similar sites will be identified.

Promotion of superior performers, whether old, established cultivars, or newly released products, will be done to increase industry awareness and contribute to enhanced revegetation success and conservation benefits. Experimental materials and local collections that show promise will be developed further for eventual release and commercial production.

If no releases result, the analysis of data will document the findings of the project. These results will show that the most suitable products, at the time of the installation of the study, already exist in the commercial market. Regardless, the study will provide confidence in the selection of the best revegetation materials for comparable sites. At the completion of this project, what to plant and how to plant for successful revegetation of well pads will be better understood. Both NRCS and BLM will have the most up to date information for specifications and recommendations for seeding mixes, individual plant material performance and planting methods for the Piceance Basin.

Project: COPMC-F-0806-RI
Report- 2008
By: Heather Plumb and Terri Blanke

Mack Field Evaluation Planting

OBJECTIVE

To establish herbaceous plant materials on post treated tamarisk and Russian olive infested riparian sites.

INTRODUCTION

Salt Creek runs through Stan Young's property in Mack, Colorado. The creek is so named from the high concentration of salt that is in the area soil. The area receives minimal amounts of precipitation and is generally hot in the summer. Over the years tamarisk invasion has further depleted the riparian area's ability to support its native ecosystem. Several methods of removing the tamarisk have been applied to the infested areas along the creek. Upper Colorado Environmental Plant Center (UCEPC), Grand Junction NRCS field office, the Tamarisk Coalition, the Palisade Insectary, and the Young Ranch are working cooperatively to rehabilitate the once infested site. A field evaluation planting was placed on the ranch to help identify which grass and forbs species will thrive in a known salty soil site.

EXPERIMENTAL DESIGN

This planting consists of 25 entries replicated three times in a randomized block design.

MATERIALS AND METHODS

The site was prepared with a spring application of herbicide, Round-up, on May 29, 2008, to eliminate existing weeds, cheatgrass, native forbs, and grasses. The site was then plowed and disked by the property owner. On August 12 and 13, 2008, UCEPC staff and Grand Junction field office personnel planted 25 entries consisting of 15 species. (see Table 1) Twenty-three grasses and two forbs were seeded using a planet junior. The total plot size is 4275 square feet (62.5 feet wide and 70 feet long). Borders and alleys around and in the plot were seeded with 'Hycrest'.

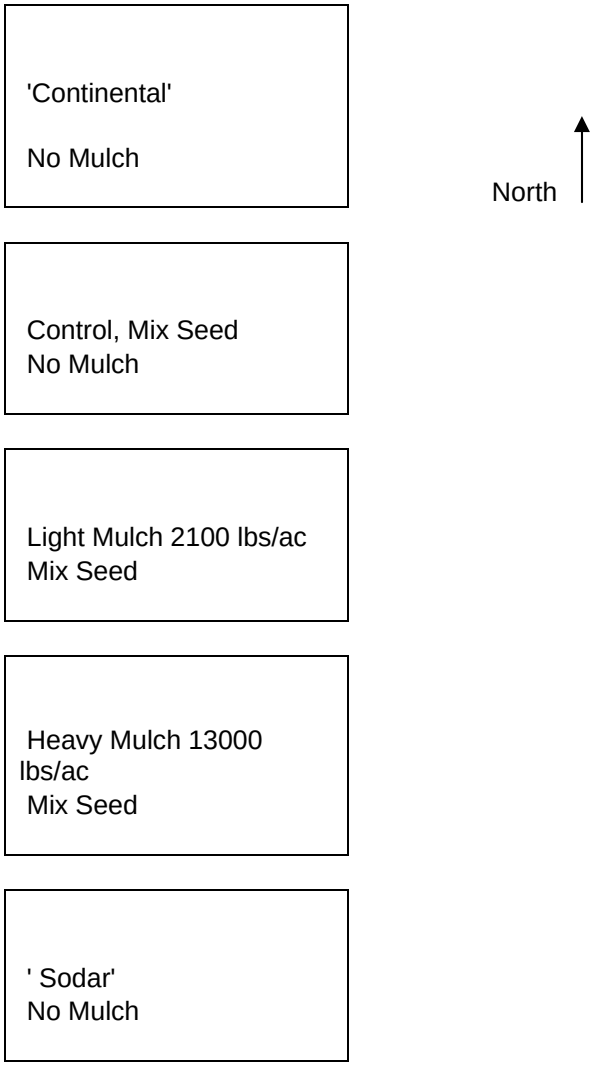
After the evaluation planting was completed it was decided by UCEPC staff to create an observational seed broadcast trial with mulching. Five blocks were created to the east of the planting. 'Sodar' and 'Continental' were the accessions chosen to be used for the seed broadcasting. The mulch, attained from a restoration company, was wood shavings ¼ inch in diameter and 4-12 inches long. All five blocks were hand raked. One block was broadcasted with just 'Continental' and one was broadcast with just 'Sodar', the remaining blocks were broadcasted with both species. After broadcasting was completed mulch was applied at different rates, by hand, to the observational blocks (see Table 2).

Project: COPMC-F-0806-RI
Report- 2008
By: Heather Plumb and Terri Blanke

Table 1. Plot plan for Young Ranch Field Evaluation Planting.

Entry No.	Species	Name/Accession		Blocks I	II	III
1	Alkali muhly	9066232	Plot-1	18	4	3
2	Alkali sacaton	Salado		3	8	5
3	Basin wildrye	Continental		20	3	25
4	Basin wildrye	Trailhead		7	5	24
5	Beardless wildrye	Shoshone	Plot-5	4	2	15
6	Bluebunch wheatgrass	Secar		22	23	13
7	Bottlebrush squirreltail	Fish Creek		12	9	14
8	Bottlebrush squirreltail	Toe jam creek		24	22	1
9	Crested wheatgrass	Hycrest		17	12	16
10	Crested wheatgrass	Hycrest-II	Plot-10	15	6	9
11	Forage Kochia	Kochia		8	14	8
12	Indian ricegrass	661		21	1	20
13	Indian ricegrass	664		23	24	2
14	Indian ricegrass	735		11	13	21
15	Indian ricegrass	741	Plot-15	25	10	23
16	Indian ricegrass	Paloma		2	20	4
17	Mammoth wildrye	Volga		10	17	12
18	Penstemon	San Juan		13	18	18
19	Sand drop seed	VNS		14	25	6
20	Siberian wheatgrass	Vavilov	Plot-20	5	15	19
21	Siberian wheatgrass	Vavilov-II		16	7	22
22	Streambank whtgrass	Bannock		9	19	7
23	Streambank whtgrass	Sodar		19	16	11
24	Tall wheatgrass	Jose		6	21	17
25	Thickspike	Critana	Plot-25	1	11	10

Table 2. Plot plan for the observational seed broadcast and mulching blocks.



CONCLUSION

The plan for further follow-up is to go back and visit the site in the summer of 2009. UCEPC staff and members from the Grand Junction field office will visit the treated tamarisk infested site. Evaluations, observations, and maintenance of the site will be conducted as needed.

Project COPMC-P-0301-RA
Report - 2008
By: Manuel Rosales

Advanced Evaluation of Indian Ricegrass *Achnatherum hymenoides* for Heavy Soils

OBJECTIVE

To find a selection of Indian ricegrass that is best adapted to clayey soils.

INTRODUCTION

Indian ricegrass *Achnatherum hymenoides* is a native cool-season, perennial bunchgrass; it grows one to two feet tall that is often a major stand component of harsher, sandy sites. It occurs in Canada from Manitoba to British Columbia, in the United States it is found in all states west of the Missouri River, and Northern Mexico. While the species is best adapted to dry, sandy soils, it can also be found on clayey, silty, and shaley sites. It does well on southern exposures, especially at higher elevations. Indian ricegrass is found in the 6 to 18 inch precipitation zone at elevations ranging from 2000 to 10,000 feet. Stands tend to be short-lived (three to four years) and reproduction is primarily from seed. It is very drought tolerant and is often a pioneer species on open or disturbed sites. It tends not to compete well with other perennial grasses. Indian ricegrass moderately tolerates saline or alkaline soils, but does best under more mesic conditions. The species performs poorly under shade and high water tables.

Indian ricegrass is highly palatable and serves to provide nutritious forage for wildlife and livestock under harsh site conditions. It reaches peak production from mid-June through mid-July, holding its nutrient value at maturity. It also has strong potential for use with mined land reclamation, critical area stabilization, and as a standing winter feed.

Past releases of Indian ricegrass ('Nezpar', 'Paloma', 'Rimrock', and Ribstone germplasm) are more adapted to light to medium textured soils. As a consequence of its good nutrition, palatability, and establishment characteristics on critical areas, there is a need for a cultivar or selection of Indian ricegrass that is adapted to heavier (clayey) soil types.

EXPERIMENTAL DESIGN

The experimental design for the advanced study is a randomized complete block with three replications.

MATERIALS & METHODS

In 1988, collections of Indian ricegrass ecotypes from heavy soils were made in Colorado, Wyoming, Utah, and Nevada. Starting in 1991 up to 1998, Upper Colorado Environmental Plant Center (UCEPC) conducted initial evaluations that led to ten superior selections for an advanced study.

On September 2003, preparations were made to plant the advanced study, however, due to unforeseen circumstances the study was postponed for 2004. On July 29, 2004, the advanced study was planted at UCEPC with a hand pushed belt seeder.

Project COPMC-P-0301-RA
Report - 2008
By: Manuel Rosales

Twelve entries; nine accessions, and three cultivars used as standards for comparison were planted. The rate of seeding was 30 pure live seeds per linear foot of row. The soil for the study site was identified by Charles Peacock, USDA-NRCS Soil Scientist, to contain 27 percent clay (texture class-silty clay loam) in the surface with an average of 40-50 percent clay (texture class-clay) in the subsoil. A plot plan for the study and a table with the entries and their collection site are presented below:

Indian Ricegrass
Plot Plan - Summer/2004

↑
North

Rep I				Rep II				Rep III			
741	Alley	735	Alley	818	Alley	Paloma	Alley	716	Alley	Rimrock	Alley
739		818		661		664		818		735	
Rimrock		661		749		Rimrock		749		741	
749		716		735		Nezpar		715		661	
664		Nezpar		739		741		Nezpar		664	
715		Paloma		715		716		Paloma		739	

Note: The last 3 digits of the accession numbers were used in the table.
Plot size: (20 Feet x 12 Feet) = 240 square feet
Rows/Plot = 4 (3 foot centers) **Number of entries** = 12 **Alley width** = 10 feet

Accessions/Cultivar	Collection Site
9024664	Moffat Co., CO
9024716	Colorado Springs, CO
9024818	unknown
9024715	Colorado Springs, CO
9024741	Pagosa, CO
9024661	Delta, CO
9024739	Pagosa, CO
9024735	Grand Junction, CO
9024749	Durango, CO
Nezpar	Whitebird, ID
Paloma	Pueblo, CO
Rimrock	Bridger, MT
A total of 12 entries were planted on July 29, 2004	

RESULTS

Year-2006

Results for 2006 are presented in the following table:

Table 1. Seed Yield and Other Parameters for 12 Entries of Indian Ricegrass. UCEPC-2006

Accession/ Release	Seed Yield (Lb/acre)	Forage (dry-wt) Ton/acre[1]	Plant Height[2] (cm)	Percent Plant Stand[3]	Re-growth[4]
9024741	**191.0**	0.76	71.0	93.3	2.0
Rimrock	165.5	0.76	70.0	**94.4**	**2.7**
9024739	165.2	0.68	67.4	90.0	**2.7**
9024715	119.9	**0.91**	70.0	91.7	2.0
9024661	113.8	0.83	69.4	89.3	1.3
9024735	103.9	0.87	59.7	**95.0**	1.3
9024749	95.7	0.83	65.6	90.0	1.7
Nezpar	83.7	0.65	77.5	90.7	2.0
9024664	68.2	**0.94**	58.2	91.7	1.7
9024716	58.4	0.68	65.2	91.0	1.3
Paloma	24.0	0.68	52.3	60.0	1.0
9024818	13.3	0.36	47.3	61.7	1.0
Mean	**100.3**	**0.75**	**64.5**	**86.5**	**1.7**
	S[5]	**NS**	**S**	**S**	**S**

1. Air-dry above ground biomass (cut four inches above soil surface)
2. Plant height measure in centimeters to top of seed panicle
3. Visual estimate per plot basis.
4. Visual rating taken 35 days after forage cutting, where 1 = Excellent re-growth, 2 = Moderate & 3 = poor.
5. Statistically Significant(S) or not significant (NS) at the five percent level of significance.

Note: All data is the average of three replications.

Data collection will continue for at least another two more years in order to conclude the project.

Year-2007

Results for 2007 are presented in table 2. The performance of all entries for 2007 was not consistent with the results obtained for year-2006. Table 3 presents a comparison for seed yield for the year 2006 and 2007 and table 4 presents a comparison for forage production for both years.

Table 2. Seed Yield and Other Parameters for 12 Entries of Indian Ricegrass. UCEPC-2007

Accession/ Release	Seed Yield (Lb/acre)	Forage (dry-wt) Ton/acre[1]	Plant Height[2] (cm)	Percent Plant Stand[3]	Shatter[4]
9024749	**195.3**	**1.4**	76.8	92.3	2.7
9024661	180.7	1.3	76.8	92.0	2.7
9024715	160.7	1.3	71.5	95.0	2.3
9024664	155.0	1.1	77.6	**97.7**	2.3
Paloma	138.8	1.2	59.8	55.0	1.0
9024716	138.0	1.1	71.5	95.0	2.7
9024739	117.2	0.7	69.9	91.7	**3.0**
9024735	97.8	1.0	60.9	96.7	**3.0**
9024741	96.2	0.9	70.2	95.0	1.7
9024818	90.0	0.6	49.5	63.3	1.0
Rimrock	77.0	0.8	**79.0**	96.7	2.0
Nezpar	57.8	0.8	78.8	95.0	1.0
Mean	**125.4**	**1.0**	**70.2**	**88.8**	**2.1**
	S[5]	**NS**	**S**	**S**	**S**

1. Air-dry above ground biomass (cut four inches above soil surface)
2. Plant height measure in centimeters to top of seed panicle
3. Visual estimate per plot basis.
4. Visual rating taken on June 27, 2007, where 1 =No shatter, 2 = Moderate Shatter & 3 = Heavy Shatter
5. Statistically Significant(S) or not significant (NS) at the five percent level of significance.

Note: All data is the average of three replications.

Year -2008

This is the third year of production for this study. Overall seed production and forage production for the growing season of 2008 was about half as compared to growing seasons on 2006 and 2007. The frost free growing season for 2008 was shorter than usual with 75 days as compared to 106 and 107 days for 2006 and 2007 respectively. The long-term average is 90 days.

Results for the 2008 growing season are presented in table 3. Summary tables for 2006 to 2008 for seed yield and forage production are presented in table 4 and 5.

Table 3. Seed Yield and Other Parameters for 12 Entries of Indian Ricegrass. UCEPC-2008

Accession/ Release	Seed Yield (Lb/acre)	Forage (dry-wt) Ton/acre[1]	Plant Height[2] (cm)	Percent Plant Stand[3]
9024741	**121.0**	0.41	63.6	95.3
9024739	66.6	0.39	54.9	88.3
Rimrock	66.1	0.39	74.8	96.0
9024661	58.1	**0.46**	59.4	92.3
9024749	51.2	**0.46**	60.6	91.0
9024735	51.2	0.31	53.2	94.3
9024715	40.5	0.31	57.2	91.0
Nezpar	38.4	0.39	71.9	93.3
Paloma	33.6	0.27	51.4	53.3
9024664	13.4	0.31	77.6	97.7
9024716	12.8	0.36	59.2	93.3
9024818	3.2	0.17	44.3	50.0
Mean	46.34	0.35	60.7	86.3
LSD (0.05)*	36.5	0.13	7.6	7.5

*Least Significant Difference at P<0.05

1. Air-dry above ground biomass (cut four inches above soil surface)
2. Plant height measure in centimeters to top of seed panicle
3. Visual estimate per plot basis.

Table 4. Seed Yield Comparison for 12 Entries of Indian Ricegrass *Achnatherum hymenoides* Grown at UCEPC (2006-2008).

Accession/ Release	**Seed Yield (Lb/acre) Year**			**Seed yield(lb/Acre)**	**Collection Site**
	2006	**2007**	**2008**	**3-year average**	
9024741	**191.0**	96.2	**121.0**	**136.1**	Pagosa, CO
902661	113.8	180.7	58.1	117.5	Delta, CO
9024739	165.2	117.3	66.6	116.4	Pagosa, CO
9024749	95.7	**195.3**	51.2	114.1	Durango, CO
9024715	119.9	160.7	40.5	107.0	CO Springs, CO
Rimrock	165.5	77.0	66.1	102.8	Bridger, MT
9024735	103.1	97.8	51.2	84.0	G. Junction, CO
9024664	68.2	155.1	13.4	78.9	Moffat, CO
9024716	58.4	138.6	12.8	70.0	CO-Springs, CO
Paloma	24.0	138.8	33.6	65.4	Pueblo, CO
Nezpar	83.7	57.8	38.4	60.0	Whitebird, ID
9024818	13.3	90.1	3.2	35.5	Unknown
Mean	100.15	125.45	46.34	(90.64)	
LSD (0.05)*	68.4	47.5	36.5	30.7	

*Least Significant Difference at P<0.05

Table 5. Forage Production Comparison for 12 Entries of Indian Ricegrass *Achnatherum hymenoides* Grown at UCEPC.

Accession/ Release	Forage production[1] (tons/acre) Year			Forage production (tons/acre) 3-year average	Collection Site
	2006	2007	2008		
9024749	0.82	**1.35**	**0.46**	**0.88**	Durango, CO
9024661	0.85	1.30	**0.46**	0.87	Delta, CO
9024715	0.90	1.30	0.31	0.83	CO-Springs, CO
9024664	**0.94**	1.06	0.31	0.77	Moffat, CO
9024735	0.87	1.02	0.31	0.73	G. Junction, CO
Paloma	0.70	1.16	0.27	0.71	Pueblo, CO
9024716	0.68	1.06	0.36	0.70	CO-Springs, CO
9024741	0.77	0.92	0.41	0.70	Pagosa, CO
Rimrock	0.77	0.82	0.39	0.66	Bridger, MT
Nezpar	0.68	0.77	0.39	0.61	Whitebird, ID
9024739	0.70	0.73	0.31	0.56	Pagosa, CO
9024818	0.36	0.63	0.17	0.39	Unknown
Mean	0.75	1.01	0.35	(0.70)	
LSD*	NS**	NS	0.13	0.23	

1. Forage dry weight of above ground biomass cut four inches above soil surface.

- *Least Significant Difference at P<0.05
- ** NS = Not significant at P<0.05

SUMMARY

The data indicates that there are at least five accessions from the advance test that have potential for plant releases to be used in clayey soils sites. Accession 902471, collected in Pagosa, Colorado produced the most seed yield of all entries for the average of the three years. However, it was number eight for forage production. Accession 9024661, collected in Delta, Colorado,
took second place for both seed yield and forage production for the three year's average.

Project: COPMC-P-0701-CR
Report- 2008
By: Heather Plumb

Initial Evaluation of Blue Wildrye

OBJECTIVE

To evaluate different seed sources of Blue Wildrye *Elymus glaucus* for revegetation in critical areas, forest lands, and mining land in Medicine Bow-Routt National Forest.

INTRODUCTION

There is a constant demand for plants that are ideal for revegetation work on critical land sites, mining lands, and forested lands. Upper Colorado Environmental Plant Center (UCEPC) and the Medicine Bow-Routt National Forest are working together to evaluate if Blue Wildrye *Elymus glaucus* is an ideal plant for revegetation in disturbed land sites.

EXPERIMENTAL DESIGN

The statistical design for the study is a randomized complete block with three replications

MATERIALS AND METHODS

Forty-two collection of Blue Wildrye were attained from Medicine Bow-Routt National Forest and cleaned at UCEPC. Twenty-seven collections from the forty-two original collections from Medicine Bow-Routt National Forest were used in the initial evaluation study as well as two plant material collections from the UCEPC. For comparison Blue Wildrye releases "Arlington" and "Elkton" from Corvallis Oregon and two potential Blue Wildrye releases from Pullman Washington were used in the evaluation. A total of thirty-three collections were used in the initial evaluation. Table 1 lists the accessions used in the evaluation. No PLS seed testing was preformed on the Medicine Bow-Routt National Forest seed collections or the two plant material collections from UCEPC, thus seed viability was assumed. Planting began on August 1, 2007, a total of forty-nine plots were planted due to high wind conditions, the remainder of the plots had to be planted on August 2, 2007. The plots were designed as 16 foot long rows, three rows per plot, three replications for each entry, 30 seeds per linear foot, 12 foot and six foot spacing's between plantings for alleyways. Table 3 provides a visual for the plot plan design. This configuration allowed for 14.6 grams of seed per entry for a single test. This plot design was used due to the fact the collection grams made by the Medicine Bow-Routt National Forest were insufficient to have more replications and longer row lengths.

Plot locations were determined by using Excel. Random plot numbers were placed into the Excel randomization function and random plots were chosen. Table 2 lists the random numbers for the plots used. A belt seeder was used for the entire planting of the three replications. Prior to planting five grams of Blue Wildrye seed were measured out for each entry and placed in seed packets. These packets were spaced out evenly over the belt on the seeder for planting.
After seeding no irrigation was needed for germination due to a thunderstorm shower that provided enough water for germination to occur.

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In 2008, the three replications of Blue Wildrye from Medicine Bow-Routt National Forest were evaluated during the months of June and July, during the evaluations certain parameters were evaluated and photos were taking.

For the month of June, three parameters were evaluated; plant vigor, height, and seed head maturity (Appendix 1). Plant vigor was evaluated ocularly as: excellent, good, fair and poor. Heights for each accession were attained from the center row approximately five feet in. Seed head maturity was evaluated by ocular observation. Photos were then taking of the observed good performers.

For the month of July, four parameters were evaluated; plant vigor, percent stand cover, height, and width (Appendix 2). Plant vigor was evaluated as: excellent, good, fair, and poor. Heights and widths for each accession were attained from the center row approximately five feet in. Percent stand cover was evaluated as: 1-15%, 16-25%, 26-50%, 51-75% and 76-100%. Plant vigor and percent stand cover were both ocular observations. Photos again were taken of the observed good performers.

Table 1. List of Blue Wildrye accessions used in the Initial Evaluation.

Number of Entries	Collection	I.D. in Plot Design
1	080106-A1	A
2	080106-A2	AA
3	073106-A2	AB
4	073106-A1	AC
5	072706-A3	AD
6	072006-A1	AE
7	214-03	AF
8	214-02	AG
9	221-03	AH
10	080406-A1	B
11	080106-A4	C
12	091406-A1	D
13	091406-A2	E
14	481-02	F
15	091206-A1	G
16	481-06	H
17	481-04	I
18	091206-A3	J
19	091206-A2	K
20	481-07	L
21	221-02	M
22	080306-A1	N
23	481-05	O
24	080106-A3	P
25	Marvine Creek	Q
26	Uncompaghre 04	R
27	080906-A1	S
28	214-01	T

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Number of Entries	Collection	I.D. in Plot Design
29	221-01	V
30	SP05-1	W
31	BO5-1	X
32	SBR-06-Arling	Y
33	SBR-06-Elkton	Z

Table 2. Randomization blocks from Excel used to determine plots.

	Block 1		Block 2		Block 3	
Plot no	**Treatment**	**Random no**	**Treatment**	**Random no**	**Treatment**	**Random no**
1	A	0.12685	Z	0.827168	N	0.934148
2	AA	0.093156	Q	0.253182	X	0.607366
3	AB	0.174891	L	0.675272	F	0.432386
4	AC	0.617568	AD	0.832958	H	0.512774
5	AD	0.582068	V	0.431124	Y	0.615301
6	AE	0.737657	K	0.109453	P	0.30672
7	AF	0.857693	B	0.480481	O	0.094621
8	AG	0.605914	H	0.22079	L	0.843278
9	AH	0.087742	AF	0.027586	J	0.732068
10	B	0.196349	AA	0.242081	AH	0.837903
11	C	0.832278	S	0.327228	Z	0.055589
12	D	0.492825	I	0.630387	AF	0.327078
13	E	0.584923	R	0.186464	D	0.220671
14	F	0.234286	E	0.262094	M	0.640431
15	G	0.303769	J	0.768045	V	0.765237
16	H	0.514176	AH	0.01053	C	0.369469
17	I	0.579793	AE	0.816434	K	0.723174
18	J	0.811658	AB	0.207076	I	0.740771
19	K	0.316422	C	0.086017	G	0.560539
20	L	0.236978	M	0.037421	AC	0.014513
21	M	0.625428	N	0.17345	AA	0.746739
22	N	0.934488	A	0.557107	AD	0.339793
23	O	0.797779	X	0.366823	AB	0.789311
24	P	0.643109	G	0.94481	T	0.821769
25	Q	0.644642	AG	0.51776	S	0.03205
26	R	0.481264	T	0.091443	AG	0.358766
27	S	0.061983	P	0.686283	Q	0.661964
28	T	0.557049	O	0.290737	AE	0.274787
29	V	0.585388	D	0.191142	E	0.787584
30	W	0.072611	Y	0.514224	A	0.757198
31	X	0.309719	AC	0.043549	R	0.30303
32	Y	0.434518	F	0.392722	W	0.412138
33	Z	0.830207	W	0.199344	B	0.846997

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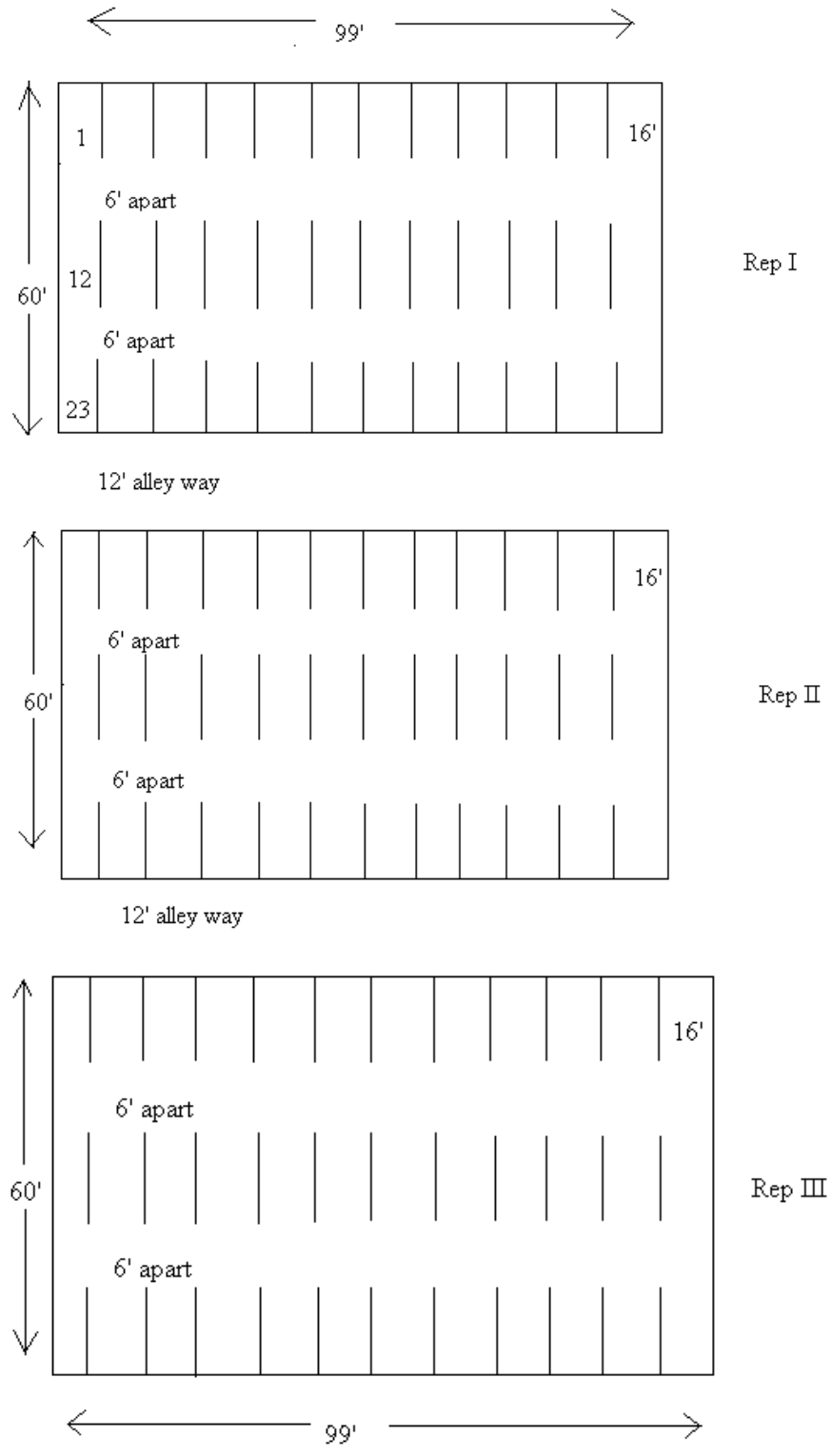
Table 3. The plot plan design for Blue Wildrye



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RESULTS

In 2008, it was observed that accession 091406-A1 from seed zone 481 and accession 080406-A1 from seed zone 221 were overall good performers from two of the three different seed zones being evaluated for Medicine Bow-Routt National Forest. No single accession from seed zone 214 was observed as a good producer.

In June, it was observed that accession 481-05 from seed zone 481 was an early seed head producer, seed heads were completely headed out on June 12, 2008.

In both June and July 2008 evaluations, it was observed that accessions 080906-A1, 214-01, 221-01 and 221-02 consistently did poor in all three replications.

CONCLUSION

Data from the first year (2008) of evaluations indicated that two accessions had been observed as good producers and four accessions of the 33 total accessions being evaluated had been observed as poor producers. Accessions 091406-A1 and 080406-A1 consistently had good percent cover, height, width, and vigor. Accessions 080906-A1, 214-01, 221-01 and 221-02 consistently had poor percent cover, height, width, and vigor.

However, 2008 has been the first official year evaluations have been conducted on the Blue Wildrye from Medicine Bow-Routt National Forest and no statistical data has been conducted for comparison thus far. Further evaluations and statistical analyses in the future are needed to see if other accessions will surface as good or poor producers.

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Appendix 1. Plant vigor, height and seed head comments for June 2008 evaluation.

REP I	Plant Vigor	Height (Inch)	Comm.
A	1	16	NA
AA	1	20	NA
AB	2	15	NA
AC	1	15	NA
AD	3	11	NA
AE	2	17	NA
AF	1	16	H
AG	3	17	NA
AH	2	17	NA
B	1	21	NA
C	1	18	NA
D	1	18	BH
E	1	19	BH
F	2	13	BH
G	2	17	BH, H
H	2	13	BH
I	2	13	NA
J	3	14	BH
K	3	14	BH
L	3	15	BH, B
M	4	9	NA
N	3	15	BH
O	2	16	BH, H, *
P	1	12	BH
Q	2	16	NA
R	2	18	NA, S
S	4	8	NA, S
T	4	10	H, S
V	4	11	NA, S
W	1	10	even, thick
X	1	13	even, thick
Y	3	5	flat appernc.
Z	2	14	NA

REP II	Plant Vigor	Height (Inch)	Comm.
Z	2	17	BH
Q	1	17	BH
L	3	15	BH, B
AD	3	14	BH
V	4	10	NA
K	2	11	BH
B	1	15	BH
H	2	17	NA
AF	2	16	BH
AA	2	18	BH
S	4	11	NA
I	3	17	stemmy, BH
R	3	16	NA
E	2	13	NA
J	3	13	NA
AH	3	14	NA
AE	3	12	NA
AB	2	18	B
C	3	17	NA
M	4	7	NA
N	3	13	BH
A	2	17	NA
X	2	17	NA
G	1	18	BH, H
AG	3	13	NA
T	4	8	BH, H, S
P	2	18	BH
O	1	18	BH, H
D	1	19	BH
Y	1	12	flat appernc.
AC	1	16	B
F	2	17	BH
W	1	10	even, thick

REP III	Plant Vigor	Height (Inch)	Comm.
N	3	14	BH
X	1	13	NA
F	2	11	BH
H	2	16	BH
Y	1	9	NA
P	2	14	NA
O	1	17	BH, H, *
L	2	16	BH, B
J	2	17	BH
AH	3	15	NA
Z	1	14	thick
AF	2	16	H
D	2	15	NA
M	4	7	NA
V	4	12	NA
C	2	17	NA
K	2	17	BH
I	2	14	NA
G	1	19	BH
AC	3	16	BH, soil?
AA	2	15	NA
AD	3	16	H, S
AB	3	13	NA
T	4	8	H, **(BAD),** S
S	4	6	NA
AG	3	12	NA
Q	2	15	NA
AE	3	14	NA
E	4	12	NA
A	3	14	NA
R	4	12	NA
W	2	12	NA
B	2	14	BH

Plant Vigor
1- Excellent
2- Good
3- Fair
4- Poor

Comments (Comm.)	
brome=B	*=Good heads
possible sprayed= S	no heads = NA
headed=H	beginning to head=BH

Blue Wildrye Project
Evaluations

Date Evaluated: 6/12/2008

Person(s) Evaluating: Terri Blanke, Heather Plumb

24 DEGREES last night

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Appendix 2. Plant vigor, percent stand cover, height and width for July 2008 evaluation.

REP I	Plant Vigor	% Stand Cover	Height (Inch)	Width (Inch)
A	2	5	35	9
AA	2	5	38	10
AB	2	5	32	8
AC	2	5	34	12
AD	3	4	30	11
AE	2	4	31	8
AF	2	5	32	10
AG	3	4	30	7
AH	2	4	25	8
B	2	5	30	10
C	1	5	31	11
D	1	5	35	11
E	2	5	34	10
F	3	5	30	10
G	2	5	33	8
H	2	5	26	10
I	2	5	31	13
J	3	4	27	12
K	3	4	29	11
L	3	5	30	10
M	4	2	24	10
N	3	4	28	9
O	3	5	28	11
P	2	5	27	9
Q	2	5	34	9
R	2	3	29	10
S	4	1	16	6
T	4	2	11	4
V	4	2	17	7
W	2	5	29	9
X	2	5	30	6
Y	3	5	21	10
Z	2	5	24	8

REP II	Plant Vigor	% Stand Cover	Height (Inch)	Width (Inch)
Z	1	5	29	11
Q	1	5	31	9
L	2	5	31	9
AD	3	4	23	8
V	4	2	17	5
K	3	4	27	8
B	2	5	31	8
H	2	5	32	12
AF	3	5	28	9
AA	2	5	35	10
S	4	2	12	6
I	2	5	32	9
R	2	4	32	11
E	2	5	28	9
J	1	5	28	8
AH	2	5	28	9
AE	3	4	24	10
AB	2	4	34	11
C	2	5	21	8
M	4	1	15	7
N	3	4	25	9
A	1	5	35	10
X	2	5	32	8
G	3	5	32	7
AG	3	4	28	7
T	4	2	15	5
P	2	5	36	9
O	1	5	31	9
D	1	5	30	9
Y	1	5	20	10
AC	1	5	30	10
F	2	5	28	8
W	2	5	27	7

REP III	Plant Vigor	% Stand Cover	Height (Inch)	Width (Inch)
N	3	4	31	8
X	2	5	37	7
F	3	5	27	6
H	2	5	31	7
Y	1	5	20	8
P	2	5	36	6
O	2	5	31	9
L	2	5	31	8
J	2	5	32	9
AH	2	5	36	8
Z	2	5	26	7
AF	2	4	30	7
D	2	5	31	7
M	3	3	17	6
V	4	2	13	4
C	2	5	33	8
K	3	4	28	7
I	2	5	33	7
G	1	5	35	7
AC	3	5	31	4
AA	2	5	35	9
AD	3	4	30	8
AB	2	3	30	7
T	4	1	9	2
S	4	1	16	2
AG	3	4	24	5
Q	2	5	28	7
AE	2	4	30	7
E	3	3	29	5
A	3	4	32	5
R	3	3	26	5
W	2	5	28	6
B	2	5	31	8

Plant Vigor
4- Poor
3- Fair
2- Good
1- Excellent

Stand Cover	
1= 1-15%	**2**= 16-25%
3= 26-50%	**4**= 51-75%
5= 76-100%	

Blue Wildrye Project

Evaluations

Date Evaluated: 7/10/2008

Person(s) Evaluating: Terri Blanke and Heather Plumb

Project COPMC-P-0801-CP
Report-2008
By: Manuel Rosales

Comparative Evaluation of Tall Wheatgrass

OBJECTIVE

To comparatively evaluate three commercially available plant releases of tall wheatgrass *Thinopyrum ponticum* from the U.S. to an improved cultivar from Hungary for potential use as a bio-fuel crop in the cool season grass ecosystem of the west and northeast.

INTRODUCTION

Bio-fuels can be produced from any biological carbon source; although, the most common sources are plants. Biomass produced from plants is processed into liquid fuel such as ethanol and biodiesel. In order to be considered a bio-fuel the fuel must contain over 80 percent renewable materials. This study is a cooperative effort between various plant materials centers in the west and northeast to learn more about the potential of tall wheatgrass, a cool season grass, as a source for bio-fuel. The study is linked to the NRCS 2006 National Strategic Plan, 2006-2010 National PM Strategic Plan, and the FY-2007 West Region technology working group business plan.

EXPERIMENTAL DESIGN

The statistical design for this study is a randomized complete block with four replications.

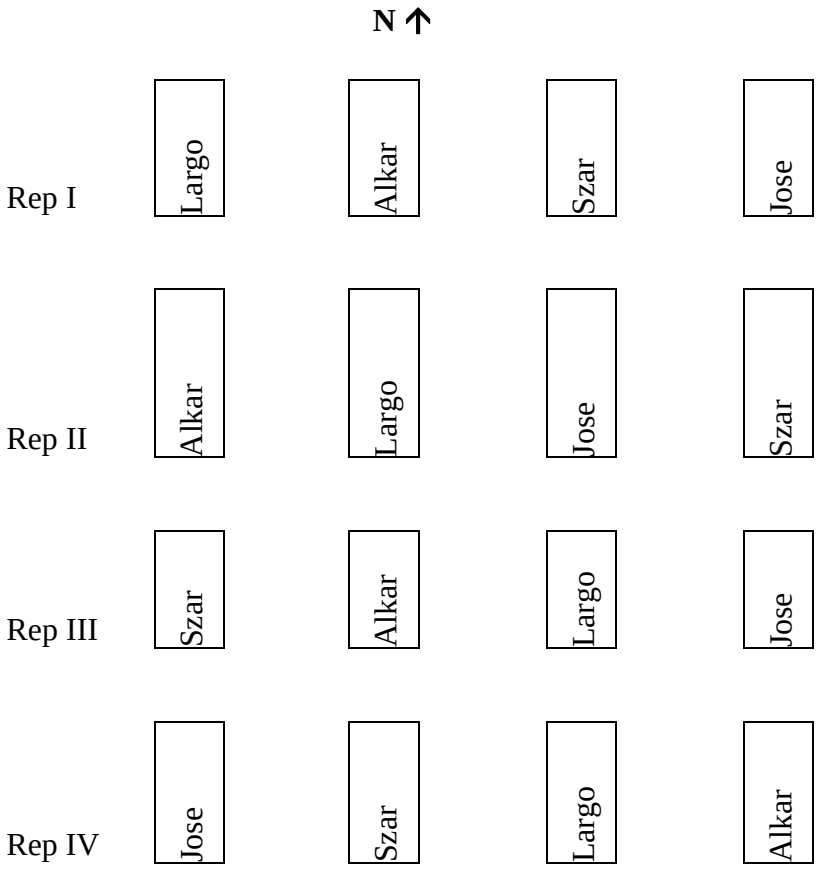
MATERIALS & METHODS

Four entries of tall wheatgrass; 'Alkar', 'Jose', and 'Largo' from the US and one from Hungary 'Szarvasi-1' were seeded on November 20, 2007. The entries were seeded with a hand-pushed Planet- Jr.-drill at the rate of 24 seeds per linear foot or eight pounds per acre of pure live seed. The plot size is four feet wide by 20 feet long, with four rows per plot at one foot centers. The planting was irrigated to get it established and herbicide was applied to control broadleaved weeds in the first growing season. Nitrogen fertilizer will be applied in the spring of the second growing season at the rate of 100 pounds of nitrogen per acre. Plots will be harvested at full maturity. Eighty inches (6.66 feet) of middle two rows will be harvested and dried for biomass production. Plots will also be evaluated for plant stand. Biomass samples will be sent to the lab to obtain a chemical analysis of bio-fuels parameters to compare the entries. The study will be conducted for three years. Below is the plot plan for the study.

Project COPMC-P-0801-CP
Report-2008
By: Manuel Rosales

Plot Plan

Tall Wheatgrass
ICST Bioenergy
November 2007



RESULTS

The plots were evaluated for establishment on September 2, 2008, and harvested for biomass production on September 17, 2008. Table 1 summarized the data collected for 2008. The trial will continue for at least two more years.

Project COPMC-P-0801-CP
Report-2008
By: Manuel Rosales

Table 1. Comparative Evaluation for Tall Wheatgrass for Use in Bio-fuel Applications. UCEPC-2008

Entry	**Dry-Biomass tons/acre[1]**	**Percent Dry Weight at Harvest[2]**	**Plant Height[3] (cm)**	**Percent Plant Stand[4]**
Largo	0.52	49.4	90.7	73.7
Szar	0.29	50	86.4	51.2
Alkar	0.24	39.5	79.1	80
Jose	0.18	48.3	80.8	53.7
Mean	0.31	46.8	84.2	64.7
LSD[5] (0.05)	NS[5]	NS	NS	10.1

1. Air-dry above ground bio-mass (cut five inches above soil surface).
2. Percent dry weight calculated by: the following formula: Dry weight/ wet weight X 100.
3. Plant height measure to top of spike.
4. Visual estimate per plot basis: four complete rows per plot = 100 percent.
5. Least Significant Different at P<0.05. NS = Not Statistically Significant.

Project COPMC-P-0802-RA
Report-2008
By: Manuel Rosales

Observational Planting of Canada Milkvetch

OBJECTIVE

To determine suitability and performance of accession of Canada Milkvetch from Washington Plant Materials Center under the environmental conditions at Meeker.

INTRODUCTION

Canada milkvetch *Astragalus Canadensis* is a native legume widely distributed throughout the United States. It is commonly found in dry prairies, moist shores, marshy grounds and open or partly shaded habitats. Canadian milkvetch is propagated by seed. This is an inter-center strain observational trial in cooperation with the Washington (Pullman) Plant Materials Center. Information obtained from the observation will aid in collecting agronomic information for technology development and plant releases.

EXPERIMENTAL DESIGN

None: This is a non replicated trial for observational purposes.

MATERIALS & METHODS

Seed sent from the Pullman Plant Material Center, was planted at Upper Colorado Environmental Plant Center (UCEPC) in the demonstrational planting site. A hand-pushed belt seeder was used to plant the seed. Two rows 20 feet long at three foot-centers were seeded in November 20, 2007, at the rate of two grams per 20 feet of row.

RESULTS

The plot was evaluated for establishment on July 1, 2008. See evaluation worksheet below.

Project COPMC-P-0802-Ra
Report-2008
By: Manuel Rosales

Observational Plantings Evaluation Worksheet			**Establishment year:2008** **Evaluation year: 20008**
Releasing PMC	**WAPMC**	**Contact person for originating PMC**	**Mark E. Stannard PMCM**
Testing PMC	**COPMC**	**Contact Person for Participating PMC**	**Manuel Rosales, Cons. Agronomist**
Study Title: Observational Planting of Canada Milkvetch		**Study Purpose**	**To determine suitability and performance of accession at UCEPC**
Study Number: COPMC-P-0802-RA		**Study Duration : 2007-2010**	
Precipitation During Growing Season (in.): 6.55 (April-August)		**Irrigation Applied During Growing Season (in)** **12**	

	1			
Scientific Name	*Astragalus Canadensis*			
Accession #				
Release Name				
Evaluation Date 1	July 1, 2008			
% Stand [1]	35%			
Vigor*	5			
Evaluation Date 2				
% Stand				
Vigor				
Drought Tolerance	Irrigated			
Insect Problems	None observed			
Disease Problems	None observed			
Seed Production	None for 2008			
Plant Height (in.)	4 inches			
Notes: Planted two rows 20 feet long at three feet centers, November 20, 2007, at rate of two grams per 20' of row**.**				

* Vigor; where 1 = excellent; 3 = good; 5 = average; 7 = fair; 10 = none

1. Plant stand: visual estimated per plot (two complete rows = 100 percent)

Project COPMC-P-0803-WI
Report-2008
By: Manuel Rosales

Observational Planting of Bismarck Shrubs

OBJECTIVE

To determine suitability and performance of four shrub accessions from Bismarck's Plant Materials Center.

INTRODUCTION

This is an Inter-Center Strain Trial (ICST) for observational purposes. These types of plantings are intended to determine basic adaptability and performance of the materials at different localities to spread out their suitability. In addition, the plantings should serve to demonstrate and educate the Upper Colorado Environmental Plant Center (UCEPC) staff as well as visitors to UCEPC on recent plant releases or potential candidates for future plant releases.

EXPERIMENTAL DESIGN

None: This is a non-replicated trial for observational purposes.

MATERIALS & METHODS

Four shrubs were received from Bismarck's Plant Materials Center on May 22, 2008. The table below describes the shrubs:

Table 1. Bismarck's Shrubs for Observational Planting

Accession No/Name	Common Name	Scientific name	Lot No.	Plants Shipped No.
323957	Black chokecherry	*Photinia Melanocarpa*	VCE-07-BIGSIOU	5
9047203/Prarie Red	Plum	*Prunus*	VCE-07-BIGSIOU	5
9076686	Fireberry hawthorn	*Crataegus chysocarpa*	VCO-07- BIGSIOU	5
9082687	American black currant	*Ribes americanum*	VCE-07-BIGSIOU	5

The shrubs were shipped bare-root and transplanted on June 25, 2008, in the windbreak demonstrational planting site at UCEPC. Planting holes were dug with a post hole digger. A basin was prepared around each hole to retain water. Shrubs were hand watered immediately after transplanting. A drip system was installed on August 8, 2008. An initial evaluation of the shrubs was also taken after planting (see table 2).

Table 2. Initial Evaluation of Bismarck's Shrubs

Accession/ Common Name	Shrub Number (North-South)	Height [1](inches)	Stem Diameter[2] (inches)
0.25	1	25	0.25
0.37	2	26	0.37
0.25	3	24	0.25
0.20	4	26	0.20
0.13	5	15	0.13
0.13	1	25	0.13
0.13	2	21	0.13
0.25	3	27	0.25
0.25	4	26	0.25
0.25	5	26	0.25
0.37	1	21	0.37
0.15	2	18	0.15
0.25	3	6	0.25
0.25	4	19	0.25
	5(dead)		
0.25	1	14	0.25
0.30	2	21	0.30
0.20	3	16	0.20
0.20	4	18	0.20
	5	16	0.20

1. Height in inches of tallest stem.
2. Stem diameter taken at the base (root collar) of thickest stem.

RESULTS

Shrubs will be evaluated in spring-2009 for survivability and growth measurements will be taking in September 2009.

Project: COPMC-S-0103-UR
Project Report-2008
By: Terri Blanke

Aphid Resistant Utah Honeysuckle

OBJECTIVE

This project was created to produce cutting stock for use in xeriscape and landscape horticulture, windbreaks, and urban beautification. The duration of the project is 2001 – 2011.

INTRODUCTION

On August 8, 1977, a planting of 179 accessions of woody tubling species was completed. This project (081020J - Orchard) was initiated to evaluate the survival and performance of those materials at UCEPC in Meeker, Colorado. Included in this project were four accessions of *Lonicera utahensis,* Utah honeysuckle. The information for these four accessions can be found in the 1998 progress report by Dr. Gary Noller. Witches broom aphids, *Hyadaphis tartaricae,* were first noted in the orchard in 1986. These aphids are found on the tips of branches of Utah honeysuckle and produce a growth called a witches broom. It was noted that two of the accessions had no infection. Those plants were marked and monitored from 1987 to 1992. In 1996, new accession numbers were given to the plants that were sent to Dr. Whitney Cranshaw at Colorado State University. Dr. Cranshaw conducted experiments at the University greenhouse for witches broom aphid resistance. The information received from Dr. Cranshaw in 2000 indicated that two plants (#3 and #15) were highly resistant to witches broom aphids. Plant 3 from accession 9070920 and plant 15 from accession 9070921 were then selected for cutting block material. In 2001, cuttings were taken from these shrubs for a field planting. They were rooted in the greenhouse following standard protocol.

EXPERIMENTAL DESIGN

This is a non-replicated planting.

MATERIALS & METHODS

Plant 3 of accession 9070920 and plant 15 of accession 9070921 are both located in field 14 – West (shrub orchard) of the COPMC. The Shrub orchard diagram below shows their location.

In March of 2007, the 23 remaining honeysuckle cuttings that had been rooted in 2001 were transplanted into two-gallon containers. They were pruned, fertilized, and then moved outside to the UCEPC lathhouse in June to be hardened off.

Project: COPMC-S-0103-UR
Project Report-2008
By: Terri Blanke

N
W + E
S

UCEPC Map

Field 14 – Shrub Orchard abbreviated diagram

Row	Accession Group	Accession Group	Accession Group	Accession Group
1	Mtn. Mahogany		Ash	Maples
2	Serviceberry	Serviceberry	Serviceberry	Serviceberry
******				
10	Gldn Currant	Wax Currant	Mtn. Mahogany	
11	Twinberry Honeysuckle 2*	Utah Honeysuckle 9070920 22* Plant *3* in group	Utah Honeysuckle 9070921 22* Plant *15* in group	Gooseberry

***** Number of plants in this accession
****** Rows 3 through 9 not shown in diagram

RESULTS/ACCOMPLISHMENTS

On August 21, 2007, twenty-one Utah honeysuckles were transplanted by hand in a single row (North-South) with 8–feet spacing between each shrub. The honeysuckles were watered by hand immediately after planting. They were weeded, watered, and monitored through the fall. The planting is on the West side of the plant material center and serves as a demonstration for the use of woody materials in a windbreak/shelterbelt.

Growing season of 2008
On June 25, 2008, the honeysuckles were evaluated on survival, height, and browse. The table below shows the first year's growing season results. Plant 1 begins on the Northern most end of the row. The plant height was measured to the tallest branch and recorded in inches.

Project: COPMC-S-0103-UR
Project Report-2008
By: Terri Blanke

2008 Aphid Resistant Utah Honeysuckle Evaluation Results

Plant No. *	Height **
1	31
2	24
3	18
4	19
5	21
6	24
7	16
8	18
9	21
10	26
11	21
12	26
13	20
14	21.5
15	23
16	20
17	18
18	21
19	23
20	20.5
21	19
22	14

* Evaluated from North to South
** Recorded in inches

A new one-inch drip line irrigation system was installed during the summer. The system provides water to all windbreak species. Irrigation is applied once a week at four hours per setting. A basin was hand dug around each plant and weeding was done as needed.

The plants will be pruned and fertilized in the 2009 season. Evaluations will be conducted yearly to determine xeriscape, landscape horticulture, windbreak, wildlife, and urban beautification value. Various methods of propagation are being conducted in the greenhouse.

Project COPMC-S-0201-WL
Final Report-2008
By: Steve Parr

Seed Increase of Prairie Junegrass
Koeleria macrantha

INTRODUCTION

Koeleria macrantha prairie Junegrass is a perennial, cool-season bunchgrass that is widely distributed throughout the United States. According to Hitchcock, 1935, its range extends from Ontario to British Columbia, south to Delaware, Missouri, California, and Mexico. The species is also widely distributed in the temperate regions of the old world. In the Central Rocky Mountains, it is commonly found as a component of prairies, open woods, mountain parks, sagebrush, and mountain brush communities. In Colorado, it is found in elevations ranging from below 4000 feet to over 11,000 feet. The species provides good forage for both livestock and grazing wildlife species, and fair forage for browsing species of wildlife. *Koeleria macrantha* is usually sparsely distributed and is generally not found as the dominant range species in a particular stand. Because of this, its importance as forage to both wildlife and livestock may be more related to its abundance than its preference.

Prairie Junegrass also responds well after fire and studies have found positive effects to plant size and seed head abundance following fire. Other studies show it has increased in abundance after prolonged drought conditions and man induced surface disturbances. Although prairie Junegrass has a number of characteristics that make it an attractive product for inclusion in seed mixtures for revegetation, there is only one released variety, Barkoel, which is from the Netherlands. There is no release from the United States. This may be a factor in whether the species is recommended in mixtures. Because of the potential benefit to native ranges, prairie Junegrass has been a product under selection at Upper Colorado Environmental Plant Center (UCEPC) since 1984.

Forty accessions of *Koeleria macrantha* were planted as a fall seeding, Project 08I115, on August 23, 1985. Due to poor establishment of this planting, a spring planting, Project 08I152, was established on June 12, 1986. Because of insufficient seed, only 32 accessions of the original 40 were included in Project 08I152. In addition, 19 International collections were included in Project 08I152, bringing its total number of accessions up to 51. In 1988, Projects 08I115 and 08I152 were combined into a single project designated as 08I115.

In 1991, Dr. Jack Carlson, who was at the time the Northwestern Regional Plant Materials Specialist for the SCS, recommended that a composite of the best strains from the Central Highlands of Turkey (PI-204451, PI-206274, PI-383672, PI-383673, and PI-383674), be made. In addition, Dr. Carlson recommended that a second composite be put together that consisted of the best performing strains from Northwestern Colorado. At that time, Northwest Colorado accessions 9024197, 9024421, and 9039787 were recommended.

In 1993, Dr. Gary Noller, UCEPC Senior Scientist, determined the top three Northwest Colorado and the top three Turkish Central Highlands accessions for the project. Dr. Noller recommended that accessions PI-383672, PI-383673, and PI-204451 be chosen from the Turkish Ecotypes. In

addition, Dr. Noller recommended that accessions 9024197, 9039786, and 9039787 be chosen to represent the Northwest Colorado ecotypes. Accession 9024197 is from Rio Blanco County, while accession 9039786 and 9039787 are from Routt County.

During the summer of 1994, UCEPC established separate crossing nurseries for the Northwest Colorado and Central Turkish Highland accessions in UCEPC. The nurseries were established with vegetative culms transplanted from UCEPC Field 21 onto 3-foot centers. Each nursery was laid out in a Randomized Complete Block design and included three replications. Each genotype is represented within a given replication seven times. The Northwest Colorado crossing block represents Project 08A207 while the Turkish Central Highlands crossing block represents Project 08A208. Dr. Tom Jones, ARS, Logan, Utah pointed out that *K. macrantha* cross-pollinates and is self-incompatible. Upon cross-pollination, seed borne on each individual representing one of the three accessions will be considered a half-sib family (one parent known, one parent unknown).

OBJECTIVE

To develop a release of *Koeleria macrantha* for conservation use from a composite selection of superior Northwest Colorado ecotypes.

METHODS FOR PRODUCT DEVELOPMENT

The original project methodology was to utilize genotypic recurrent selection only for the establishment of an F1 nursery. The original parental plants, 63 in all, were to provide the seed source for 63 F1 type plants, replicated three times, to produce an F1 nursery with 189 plants.

Each of the F1 plants was to be maintained as a separate line and eventually used to create an F2 nursery. The F1 seed, F2 seed, and Parental seed would be compared and a subsequent release be initiated based on the results.

In 1996, seed was collected and harvested by individual plant, but was not identified as to which plant or accession. In 1997-2000, seed was harvested and identified for parental determination. In 2001-2003, the seed from the crossing block was bulk harvested. Because a recurrent selection process would take an additional three to five years to establish and compare seed production results, it was determined by UCEPC to go forward with a release of prairie Junegrass based on results of advanced evaluations.

RESULTS

Individual plant harvests were conducted with reference to accession from years 1997-1999. Harvest results from accession 1 (9024197) from Rio Blanco County and accession 2 (9039786) and accession 3 (9039787) from Routt County are provided below.

Year	Accession 1	Accession 2	Accession 3	Total
1997	209	240	225	674
1998	653	710	581	1944
1999	174	237	255	666
Totals:	1036	1187	1061	

Analysis of variance statistics were run for the randomized complete block design of this study. Although there is an apparent accessional difference, the difference is not significant at the 5% level. Of the 63 parental plants, there is mortality in ten.

CONCLUSION

Data from three years (1997-1999) indicates there is no significant difference in accessional performance relative to seed production. Furthermore, accession 9039786 has produced the highest total and highest average amount of seed over the three-year period. However, this accession has also had the highest plant mortality with five dead plants out of ten total dead plants in the project. On the other hand, the poorest producing accession, #9039787, had the least mortality with two plants.

Because there is no statistically significant difference between accessions for seed production, and there are other characteristics within accessions that may contribute positive attributes (plant survival) to the germplasm, it was determined that a blend of all three accessions be used to establish a Northwest Colorado Junegrass seed increase field for eventual release.

2002

On July 16, 2002, blended seed from the 2001 harvest was used to seed one acre of prairie Junegrass in Field 11 at UCEPC. Seed density was targeted at 30 seeds per linear foot and the seeding was completed with a hand pushed Planet Junior. A poor to weak stand was noted until late fall, when a good stand was finally evident.

2003

On July 15, 2003, 47 pounds of Junegrass were harvested by direct combining. Seed test results indicated a low purity and 71% germination. This resulted in 24 PLS pounds produced on the one seeded acre in the first production year. This seed will be used for testing at other locations to test for the range of adaptation for the release of this product.

2004

On July 7, 2004, 221 pounds of cleaned Junegrass were harvested by direct combine from the seed increase field of one acre. Seed test results from this field show that purity is 93.4% and germination 45.0%. This resulted in 93 pounds of Pure Live Seed per acre.

2005

July 13, 2005, 100 pounds of clean seed were harvested with the combine. Seed test results are not available at this time.

2006

In 2006, 120 pounds were harvested with the combine on July 1. However, the pure live seed component is only 23%. An additional problem was identified during seed analysis with species identity. The Colorado Seed Laboratory reported the seed to be that of *Poa secunda*, big bluegrass. An additional lot was sent for resampling, but it too, was determined to be big bluegrass. Identification was attempted by UCEPC personnel, but there are very close resemblances of several *Poa* species to *Koeleria*. Tom Jones with ARS was asked if ARS could do genetic testing of our product or if he knew of competent taxonomists with whom he felt comfortable, but he suggested using university taxonomists. After our product heads out, we will send samples to several taxonomists for physical identification.

2007

On July 2, 134 clean pounds of seed were harvested from UCEPC field 11A. However, seed quality was extremely poor. Purity was identified at 40 percent and germination at only 4%. The results of this seed test, along with a number of other seed samples of harvested products this year, were very low in germination. We do not know why this is the case, nor do we have any ideas why this has occurred. We have speculated that the only variable that we did differently in 2007 was to apply a pre-emergent herbicide, Pendulum, to suppress annual weeds.

Field observations noted a lot of white or pale stems that may be the result of stem maggots, but a positive identification of a damage causing insect has not been obtained to date. This will be monitored in 2008.

Taxonomic identity has also been challenging for this species. In 2006, as noted above, seed test results from the Colorado Seed Laboratory indicated that we had not been producing a Junegrass, but rather a bluegrass. Other than seed identification, vegetative identification was the next step to determine species, or perhaps variety or source, identity.

Seed was planted in the greenhouse, and samples of headed material were sent to Dr. Mary Barkworth, Utah State University Herbarium, for taxonomic identification. Dr. Barkworth felt the material was most closely related to a *Poa*, but she was not certain which one. As a result, we sent seed samples of individually collected accessions from our crossing block, as well as some 'Sherman' obtained from Pullman, WA PMC and three Junegrass accessions that were from original collections and used in the initial evaluation project, to Dr. Steve Larson, ARS in Logan, Utah for genetic comparison and identification. At this time, Dr. Larson noted that all samples submitted are germinating, and results will be obtained in a few weeks.

If the materials by accession are identified as products other than 'Sherman', then release potential still exists. If the original collections are identified as *Koeleria*, then the initial evaluation results for the Junegrass Initial Evaluation Project will be reviewed, the top performers pulled, germinated and planted in an advanced evaluation planting. In addition, if the three accessions from our "Junegrass" crossing block are *Poa ampla*, but not 'Sherman', we can still release a blended big bluegrass. For now, however, this progress report identifies what is known at this time.

2008

As indicated in the remarks for 2007, the release of Prairie Junegrass was on hold until a final determination on the identification of the accessions was secure. On March 17, 2008, Steve Larson from USDA-ARS Forage and Range Research lab, Utah State University reported the followings: "We have determined that eight of eight DNA (AFLP) profiles of 9024197, 9039789, and 9039787 are exactly identical to Sherman and much different from the two *Koeleria* samples. I am very certain that 9024197, 9039786, and 9039787 are Sherman".

This report came as a surprise, since in the 20 plus years that this species has been in evaluation at the center, nobody ever reported that the *Koeleria* was not the identified species. Moreover, the three selected top performers from the initial evaluation planting ended up being all one source of *Poa ampla*, 'Sherman', according to genetic test results obtained from Dr. Steve Larson. There is simply no explanation for the events that have led to this discovery, disappointing as they are.

A small demonstration plot of 'Sherman' and accession number 9092261, the blend of the three selected top performers, was planted in October of 2008 to compare physical characteristics of these two selections.

Because of the findings from Dr. Larson, no harvest was conducted in 2008, and the increase field has been removed.

Project COPMC-S-0401-CR
Project Report 2008
By Steve Parr

Seed Increase for Fire Rehabilitation Needs
Bureau of Land Management-Colorado

INTRODUCTION

The Bureau of Land Management has reseeded over 50 thousand acres in western Colorado over the past 15 years. Like many western states, large wildfires in Colorado are recently more common; being both more numerous and larger in scale than had been historic wildfires. In fact, the largest fire in Colorado's history occurred in 1988. The "I Do" fire near Maybell, Colorado, consumed more than 15,000 acres with about one third of those acres on BLM managed lands. Only two years later, the "Bircher" fire near Cortez, Colorado, broke the record again by burning over 23,000 acres. In 2002, the Hayman fire consumed over 70,000 acres. The trend does not appear to have peaked, as much of the west is consumed by individual wildfire events burning thousands of acres annually. Since much of the burned acreage is also treated with some type of seeding to reduce erosion and to reestablish vegetative cover, seed has been in high demand.

With increases in sizes of wildfires and frequency of events, the demand on the seed industry, especially for native species, has been greater than the supply during recent years. This demand has created an unfavorable situation in which seed of desired species may be in short supply, costly, of low quality (poor germination or purity), or unavailable altogether. This often results in price fluctuations and quality or even species sacrifices by entities purchasing seed for revegetation projects. These seed substitutions often result in revegetation projects achieving less than they are capable of based on testing.

BACKGROUND

During the record fire season of 2000, BLM of Colorado treated over 18,000 acres at a cost of over one million dollars. Limited availability and quality of desired native materials prompted the BLM office in Meeker, Colorado, to contact Upper Colorado Environmental Plant Center (UCEPC) about a potential cooperative project for seed increase. An informational meeting was held on January 16, 2001, with UCEPC staff and Meeker BLM personnel to determine what the local BLM office needed and how UCEPC could help them get what they needed. What was expressed by BLM as the most important items included a consistent supply of locally adapted native seed with purity and germination standards no less than the industry standard for certified seed of that individual species, and at a price that was not prohibitive for project inclusion.

Interest in the project soon expanded from the Meeker field office to include a good portion of those offices affected by the same chronic seed source problems related to revegetation projects. Jim Cagney of the Meeker BLM office contacted Mark Stiles about the project potential in late February, and interest was expressed at the state level. On March 19, 2001, a meeting was held at UCEPC, which included local and state BLM personnel, UCEPC staff, and members of the Administrative Board. BLM needs were addressed as well as the capabilities of UCEPC to deliver products and services to meet the expressed needs. A review of UCEPC facilities and its

structure as well as a potential scope of activities were discussed. In addition, a list of potential seed increase species was reviewed and Rusty Roberts agreed to survey field offices for input regarding desired species for fire rehabilitation.

Rusty reported back via e-mail on May 7, 2001, that six of the species reviewed during the meeting in March had favorable responses and three additional species were added to the list of candidates. A preliminary proposal from UCEPC was submitted to Dennis Zachman of the state BLM office for review. Dennis submitted to the state a proposal to determine the level and willingness of the state to support a seed increase project. Revisions and further proposal development continued, but species for the increase effort had to be targeted so collections could be initiated and conducted as efficiently as possible.

Rusty followed up with an e-mail to field offices on June 7, 2001, that five species had been selected for initial increase efforts and that contact by UCEPC personnel would be forthcoming. On June 8, a detailed project proposal with budgetary estimates was submitted by UCEPC to Dennis Zachman for inclusion into a cooperative agreement between BLM, UCEPC, and NRCS.

METHODS

Project activities started with a sit down session in Grand Junction on June 25, 2001. This, as with the other sit down sessions at field office locations, was extremely beneficial in identifying potential collection sites, revegetation history, grazing or other use history, fire history etc. These factors and others were discussed to aid in selecting the sites with the highest potential for successful collecting.

A few days later, on July 3, the first day of collection by UCEPC occurred in the Little Park area on the Uncompahgre Plateau south of Grand Junction. A recap of the coordination meetings, collection areas, and clean seed amounts obtained from 2001, 2002, 2003, and 2004 is included in this report as a separate attachment.

Seed collection results were disappointing for the first year. Drought conditions over much of the collection area produced little amounts of viable seed. In addition, a hard freeze occurred on May 20, which also contributed to the poor seed fill in much of Northwest Colorado. Seed of one species, Utah sweetvetch, was collected in quantities large enough to plant a seed increase field, but was collected primarily from one site. It is the recommendation of UCEPC that we add to the genetic variability and diversity of the increase species by collecting from several locations, bulking the seed and then planting the source field. Additional collections were obtained in 2007, but on a limited scale. The other four materials, bottlebrush squirreltail, beardless bluebunch wheatgrass, western wheatgrass, and Sandberg's bluegrass were collected in gram quantities in 2001. One species that was noted to have produced good quantities of seed but was not collected was bluebunch wheatgrass *Pseudoroegneria spicata spicata*. Our agreement called for the collection of beardless bluebunch *Pseudoroegneria spicata inermis*. Because of such limited success with beardless bluebunch collections (12 grams), we decided

during our coordination meeting with Dennis Zachman on March 30, 2002, to expand the collection list to include bluebunch wheatgrass and needle and thread. Adding these two species would increase the opportunities to collect quantities necessary to establish some production fields for the project.

In 2002, collection results were also limited. As the driest recorded year since the establishment of UCEPC, extremely poor seed fill resulted in collections of gram quantities of two species, Sandberg's bluegrass and bottlebrush squirreltail. A single site produced a little less than two pounds of needle and thread.

As fate would have it, collections in 2003 were quite good. Even though 2002 was one of the driest years in recorded history in the west, spring moisture was adequate to produce seed in most early season species in 2003. As a result, good quantities of seed of five of the targeted six species were obtained. Utah sweetvetch was the only targeted species that did not produce good collections in 2003. One site located north of Gypsum, Colorado, had good numbers of plants blooming on a collection trip June 17, 2003. The following week, a brush fire encompassed the area which prohibited access. In addition, Carla Scheck, Glenwood office BLM indicated there would likely be no seed to collect for a few years on the sites we were using because of the scope and location of the fire.

A cool but dry spring in 2004 also resulted in extremely poor seed fill. On two collection trips, no seed of targeted materials was collected. As a result, no additional attempts at seed collection were made in 2004. Seed collection quantities were good in 2003, and after confirmation with Dennis Zachman, BLM state office, it was determined to proceed with the project. As planned, blended collections were used for the seed increase plantings to maximize species diversity within the range of anticipated use.

Bottlebrush squirreltail was planted using two separate collections from separate years, but from the same source. Accession 9092275 was collected in 2001 and again in 2003. Together, the collections provided adequate seed for an increase planting. Furthermore, the bottlebrush squirreltail complex was undergoing taxonomic transformation during the collection years. Historically, bottlebrush squirreltail was know as *Sitanion hystrix*, but was renamed *Elymus elymoides.* There had been much confusion on separate species, subspecies or genetic gradients of individual populations by taxonomists with squirreltails. Currently, there are two accepted species, *E. multisetus* and *E. elymoides*, with four subspecies of the latter. In Colorado, two subspecies of *E. elymoides* exist in identifiable populations: *E. elymoides elymoides* and *E. elymoides brevifolius.* We had also collected from extreme northwest Colorado an *E. elymoides elymoides* sub-species. Again, after consultation with Dennis Zachman, we opted to use the same source material rather than mixing sub-species or waiting for a good collection opportunity for the *elymoides* sub-species.

Western wheatgrass is represented by one collection, accession 9092278, from one location during a single year. This increase, although containing the least genetic diversity of the collected increase species, was also the only collected population with enough viability in the seed to establish a planting.

The third material, bluebunch wheatgrass, was the most equally represented blend used for increase. Three collections from northwest Colorado were utilized to establish this species. Collections were obtained from Pisgah Mountain in north central Colorado, State Bridge in the central portion of the mountains and Irish Canyon in extreme northwest Colorado. These collections are identified by accessions 9092276, 9092277, and 9092274, respectively.

On April 28, 2005, a site visit was conducted with the State Plant Materials Specialist and the State Range Conservationist for NRCS to determine the collection potential for Utah sweetvetch. It was determined that the site would not have adequate seed for a collection effort, so no collection effort for this species was conducted for 2005. To date, Utah sweetvetch has been collected one year out of five from a single site. Concern had been expressed about the lack of genetic composition for a material that may be used throughout the state of Colorado on BLM lands. However, the species has been recognized as being an important component in the fire rehabilitation seed mix. Because the species is also insect pollinated, subsequent seed collections could be added to a seed production field to increase the genetic base if the opportunity exists for additional collections.

2006

A collection trip was taken on June 2, 2006, along Highway 64 and Highway 40 in extreme northwest Colorado. A small amount of seed was acquired from the trip, but seed collection potential looked to be grim for 2006. Thirteen grams of Sandberg's bluegrass were collected from two different sites. No other collections of target species were made in 2006.

Two additional plantings for Utah sweetvetch were made by UCEPC in 2006 in order to improve the stand. Seed harvest of two of the three fields planted in 2004 was accomplished in 2006. In addition to seed harvest and maintenance, a comprehensive plan for the infusion of contracted seed production will also be completed. It is estimated that seed distribution to growers will be initiated in 2008 and 2009 for contracted seed increase.

2007

In light of the difficulties encountered with Utah sweetvetch collections, activities for 2007 included a transplant effort of containerized stock and two intra-seedings in the spaced planting. The Sandberg's bluegrass was not strongly evident in 2006, so additional efforts were necessary for the establishment of it in 2007. A small seeding was also conducted in the north end of the

bottlebrush squirreltail field. The bluebunch and western fields have filled in nicely, and they were productive in 2007.

Collections were done on several dates in 2007, and seed for each of the increase materials was acquired. However, most of the collections were limited in quantity and will likely be used more for testing than seed increase.

Species	Date	Collection Amt.	Location
Bluebunch wheatgrass	July 18, 2007	25 g	Little Hills
Bottlebrush squirreltail	June 7, 2007	89 g	Masadona
Sandberg's bluegrass	June 7, 2007	20 g	Moffat Cty. Rd. 61
	June 8, 2007	5 g	Gypsum drainage
	June 8, 2007	3 g	Gypsum radio tower
	July 23, 2007	16 g	Ryan Ridge
	Undated	15 g	R. Blanco Cty. Rd.73
Utah sweetvetch	Undated	2 g	Blair Mesa
	July 18, 2007	23 g	" "
	July 23, 2007	22 g	" "
Western wheatgrass	Aug.16, 2007	324 g	Irish Canyon

In 2007, seed was harvested from the bottlebrush squirreltail, western wheatgrass, and the bluebunch wheatgrass fields. No seed was harvested from the Utah sweetvetch or Sandberg's bluegrass fields, as work to establish stands continues for both of these products.

2008

Seed collections from native stands were excellent in 2008. A total of 15 separate collections were obtained, 11 of which were for the five targeted species. The table below identifies the collections

Species	Date	Collected Amount	Location
Basin wildrye		6.9 pounds	Yellow Creek
Bluebunch wheatgrass	7/15	721 grams	Piceance Creek County Road 22
Bluebunch wheatgrass	7/24	418 grams	Rio Blanco County Road 20
Blue flax	7/15	299 grams	Piceance Creek
Bottlebrush squirreltail	6/27 & 7/9	31 grams	Deserado Mine
Prairie Junegrass	7/29	18 grams	Pinto Mesa
Prairie Junegrass	8/7	17 grams	County Road 1509
Sandberg's bluegrass	6/27	106 grams	County Road 73
Sandberg's bluegrass	7/11	63 grams	County Road 1509
Sandberg's bluegrass	7/21	19 grams	Irish Canyon
Sandberg's bluegrass	7/9	47 grams	Deserado
Sandberg's bluegrass	7/24	76 grams	Pinto Mesa
Utah sweetvetch	6/27	95 grams	Blair Mesa
Utah sweetvetch	7/29	354 grams	Pinto Mesa
Western wheatgrass	8/11	80 grams	Ryan Ridge

These collections will be tested against the products that are presently in production for the BLM project. Presently, the bluebunch, western, and bottlebrush fields are producing seed, while the sweetvetch and Sandberg's are just coming into production. The added collection of sweetvetch will be particularly important as the field has been established on a spaced planting basis, and individual "hills" can be seeded with this new collection to add to the diversity of the crop. This has been the intent of this project with each product from the inception.

Project COPMC-S-0401-CR
Project Report 2008
By Steve Parr

Production in 2008 was down from the previous year for all products. Because of the apparent reduction in productivity, a new western wheatgrass field was established. Commonly, rhizomatous species tend to put more energy into lateral vegetative spread than seed production, so older stands need to be reestablished with greater frequency than bunch grasses. A typical stand life for western is four years. Additional work continues with the Utah sweetvetch field and the Sandberg bluegrass field. However, it does appear that both will produce seed in 2009.

SPECIES	UCEPC FIELD #	ACREAGE	PLANTING DATE	HARVEST DATE	YIELD
Bluebunch	6	0.87	Aug.13, 2004	6/29/2006	32.00 lb
				7/6/2007	61.00 lb
				7/14/2008	50.00 lb
Bottlebrush	17	0.80	Aug. 13, 2004	7/13/2006	45.00 lb
				7/20/2007	55.00 lb
				7/28/2008	27.50 lb
Sandberg's bluegrass	12	1.00	Aug. 8, 2005 Aug. 9, 2007	No harvest	
				7/17/2008	1.86 lb
Utah sweetvetch	12	1.00	Sept. 15, 2005	No harvest	
			Intra-seeded June 6, 2007		
			Transplanted June 2007		
			Transplanted and seeded three times in 2008; June 19, July 30 and August 19		
Western wheatgrass	7A	0.80	Aug. 13, 2004	8/2/2007	212.00 lb
				8/6/2008	43.00 lb
			Aug. 26, 2008		

CONCLUSION

After attempting to collect seed since 2001, seed from minimal prior collections was used to supplement sparse or weak stands of previously planted materials; specifically Utah sweetvetch and Sandberg's bluegrass. Additional collections will be necessary to supplement the existing collections and to ensure that "source seed" is on hand for future testing or development. Minor field establishment efforts will be necessary to obtain good stands of Utah sweetvetch and Sandberg's bluegrass. A comprehensive and equitable distribution plan must also be completed and agreed upon for pre-determined contract production.

Seed production has been obtained on three of five species. Three species, bluebunch wheatgrass, western wheatgrass, and bottlebrush squirreltail, all have excellent stands and appear to be good producers. Colorado State University Extension Entomologist Bob Hammon also brought some leafcutter bees to UCEPC in 2007 in an effort to assure the presence of pollinators for the crop. However, UCEPC had difficulty keeping deer out of the sweetvetch, and as a result, there was no production. This year, the perimeter fence was fixed in areas where it appeared deer were getting into UCEPC. However, deer were able to get in when the irrigation ditch was turned off, and they immediately went to the sweetvetch field for grazing. UCEPC experimented with a small electric fence around a small penstemon field with excellent results. If deer are again successful in breeching our perimeter fence, we will use electric fencing to try to keep them out of the field.

A coordinated plan for seed dispersal will need to be finalized so that seed increase efforts on a large scale will be initiated. Coordination partners include Upper Colorado Environmental Plant Center, Colorado Seed Growers Association, and BLM.

Project COPMC-S-0402-WL
Project Report 2008
By Steve Parr

Seed Increase for Uncompahgre Restoration Project

INTRODUCTION

Years of noticeable mule deer declines in areas that once held healthy populations prompted a series of studies by Colorado Division of Wildlife to determine the cause(s) for these dramatic population declines. What was discovered was not specific to mule deer, but rather was much more widespread. It was apparent that many of the problems related to mule deer declines were shared by other species, including plants. Because of the recognition of declining habitat on the Uncompahgre Plateau, and the ramifications that unchecked decline would have on mule deer and other species, a collaborative, community based effort was formulated to address the concerns. As a result, the Public Lands Partnership was created. Upper Colorado Environmental Plant Center (UCEPC) was contacted by Rick Sherman in 2001. A series of meetings were held at UCEPC and BLM and Forest Service offices in Delta and Montrose in 2001 and 2002. Correspondence was received from UCEPC in May 2002 from Rick Sherman that a large grant had been obtained by the Uncompahgre Restoration Plateau project, and UCEPC was from that point included in the project.

METHODS

Collections

Upper Colorado Environmental Plant Center was contracted to collect and increase seed of selected species in 2002. Because of substantial and prevalent drought conditions throughout much of western Colorado, collectible populations were very isolated and it was deemed uneconomical to continue to attempt collections on such a poor year.

Collections the following year, and on several years since, were much more productive. To date, UCEPC has collected four grass species, three shrubs, and two forbs that can be utilized for seed increase or containerized production. Table 1 outlines the clean seed quantities collected during the 2002, 2003, and 2004 field seasons. A total of five collection days were used to obtain the seed. The six materials collected in 2002 were from two trips. The first trip on July 1 was conducted south and east of Montrose and the second trip, July 19, was done on the Uncompahgre Plateau. In 2003, a collection was conducted June 23 on Sims Mesa and on July 30, the entire staff again collected on the Plateau. A single trip, August 12, was taken to the Uncompahgre Plateau in 2004. All of these materials remain on inventory at the Plant Center.

UCEPC has not collected from the Uncompahgre Plateau since most of the seed collection and program coordination was turned over to Steve Monsen in 2003. Each of the collected grass species represent products that have practical application for use in the Pinion-Juniper zone, which is where most of the emphasis for the project originated. Since the early planning meetings, many more species represented by most habitats have been added to the project.

Table 1
Uncompahgre Restoration Project
UCEPC Collections

Species	Scientific name	2002	2003	2004
Blue wildrye	*Elymus glaucus*	---	---	308 g
Bluestem penstemon*	*Penstemon cyanocaulis*	11 g	76 g	
Bottlebrush squirreltail	*Elymus elymoides*	47 g	361 g	
Indian ricegrass	*Achnatherum hymenoides*	---	361 g	
Lewis flax*	*Linum lewisii*	23 g	---	
Mexican cliffrose	*Cowania mexicana*	2 g	---	
Mountain mahogany	*Cercocarpus montanus*	18 g	566 g	
Needle and thread	*Hesperostipa comata*	---	169 g	
Utah serviceberry*	*Amelanchier utahensis*	13 g	87 g (rust)	
Utah serviceberry*	*Amelanchier utahensis*		120 g	

* Positive identification pending

The blue wildrye was included in an initial evaluation planting at the UCEPC for comparison against 32 other collections, including two released products, Arlington and Elkton. The data compiled from this project will help support the decisions about the use of this selection of blue wildrye for potential development. Bottlebrush squirreltail will be added to a trial in 2009 to compare the UP collection to 6 other products, including the releases, Wapiti, Pueblo, Toe Jam Creek, Fish Creek and Tusas.

Project COPMC-S-0402-WL
Project Report 2008
By Steve Parr

Plantings

2004

The project plans had originally called for the use of seed from collections rather than greenhouse grown stock. However, region wide drought conditions did not provide good collectible populations of target materials. Steve Monsen, Native Plant Coordinator for the UP Project, provided seed to greenhouses for container production. In 2004, three species were provided to UCPEC for field increase as containerized stock. These materials were placed in production fields with the use of two Holland Old Faithful model transplanters. On June 16, 2004, a crew of eight people planted six rows (0.2 acre) of yarrow plugs that were grown in cone type containers. The crew started preparing the plugs for planting at 10:30 a.m. and by 3:30 p.m. the yarrow transplanting was done. The following day, 0.27 acre of muttongrass was transplanted by 12:30 p.m. and on June 18, 0.27 acre of Junegrass was done. A crew of seven transplanted the muttongrass and six people transplanted the Junegrass.

Two transplanters were placed on a toolbar, each with seating for two. This allowed four people to transplant into two rows, alternating the placement of plugs. Depth adjustments were made on the planting shoe for the size of the rooted stock. As the shoe opened the furrow, the plugs were placed at a slight angle in the furrow, held in place until the packer wheels approached the planting spot, and then released as the packer wheels pressed the soil around the plug. The second person would have the next plug in place while the first person closely observed and adjusted the placement of the plug being planted. Alternating in this way with two people planting per row provided excellent placement. Two people followed on foot, one for each row, to adjust planting depths on the transplants as necessary. Hand move sprinklers were set immediately after the plantings were completed each day. Survival and stand establishment were excellent on all three products utilizing these methods.

2005

An additional material was planted in UCEPC Field 3A. Approximately 1800 “Conetainer” type transplants of *Senecio multilobatus* were planted the first of July 2005 in the same manner the other materials were planted.

2006

No plantings were done in 2006.

2007

One additional material was provided to UCEPC for seed increase from direct seeding. A planting of 0.2 acre of bluestem penstemon was completed on August 17, 2007. Germination and establishment success will be evaluated in the spring of 2008 to determine the potential for this species.

2008

No plantings were done in 2008.

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By Steve Parr

Harvests
Each product was harvested with the Hege plot combine in 2005 and 2006. All materials except the Senecio were harvested in 2007 with a pull type swather. The swathed windrows were then picked up with pitchforks and transported to seed drying areas in buildings. After the material was dry, it was run through the Hege combine repeatedly until no appreciable seed recovery was obtained.

A small amount of Senecio was harvested by hand in 2007. It is apparent that the product is either a biennial or a short lived perennial. The Senecio was planted in 2005, harvested in 2006 and the vast majority of plants died after harvest. During the spring of 2007, however, it was noted that a large number of seedlings were emerging. Jim Free, UP Technical Committee, viewed the fields, including the Senecio seedlings, on a visit June 21, 2007. From appearances in the fall of 2007, there should be a crop in 2008.

2008
Seed from the muttongrass, Junegrass, and multi-lobed senecio were harvested in June and July. It was mutually determined by UP and UCEPC to discontinue the production of yarrow. Bluestem penstemon did not produce a seed crop in 2008.

RESULTS

Below, a summary of planting dates, acreage, harvest dates and harvest amounts is provided as a table.

Species	Accession	Year Established	Acreage	Harvest Amount	Harvest Date
Junegrass	9092273	6/18/2004	0.27 acre	-0-	NA
				15 lb	7/26/2005
				10.4 lb	7/12/2006
				9.0 lb	7/12/2007
				9.6	7/23/08
Muttongrass	9092272	6/17/2004	0.27 acre	-0-	NA
				2 lb	6/8/2005
				16.5 lb	5/30/2006
				5.0	5/30/2007
				15.0	6/13/08
Senecio	9092280	7/1/2005	0.13 acre	-0-	NA
				15 lb	6/21/2006
				292 g	7/5/2007
				23 lb	7/04/08

Yarrow	9092271	6/16/2004	0.20 acre	43 g	11/2/2004
				17.5 lb	8/6/2005
				14 lb	8/2/2006
				10 lb	7/27/2007
				No harvest	2008

A formalized work plan was agreed to for work to be conducted in 2008, and is being developed for 2009. This plan identified the harvest of muttongrass, Junegrass and the maintenance of the bluestem penstemon planted in 2007. This represents the final year of production for the two grass species for UP, as neither shows substantial promise for commercial application.

On November 25, 2008, UCEPC met with Ron Bell, Jim Free, Ken Holsinger and Pam Motley of the UP to discuss product increase, development, marketing and release as well as a thorough assessment of 16 UP products that have been produced or studied by various cooperators.

CONCLUSION

UCEPC will coordinate with the Uncompahgre Technical Committee about a work plan for 2009. The bluestem penstemon and a native collection of Lewis flax have been verbally agreed upon to produce at UCEPC. It is anticipated that other materials will be planted or tested at UCEPC and results and products delivered to UP growers.

A formal agreement between UCEPC, NRCS, and the PLP was ratified in August of 2007 and extends through 2011. An annual work plan will be developed between the three parties prior to the field season of each fiscal year for the life of the agreement.

Project: COPMC-S-0701-CR
Report- 2008
By: Heather Plumb

Seed Increase of Blue Wildrye for Medicine Bow-Routt National Forest

INTRODUCTION

Upper Colorado Environmental Plant Center (UCEPC) and Medicine Bow-Routt National Forest formally entered Cooperative Agreement 06-CS-11020604-042 in August of 2006. The agreement called for an increase of a single specie, blue wildrye *Elymus glaucus*, collected within the boundaries of Medicine Bow-Routt National Forest. Collection ELGL-080106-A1 from California Park was selected to be used in the 1/3 acre field planting. The field planting will increase seed from seed zone 215, one of the four seed zones Medicine Bow-Routt would like to have seed increased for. This agreement will run through the fiscal year of 2010.

OBJECTIVES

Increase a selection of blue wildrye for eventual release and use by Medicine Bow-Routt National Forest.

METHODS

In 2007, a seed increase field of 1/3 acre, was planted using material from Seed Zone 215, accession number ELGL080106-A1. After planting occurred, the field was irrigated to insure germination.

June 26, 2008, the blue wildrye seed increase field was evaluated by two UCEPC staff. The evaluation consisted of looking at plant establishment, vigor, signs of water stress, bug damage, weed infestation and seed head stage. The blue wildrye field was harvested July 13, 2008. Seed was sent to the Colorado Seed Laboratory for blue wildrye seed analysis.

RESULTS

Staff members from UCEPC evaluated blue wildrye seed increase field, 080106-A1, on June 26, 2008. It was observed that the blue wildrye plants were in the head stage and were flowering. Seed heads on the plants were abundant and healthy. Foliage was robust and was a dark green. Bare spots within the filed were minimal, blue wildrye plant vigor and percent stand cover were excellent. There were no signs of water stress, bug damage or heavy infestation of weeds. Weeds were present, but were not abundant. Squirreltail and mountain brome were mixed in with some of the blue wildrye plants, but were removed manually by the staff as the field was evaluated.

Seed harvested from the field was cleaned December 12, 2008, resulting in 44.5 pounds of blue wildrye. Seed was sent out to the Colorado State Seed Lab for analysis and PLS came back as 29.83%.

CONCLUSION

Collection 080106-A1 for Medicine Bow-Routt National Forest is going into its second year of production in 2009. Plant establishment was good in 2007, the first year of the agreement, and seed production in 2008 was average for the first production year. Further evaluations should still be conducted in the future to assess if collection maintains its vigor, percent cover and seed production. The Colorado Seed Laboratory report is available upon request for the blue wildrye.

Project COPMC-S-0702-CR
Project Report 2008
By: Steve Parr

Evaluation of Griffith's Wheatgrass and Poverty Oatgrass for Seed Increase Potential

INTRODUCTION

Interest in the use of native seed for revegetation and restoration activities has increased substantially in the last decade. Moreover, the use of more localized, site specific sources of native seed for specific revegetation needs has also gained favor among many land management agencies. Traditional concepts of desirable traits for materials used in revegetation included the potential for the product to prevent or reduce soil loss, the value as a grazeable product to livestock, most often cattle, the ease of establishment, availability of seed, and the persistence of the material on the site once established. Often, materials were chosen without regard to their affect on surrounding plant communities or ecosystems or the origin of the selected material, whether identified as native or introduced.

In contrast, the National Park Service, which is charged with genetic resource preservation, used native, site indigenous materials where practical for revegetation uses, especially since the late 1980's. In fact, seed of the same species, if not from the same site or one in close proximity to the revegetation site, is considered alien. This concept has gained considerable favor with many other public land management entities, and is used more widely in decisions about material selection for revegetation.

Boulder County, Colorado, has acquired many thousands of acres of farm and ranch lands for the preservation of open space. Some of the land uses today on those properties are consistent with historic uses. However, in some cases it is more desirable, if not appropriate, to accelerate the conversion of some agricultural lands to native rangelands. In addition, planned disturbances within the county could utilize a native seed source for revegetation if such an activity met the goals of Boulder County. In order to accomplish this, sustained seed sources of localized, native Boulder County materials were needed and desired. From this identified need, a seed increase project has been initiated between Boulder County and Upper Colorado Environmental Plant Center (UCEPC).

OBJECTIVE

This project will evaluate the cultural aspects of seed increase efforts of two indigenous, native grass species from Boulder County for use in revegetation projects by Boulder County Parks and Open Space.

Project COPMC-S-0702-CR
Project Report 2008
By: Steve Parr

METHODS

Personnel from Boulder County Parks and Open Space collected seed from several sources of big bluestem, Griffith's wheatgrass and poverty oatgrass over several years. Correspondence between David Hirt, Plant Ecologist for Boulder County, and Steve Parr, UCEPC Manager, led to decisions to attempt seed increase for Griffith's wheatgrass and poverty oatgrass. Seed tests were conducted for each of the seed lots, and decisions were made on seed quantities and seed lots to be used for the increase. While both lots chosen had good germination, off type species in each collection presented a concern. Kentucky bluegrass was present in the poverty oatgrass, but proper management should successfully reduce or potentially eliminate those plants from an increase field. The Griffith's wheatgrass, however, had high amounts of contaminants in the form of Japanese brome and downy brome.

The only practical way to manage for the amount of contaminant in the Griffith's wheatgrass collection was to plant late enough in the summer to germinate the annual bromes without presenting an additional seed contamination problem (the annual bromes would not produce seed during the establishment year). By establishing the target material early enough to reach adequate maturity during the establishment year, but late enough to eliminate annual brome seed formation, seed production should be accomplished the following year. However, in order to reduce the hand rouging necessary to remove the bromes, establishment timing had to incorporate the application of herbicide for annual brome control in the fall. We believe this was successfully accomplished. Spring evaluations will determine the level of success for this project.

Because the use of 'Plateau' herbicide on Griffith's wheatgrass is not known, a split planting was done as a dormant seeding. Two methods and two timings were done for the initial planting of Griffith's wheatgrass.

A literature search in the Plants Database indicated that poverty oatgrass was tolerant of frost heaving. We conducted one half of the planting in August to compare against a dormant planting. To our surprise, the poverty oatgrass was being lifted, roots and all, in early October. The dormant fall planting will be used to compare to the summer planting. From observations, it was also noted that the poverty oatgrass went dormant quite early in the fall compared to other 'cool season' grasses. As a seedling crop, often there is photosynthetic activity until snow cover to induce dormancy. The poverty oatgrass did not follow that pattern, and suspended growth well before snow cover.

Griffith's Wheatgrass

A 1/3 acre planting was done on August 10, 2007, with a hand-pushed Plant Junior seeder. Calibration targeted 30 pls seeds-per-foot of row. The field was irrigated for establishment, and an excellent stand resulted. The annual bromes also germinated as anticipated. On November 2, 2007, six ounces of Plateau per acre was applied to the August planting for annual brome control.

On October 11, 2007, a separate dormant planting of 1/3 acre was conducted. This planting will compare planting methods and plant response to Plateau herbicide effects. A total of 1.5 pounds of the 2003 Rabbit Mountain seed lot was used for both plantings. Approximately two pounds remain on inventory.

Poverty Oatgrass

The planting of poverty oatgrass was also conducted as a split application. One-third acre was planted on August 10 and 1/3 acre was planted as a dormant planting on October 11. Buctril herbicide was used on November 2 to control winter annual broadleaf weeds. Eight tenths of one pound of 2004 Heil Valley Ranch was used in the planting with the target again being 30 pls seeds per linear foot of row. Approximately 1.2 pounds of this lot remain on inventory.

RESULTS

The initial establishment of both materials was very good. Both products responded well to irrigation and germinated readily after a single irrigation of a two 12-hour set from overhead sprinkling. While the Griffith's continued to produce above and below ground biomass late into the season, the growth of poverty oatgrass stopped or nearly stopped by early October. The plants also started to change color and go dormant by mid October. Additionally, we noted substantial frost heave damage to the oatgrass field established in August. If the frost heave damage is severe enough to warrant an inner seeding, that will be conducted as soon as soil temperatures warrant. From minimal work conducted on the oatgrass, it has behaved much like a late seral stage, warm season species. Griffith's wheatgrass has performed very well to date. Additional notes and observations will be made on both products this spring and throughout the production year.

2008

Spring observations showed the poverty oatgrass nearly a complete loss. As a result, 0.57 acre was reseeded on June 28, 2008. Sprouting was good, and a well established field noted two weeks later. However, as was noted the previous year, the growth was very minimal with the crop and concerns about the increase potential of this product were becoming evident. There was approximately 0.17 acre of the dormant planting that remained a bit more robust than the new planting, but no seed heads were produced from this portion of the planting either.

The Griffith's wheatgrass, on the other hand, established nicely and remained healthy coming out of the winter in 2007-2008. No re-seeding was necessary in 2008, and the plants continued to mature. There was a minimal amount of seed produced, 144 grams, that was hand harvested on August 5. After a full year of establishment, the crop should be fully productive in 2009.

CONCLUSION

The Griffith's wheatgrass has shown good increase potential utilizing standard cultural methods at UCEPC. We are optimistic about its future seed production. Boulder County has been very patient with the development of the crop, which has contributed to the potential for success with this product.

The poverty oatgrass, while primarily a big disappointment, has shown some minimal signs of providing some seed. Because Boulder County has paid for two years of development with this material, UCEPC will continue to work with the established part of this crop in an attempt to produce seed. In addition, David Hirt with Boulder County, has expressed interest in doing an increase with mountain muhly as a replacement product. The mountain muhly will be planted in 2009.

Project: COPMC-S-0806-CR
Report- 2008
By: Heather Plumb

Native Seed Increase for Medicine Bow-Routt National Forest

INTRODUCTION

In August of 2006, Upper Colorado Environmental Plant Center (UCEPC) and Medicine Bow-Routt National Forest formally entered Cooperative Agreement 06-CS-11020604-042. On May 22, 2008, the agreement was modified to include more plant species to be increased in the future by UCEPC. Arapaho Roosevelt National Forests, a third party with common interests, was additionally introduced in the modification. The modified agreement calls for the increase of three additional 1/3 acre plantings of blue wildrye *Elymus glaucus*, one 1/3-acre seed increase of each of the following: western wheatgrass *Pascopyrum smithii*, bluebunch wheatgrass *Pseudoroegneria spicata*, and mountain muhly *Muhlenbergia montana.* All seed increase fields will contain materials that were collected within the boundaries of Medicine Bow-Routt National Forest.

OBJECTIVE

The objectives of this project are outlined as follows:

1) UCEPC will provide a four man seed collection crew for one full field day to collect accessions of bluebunch wheatgrass.
2) Medicine Bow-Routt National Forest personnel will provide up to 100 collections of blue wildrye, bluebunch wheatgrass, or other plant species.
1) UCEPC will clean up to 100 Forest Service collections.
2) UCEPC will increase three 1/3-acre plantings of single accessions of Medicine Bow-Routt collected blue wildrye.
3) Medicine Bow-Routt National Forest and UCEPC will provide technical assistance to agriculture science faculty and students at North Park High School.

MATERIALS AND METHODS

Medicine Bow-Routt National Forest and Arapaho-Roosevelt National Forests seed collection crews harvested slender wheatgrass, bluebunch wheatgrass, oniongrass, blue wildrye, and a *Poa* spp. The seed collections were delivered to UCEPC in August and September 2008. The seed is scheduled to be cleaned in 2009 by UCEPC staff.

RESULTS

Five grass species were collected by the Medicine Bow-Routt National Forest and Arapaho-Roosevelt National Forests crews in 2008. Collection crews were unable to find sufficient amounts of western wheatgrass and mountain muhly for the project. In a verbal agreement, it was decided in place of western wheatgrass and mountain muhly, a *Poa* spp. and showy oniongrass *Melica bulbosa* were to be collected instead. These two grass species will replace western wheatgrass and mountain muhly in future seed increase fields. This modification has not

been made on the agreement for 2008, but will be modified on the agreement in 2009. The following is a table of the high gram producers for the five grass species collected.

	Seed Zone	Grams of clean seed
Slender wheatgrass	481	408
Slender wheatgrass	221	795
Oniongrass	215	302
Oniongrass	215	271, 215
Poa spp.	214	177
Poa spp.	214	335
Blue wildrye	214	584
Blue wildrye	214	997
Bluebunch wheatgrass	211	361
Bluebunch wheatgrass	211	331

CONCLUSION

UCEPC will provide a compiled accessions list of total grams of cleaned materials to Medicine Bow-Routt National Forest. Future grass specie seed increase fields must be determined by Medicine Bow-Routt National Forest. After the desired seed increase species are determined by the Medicine Bow-Routt National Forest the UCEPC will proceed in planting the additional 1/3-acre fields for seed increase.

In 2008, because of time constraints, UCEPC was not able to meet with Medicine Bow-Routt National Forest staff as specified in the modified agreement. In 2009, a four man crew will meet with the Medicine Bow-Routt National Forest to provide a full field day to help collect accessions of bluebunch wheatgrass. Further seed collections from the four seed zones within the forest boundaries are suggested.

Project COPMC-S-9104-WL
Project Report-2008
By: Terri Blanke

Clark Source Serviceberry Seed Increase

OBJECTIVE

Release root sprouting selection of Saskatoon serviceberry; accession 9021441.

INTRODUCTION

Saskatoon serviceberry, *Amelanchier alnifolia*, is a native shrub found in the North Central United States, Northern Great Plains, Central and Rocky Mountain states. It is a cool season, clump forming deciduous shrub or small tree that will grow from three to ten feet. Stems will be numerous, branching and erect with a dark grey to reddish brown bark. Leaves are alternate, simple oblong to nearly rounded and grow one to two inches in size. They will be toothed above the middle and somewhat hairy beneath. Flowers are white, bell shaped, and clustered with red to purple diminutive apple-like pome fruit. The fruit contains four to ten dark seeds and is covered with a leathery seed coat. Roots will be well branched and both deep and superficial. This plant can reproduce by sprout suckers as well as seeds. Seed for the accession 9021442 was collected in 1975 from Clark (thus its name) in Routt County, Colorado. The estimated elevation was 7200 feet. The plant is winter hardy, moderately drought tolerant, and has good fire tolerance of native and established stands and has a moderately strong tolerance to close browsing or defoliation.

EXPERIMENTAL DESIGN

This study is a non-replicated test.

MATERIALS & METHODS

Clark's serviceberry was planted in the Upper Colorado Environmental Plant Center orchard on August 8, 1977. Fourteen years later and due to superior performance, it along with two other shrubs, Silver Buffaloberry and Chokecherry were chosen for isolation and further evaluation.

On May 24, 1991, twenty-two serviceberry sprouts were dug by hand. A channel was plowed and the sprouts were planted in one row on ten foot spacings next to the channel. They were hand-watered as needed. In July of 1992, thirty sprouts were dug and potted for field increase. Then in 1993, eight from the original thirty sprouts were transplanted in an isolated area. In April of 1994, seven more plants were added. These were watered and pruned. Today there are 15 plants surviving, five of which are the only remaining originals. This planting receives no supplemental water.

RESULTS

The planting was evaluated from 1991 to 1994. Seed was never collected from the serviceberry. The wildlife had browsed it heavily since the beginning of the project. There are currently 15 small bushes remaining. The remaining shrubs have been fenced, measured, and photographed in the fall of 2006. On April 3, 2007, the serviceberry shrubs were again evaluated. There was very little new growth. An herbicide was applied around the shrubs to help suppress weeds. Hand weeding continued through the summer and on August 31, 2007, the plants were pruned and re-evaluated. In August of 2008, small amounts of seed were hand harvested from plant 3 and plant 5. The shrubs continue to flourish with the protection from the wildlife browsing. In late October of 2008, the serviceberry were again evaluated and pruned. The table below shows how the serviceberry have performed since 2006.

Clark's Serviceberry Performance

Shrub No.	2006 Height	2007 Growth	2008 Growth	Leader Growth	Rating*
1	27"	54"x 46"	63"x 46"	20"	1
2	21"	24"x 23"	43"x 24"	18"	7
3	18"	22"x 36"	36"x 39"	16"	3
4	16"	23"x 19"	33"x19"	6 ½"	5
5	18"	34"x 36"	33"x 41"	8 1/2"	7
6	21"	36"x 36"	54"x 39"	18"	3
7	13"	25"x 20"	28"x 18"	9"	7
8	14"	23"x 22"	38"x 28"	15"	7
9	9"	8"x 3"	NA	NA	7
10	15"	28"x 17"	36"x 19 "	7"	5
11	16"	20"x 24"	35"x 27"	10"	7
12	12"	16"x 10"	19"x 18"	4"	7
13	15"	16"x 8"	17"x 9"	1"	7
14	14"	18"x 10"	26"x 14"	5"	7
15	15"	18"x 14"	22"x 9"	4"	5

*Ratings: 1-excellent, 3-good, 5-fair, 7-poor

CONCLUSION

Generally, survival has been good. By reducing the wildlife browsing and competition from weeds, the serviceberry have shown much improvement. We will continue to monitor the shrubs for survivability, seed production, and the possibility of a release.

Project COPMC-S-9105-RI
Report-2008
By: Terri Blanke

Silver Buffaloberry Seed Increase

OBJECTIVE
Pre-cultivar release, seed increase.

INTRODUCTION
Upper Colorado Environmental Plant Center (UCEPC) has identified the native Colorado shrub, Silver buffaloberry *Shepherdia argentea* as a species with many conservation attributes. Adapted to elevations below 7500 feet and requiring 13 to 21 inches of precipitation, the Silver buffaloberry offers wildlife habitat improvement, windbreak potential, landscaping, riparian enhancement, and erosion control. The plant is a deciduous, thorny shrub, or small tree reaching 6 to 20 feet in height. The leaves are silver gray in color on top and bottom and are 1 to 2 inches long, 3/8 inches wide. The thin bark becomes grayish-brown and will begin peeling as the plant matures. The plant has opposite branching. Fruit is drupe-like, ovoid, about ¼ inch long, mostly reddish orange. Rarely, yellow fruit can be seen. Roots are shallow and much branched; readily sprouting. Silver buffaloberry can be found growing along streams, in coulees and on exposed, moist hillsides. The plants are winter hardy and alkaline tolerant. Silver buffaloberry is capable of fixing nitrogen in root nodules that contain bacteria.

EXPERIMENTAL DESIGN
This study is a non-replicated test.

MATERIALS & METHODS
Accession 9008027 was planted into the orchard of Upper Colorado Environmental Plant Center on August 8, 1977. Fourteen years later this accession was chosen for its superior performance and was relocated to field 18 for further evaluation.

On May 24, 1991, a channel was plowed and holes were dug beside the channel on ten-foot spacing. Twenty Silver buffaloberry sprouts were planted and hand watered through the summer. Five sprouts had to be replaced by 1993. No further evaluations were conducted.

In January of 2006, two native shrub seeding trials were conducted at UCEPC. The trial was to determine the germination rate of non-stratified seed from native shrubs. Silver Buffaloberry seed was planted with and without the pulp/flesh in the greenhouse and in a field setting.

In the fall of 2007, a field crew pruned the original shrubs and sprayed for weeds. That winter the wildlife browsed them heavily. The damaged shrubs were pruned again in the fall of 2008.

Project COPMC-S-9105-RI
Report-2008
By: Terri Blanke

Three off-site riparian studies began in 2008 incorporating the Silver buffaloberry. Study COPMC-F-0802-IN will determine if Silver buffaloberry is suitable and effective in replacing post treated tamarisk sites. Study COPMC-F-0803RI will determine adaptation of Silver buffaloberry selection for riparian restoration plantings. Study COPMC-F-0804-RI will determine adaptation of the buffaloberry for riparian restoration plantings at high elevations.

The UCEPC orchard, windbreak, and off-site plantings receive no supplemental water.

RESULTS

Twenty Silver buffaloberry shrubs remain in field 19 at UCEPC. The shrubs have multiple trunks and have grown from 8 to10 feet tall. The first seed was harvested from the shrubs seven years after isolating the sprouts. The table below shows the years and amounts of seed collected.

Year Harvested	Cleaned Seed Weight
1998	13 Grams
2003	238 Grams
2007	751 Grams
2008	2.6 LBS

The native shrub seeding trial results from the greenhouse exhibited that the Silver buffaloberry seed requires a cold stratification period of 30 to 60 days. The trial also exhibited germination was greater, 63 percent, for the seeds with the pulp removed. The seeds left in the pulp germinated at 26.7 percent. The field trial was evaluated for two years and terminated. It is believed that due to frost heaving the seeds were pushed out of the soil and became dehydrated. No germination occurred.

The off site project information and results can be found in the individual reports listed above.

CONCLUSION

The Silver buffaloberry shrubs have potential for being released for conservation use by the general public. Further evaluations and propagation techniques will be continued. As tamarisk and Russian olive abatement projects throughout the southwestern United States continue to be successful and gather momentum for large scale implementation, suitable native woody riparian replacement materials will be in high demand. This selection of silver buffaloberry may help satisfy this anticipated conservation need.

Project COPMC-S-9106-WL
Project Report-2008
By: Terri Blanke

Chokecherry Seed Increase

OBJECTIVE

Pre-cultivar release, seed increase

INTRODUCTION

Chokecherry *Prunus virginiana* is a native shrub which grows in a large geographic range in North America. The shrub grows abundantly in many habitat types and plant associations. Chokecherry occurs naturally in a wide range of soil type and textures making it key in restoration/reclamation projects. Precipitation ranges from 13 to 65 inches annually and the shrub prefers a low to mostly mid-elevation. Chokecherry is perennial, deciduous, woody, and thicket-forming. They are a large erect shrub or small tree, rarely reaching 30 feet. The stems are numerous and slender with a root network of rhizomes. The bark of young trees may vary from gray to reddish brown. With age it will become darker, almost brownish-black and noticeably furrowed. Leaves of this shrub are alternate, simple, glabrous, oval to broadly elliptic in shape, 1 to 4 inches long and ¾ to 2 inches wide. The leaves are dark green and glossy above, paler and lighter beneath. The margins are toothed with closely-spaced sharp teeth pointing outward to form a serrated edge. They will turn yellow in autumn. Flowers are arranged in cylindrical racemes 3 to 6 inches long, ¼ to ⅜ inches in diameter with five white petals. The fruits are spherical drupes, globose, ¼ to ⅜ inches in diameter. Small ripe cherries range in color from dark red to purple or almost black. Limiting factors in the chokecherry's habitat are poor drainage, frequent flooding, or soil with large amounts of clay and shade. Chokecherry is well adapted to fire disturbance. Seed for accession 9024060 was collected in 1975 at the Meeker Jr. High School in Rio Blanco County, Colorado.

EXPERIMENTAL DESIGN

This study is a non-replicated test.

MATERIALS & METHODS

Accession 9020640 was planted in the Upper Colorado Environmental Plant Center (UCEPC) orchard on August 8, 1977. Fourteen years later, due to superior performance, it along with two other shrubs, silver buffaloberry and Clark's serviceberry, were chosen for isolation and further evaluation.

On May 24, 1991, twenty-one chokecherry sprouts were hand dug from the UCEPC orchard and planted in field 18. A channel was plowed and the sprouts were planted in one row on ten foot spacings next to the channel. They were watered by hand weekly and weeded through the summer. In 1992 and 1993, new sprouts were dug to replace those that perished. In September of 2007, the Chokecherry shrubs were pruned and sprayed for weed suppression. The following summer, the plants were fenced to help prevent the wildlife from browsing damage. Today this planting receives no supplemental watering.

Project COPMC-S-9106-WL
Project Report-2008
By: Terri Blanke

In January of 2006, accession 9024060 was incorporated into a native shrub seed germination trial and in October of 2007 the chokecherries were further tested in a direct seeding trial. For information on those trials see study numbers COPMC-T-0702-UR and COPMC-T-0801-WL.

RESULTS

The chokecherry planting in field 18 was evaluated from 1991 to 1994. In August of 1998, the first seed harvest was made from the chokecherry shrubs. Table 1 below shows the years that seed was harvested and the amount of cleaned seed quantities collected.

Table 1. Chokecherry Seed Production from UCEPC

Year of Harvest	Amount of Cleaned Seed
1998	106.0 lb
1999	9.0 lb
2000	30.5 lb
2001	21.92 lb
2003	4.80 lb
2007	47.0 lb
2008	36.5 lb

CONCLUSION

UCEPC will continue its effort towards releasing the chokecherry accession 9024060 for future public uses. This accession has been sent to other Plant Material Centers to determine it's suitability in a variety of conservation settings. Due to its aromatic flowers, the chokecherry has been chosen as a potential plant specie that UCEPC could provide for projects regarding pollinator conservation.

Project No. COPMC-T-0502-RA
Project Report-2008
By: Manuel Rosales

Mountain Brome *Bromus marginatus* Seed Treatment-Spring Seeding

OBJECTIVE

To determine effectiveness of fungicides in controlling or reducing incidence of head smut *Ustilago bullata*, in Mountain Brome (Garnet Germplasm).

INTRODUCTION

During the year 2000, Upper Colorado Environmental Plant Center (UCEPC) released Garnet Germplasm mountain brome as a tested class release. The term "Germplasm" denotes that the material is not a cultivar, but a pre-cultivar release recognized by the Association of Official Seed Certifying Agencies. Garnet Germplasm was selected for its head smut *Ustilago bullata* resistance, longevity, and ease of establishment and good production of both forage and seed. Mountain brome is widely used for conservation and reclamation plantings in Colorado. Unfortunately, seed producers in Colorado have reported more than 5% incidence of the disease smut in Garnet Germplasm. This might imply that Garnet is not totally resistant to head smut or perhaps another strain of the disease has been developed to which Garnet is susceptible. The disease is limiting production of Garnet and its use for conservation purposes. Distribution of Garnet Germplasm from UCEPC has been suspended. At present, there is no known means to control smut in our seed production fields, nor can we recommend to our seed producers any control method for smut.

This fungal disease has been reported to reduce seedling establishment. It can affect seed yields substantially, depending on incidence of infected plants. Head smut, when present in the head, produces smut instead of seed, thereby, reducing seed production. It can also reduce forage production. The disease is found on a wide range of grass hosts, but is a most important disease of cool-season grasses, especially **brome grasses** and wheat grasses. Head smut has been reported as being primarily seed-borne; however, reports also indicate that spores in the soil can infect emerging seedlings. The fungus develops systemically within the host plant. At flowering the ovaries in the infected plants are converted to bulky masses of spores covered by a thin membrane. Black or brown spore masses are released when this membrane breaks. Fungal spores disperse by wind. Spores infect seed embryos at flowering. The disease also affects the morphology of the plant. The internodes in the stem are shortened, producing a shorter stem that bears a more erect, compact panicle.

This technology development study was designed to determine if seed treatment with fungicide can prevent or reduce the incidence of head smut. Also, the study is being conducted at two planting times, **spring** versus **fall** to find out if environmental conditions during germination and establishment influence head smut incidence.

Project No. COPMC-T-0502-RA
Project Report-2008
By: Manuel Rosales

EXPERIMENTAL DESIGN

The statistical design for the study is a randomized complete block with a split plot arrangement, replicated three times.

Treatments consist of:

1. **Contaminated seed**
    a. Treated with vitavax-captan
    b. Treated with Dividend
    c. Untreated seed /check
2. **Non-contaminated seed**
    a. Treated with vitavax-captan
    b. Treated with Dividend
    c. Untreated seed /check

MATERIALS & METHODS

Contaminated and uncontaminated seed of Garnet mountain brome was treated with two fungicides prior to planting. The two fungicides were selected with the assistance and advice of Dr. Ned Tisserat, Plant Pathologist with Colorado State University. Naturally-infected seed of Garnet mountain brome was secured from a grower's field for a source of contaminated seed. The uncontaminated seed was from seed grown and harvested at UCEPC, from a non-infected field, with seed lot number SG1-04-UC6. The two fungicides used were: Enhance (vitavax-captan 20-20) and Dividend Extreme. Both seed treatment fungicides were used following the recommended rates to control head smut (often called loose smut) according to label instructions.

The experimental site is located at UCEPC in a field that previously had mountain brome and was infected with head smut. The site was chosen to insure that we get an infection by the disease and evaluate the effectiveness of the fungicides. Seed bed preparation was done by preparing flat-beds spaced at three-foot center. The **plot size** is 240 square feet: 12 feet wide by 20 feet in length. Each plot consists of four rows spaced at three-foot centers. All the data to be collected will be from the two middle rows to eliminate border effect. The **Spring study** was planted on **May 24, 2005**. The seed was drilled with a hand-pushed Planet Junior seeder. The rate of seeding was 30 pure live seeds per linear foot of row. The plots received no initial fertilizer or irrigation.

The parameters to be measured in the study are: **percent plant stand**, **disease incidence**, and **seed yield**. Disease incidence will be assessed by counting the total number of panicles within a random length of three to ten feet in the middle of the plots, and getting a percent of infected panicles within this length. Seed yield and percent stand will also be collected from this area. The study will be conducted for at least three years depending on survivability of the stand.

Project No. COPMC-T-0502-RA
Project Report-2008
By: Manuel Rosales

RESULTS

Year-2005: Excellent stands were established in all plots seeded on May 24, 2005. On June 14, 2005, all plots had 90-100 percent germination. On September 26, 2005, all plots were growing well, with an average height of four to six inches.

Year-2006:
Results for 2006 are presented in the following table:

Table 1. Effect of fungicide treatment on seed yield, % smutted heads, and plant height on infected and non-infected seed of Garnet Germplasm Mountain Brome tested release. UCEPC-2006

Seed Quality	*Fungicide*	*Seed Yield (lb/A)*	*% Smutted Heads**	*Plant Height (cm)*
Clean Seed	Control	279 bc	8 c	69 a
	Dividend	321 ab	0 c	72 a
	Vitavax	301 b	0 c	74 a
Infected Seed	Control	154 c	68 a	68 a
	Dividend	447 a	1 c	71 a
	Vitavax	328 ab	37 b	71 a
Mean		305	19	71

Means within columns followed by the same letters are not significantly different as determined by least significant difference test (LSD) at P<0.05 for the interaction seed quality by fungicide
*** Percent smutted heads was calculated by counting the number of smutted heads out of a total number of heads in a meter sample within each plot.**

As indicated in the table above, the fungicide treatment had a positive effect in the contaminated seed infected with the smut disease. Dividend performed better than Vitavax for the growing season of 2006. Pure live seed (as per lab results) of seed treated with Dividend was double the percentage of seed treated with Vitavax or control.

We will collect data again for the 2007 growing season to determine if the effect of the fungicide in protecting against the disease lasts for more than one season of growth.

Project No. COPMC-T-0502-RA
Project Report-2008
By: Manuel Rosales

Year-2007

The data for 2007 is presented in Table 2.

Table 2. Effect of fungicide treatment on smut disease, and other parameters on infected and non-infected seed of Mountain Brome-Garnet Germplasm. UCEPC-2007

Seed Quality	Fungicide	Percent Smutted Seed[1]	Seed Yield (lb/A)	Plant Height (cm)	Plant Stand
Clean Seed					
	Control	4.9	218.0	85.4	100
	Dividend	0.4	271.3	89.9	100
	Vitavax	1.1	229.1	82.5	100
Infected Seed					
	Control	56.8	170.6	91.9	100
	Dividend	3.0	297.8	89.2	99.3
	Vitavax	17.8	319.3	92.4	99.3
Mean		14.0	251.0	88.5	99.8
LSD (0.05)*		20.5	NS	NS	NS

1. Percent smutted seed was calculated by counting the number of smutted heads out of a total number of heads in a meter sample within each plot per three replications.
* Least significantly different (LSD) at P<0.05 for the interaction seed-quality by fungicide.
NS = Not Significant different at P<0.05.

Results for 2008:

This is the third growing season for this planting. In contrast with year-2007, the plots were not affected by the aphids this year and thus produced a little bit more seed. The plots were evaluated in July 10, 2008. Stands are holding very well. Results are presented in the following tables.

Table 3. Effect of fungicide treatment on smut disease, and other parameters of infected and non-infected seed of Mountain Brome-Garnet Germplasm. UCEPC-2008

Seed Quality	Fungicide	Percent Smutted seed1	Percent Smutted Visual2	Seed Yield (Lb/A)	Plant Height (cm)	Plant Stand2
Clean Seed						
	Control	**3.1**	**7.7**	**258.5**	**85.9**	**100**
	Dividend	**0.4**	**2.3**	**399.3**	**94.6**	**100**
	Vitavax	**2.2**	**4.3**	**280.3**	**88.1**	**100**
Infected Seed						
	Control	**25.9**	**70.0**	**177.5**	**88.6**	**100**
	Dividend	**1.2**	**14.3**	**257.4**	**82.1**	**99.3**
	Vitavax	**3.0**	**35.0**	**295.8**	**90.0**	**99.3**
Mean		**14.0**	**22.3**	**278.1**	**88.2**	**99.8**
LSD (0.05)*		**NS**	**18.1**	**NS**	**NS**	**NS**

1. Percent smutted seed was calculated by counting the number of smutted heads out of a total number of heads in a meter sample within each plot per three replications.
2. Visual estimate per plot basis
* Least significantly different (LSD) at P<0.05 for the interaction seed-quality by fungicide. NS = Not Significant different at P<0.05.

Table 4 Presents an average for the three years of the effect of the fungicides.

Table 4. Effect of fungicide treatment on smut disease of infected and non-infected seed of Mountain Brome-Garnet Germplasm. UCEPC-2006 -2008

Seed Quality	Fungicide	Percent Smutted seed[1]			
		2006	**2007**	**2008**	**3-years average**
Clean Seed(non-infected)					
	Control	8	4.9	3.0	5.3
	Dividend	0	0.4	0.5	0.3
	Vitavax	0	1.1	2.2	1.1
Infected Seed					
	Control	68	56.8	26.0	50.3
	Dividend	1	3.0	1.2	1.7
	Vitavax	37	17.8	3.0	19.2
Mean		19	14.0	5.9	(12.9)
LSD (0.05)*		13.4	20.5	NS	

1. Percent smutted seed was calculated by counting the number of smutted heads out of a total number of heads in a meter sample within each plot per three replications.
* Least significantly different (LSD) at P<0.05 for the interaction seed-quality by fungicide. NS = Not Significant different at P<0.05.

Project No. COPMC-T-0502-RA
Project Report-2008
By: Manuel Rosales

SUMMARY/CONCLUSIONS

The Fungicide treatments applied to the seed at planting in May 2005 are still having an effect on controlling the smut disease, as compared with the control treatment. Even though the seed yields were not statistically significantly different(except in 2006), one needs to keep in mind that once a field or plot is infected with the disease the seed produced from this field is going to be contaminated due to the action of the harvesting equipment which mixes all the seed. The degree of contamination will be dependent upon the incidence or percentage of the smut disease in the field. In addition, seed quality on contaminated seed, results in lower percent pure live seed. The data indicates that smutted seed treated with Dividend or Vitavax can effectively control the smut disease, and using non-contaminated seed is always better than using contaminated seed. Below are some recommendations.

Recommendations to control smut disease based on the findings of the study:

1. Plant in fields with no history of the disease
2. Use clean (uncontaminated)-fungicide treated seed with a good Pure Live Seed rating
3. Observe field sanitation by removing infected seed heads and plants as soon as they appear in the field.

Project No. COPMC-T-0504-RA
Project Report-2008
By: Manuel Rosales

Mountain Brome *Bromus marginatus* Seed Treatment-Fall Seeding

OBJECTIVE

To determine if seed treatment materials (fungicides), and time of seeding affects smut incidence in Mountain Brome.

INTRODUCTION

During the year 2000, Upper Colorado Environmental Plant Center (UCEPC) released Garnet Germplasm mountain brome as a tested class release. The term "Germplasm" denotes the material is not a cultivar, but a pre-cultivar release recognized by the Association of Official Seed Certifying Agencies. Garnet Germplasm was selected for its head smut *Ustilago bullata* resistance, longevity, and ease of establishment and good production of both forage and seed. Mountain brome is widely used for conservation and reclamation plantings in Colorado. Unfortunately, seed producers in Colorado have reported more than 5% incidence of the disease smut in Garnet Germplasm. This might imply that Garnet is not totally resistant to head smut or perhaps another strain of the disease has been developed to which Garnet is susceptible. The disease is limiting production of Garnet and its use for conservation purposes. Distribution of Garnet Germplasm has been suspended from UCEPC. At present there is no means to control smut in our seed production fields, nor can we recommend to our seed producers any control method for smut.

This fungal disease has been reported to reduce seedling establishment. It can affect seed yields substantially, depending on incidence of infected plants. Head smut, when present in the head, produces smut instead of seed, thereby, reducing seed production. It can also reduce forage production. The disease is found on a wide range of grass hosts, but is a most important disease of cool-season grasses, especially **brome grasses** and wheat grasses. Head smut has been reported as being primarily seed-borne; however, reports also indicate that spores in the soil can infect emerging seedlings. The fungus develops systemically within the host plant. At flowering, the ovaries in the infected plants are converted to bulky masses of spores covered by a thin membrane. Black or brown spore masses are released when this membrane breaks. Fungal spores disperse by wind. Spores infect seed embryos at flowering. The disease also affects the morphology of the plant. The internodes in the stem are shortened, producing a shorter stem that bears a more erect, compact panicle.

This technology development study was designed to determine if seed treatment with fungicide can prevent or reduce the incidence of head smut. Also, the study is being conducted at two planting times, **spring** versus **fall,** to find out if environmental conditions during germination and establishment influence head smut incidence.

Project No. COPMC-T-0504-RA
Project Report-2008
By: Manuel Rosales

EXPERIMENTAL DESIGN

The statistical design for the study is a randomized complete block with a split plot arrangement, replicated three times.

Treatments consist of:

1. **Contaminated seed**
    a. Treated with vitavax-captan
    b. Treated with Dividend
    c. Untreated seed /check
2. **Non-contaminated seed**
    a. Treated with vitavax-captan
    b. Treated with Dividend
    c. Untreated seed /check

MATERIALS & METHODS

Contaminated and uncontaminated seed of Garnet mountain brome was treated with two fungicides prior to planting. The two fungicides were selected with the assistance and advice of Dr. Ned Tisserat, Plant Pathologist with Colorado State University. Naturally-infected seed of Garnet mountain brome was secure from a grower's field for a source of contaminated seed. The uncontaminated seed was from seed grown and harvested at UCEPC, from a non-infected field, with seed lot number SG1-04-UC6. The two fungicides used were: Enhance (vitavax-captan 20-20) and Dividend Extreme. Both seed treatment fungicides were used following the recommended rates to control head smut (often called loose smut) according to label instructions.

The experimental site is located at UCEPC in a field that previously had mountain brome and was infected with head smut. The site was chosen to insure that we get an infection by the disease and evaluate the effectiveness of the fungicides. Seed bed preparation was done by preparing flat-beds spaced at three foot centers. The **plot size** is 240 square feet: 12 feet wide x 20 feet in length. Each plot consists of four rows spaced at three-foot centers. All the data to be collected will be done from the two middle rows to eliminate boarder effect. The **Fall Study** was planted on **October 18, 2005**. The seed was drilled with a hand-pushed Planet Junior seeder. The rate of seeding was 30 pure live seeds per linear foot of row. The plots received no initial fertilizer or irrigation.

The parameters to be measured in the study are: **percent plant stand**, **disease incidence**, and **seed yield**. Disease incidence will be assessed by counting the total number of panicles within a random length of three to ten feet in the middle of the plots, and getting a percent of infected panicles within this length. Seed yield and percent stand will also be collected from this area. The study will be conducted for at least three years depending on survivability of the stand.

RESULTS

Year-2006

Plots were examined on May 19, 2006, to determine how they were progressing after the winter season. Most plots had emerged at this time with an average seedling height of three inches. Replication No. III suffered water erosion after the snow melted in the spring, and some plots had fewer plants as compared to the other two replications in the test.

On July 7, 2006, the study was evaluated for percent plant stand. Results are presented in the following table. No seed was produced this year.

Table1. Percent plant stand for Garnet Germplasm Mountain Brome tested release (fall treatment study). UCEPC-2006.

Seed Quality	*Fungicide*	*% Plant Stand*
Clean Seed	**Control**	**60.0**
	Dividend	**56.7**
	Vitavax	**55.0**
Infected Seed	**Control**	**51.7**
	Dividend	**58.3**
	Vitavax	**68.3**
Mean		**58.3**
LSD (0.05)*		**7.84**

*Least Significant Difference at P<0.05. For same level of seed quality.
Percent plant stand is a visual estimate based on plot stand. Four complete rows/plot = 100 percent plant stand.

Year-2007

This is the first year of seed production for this test. The plots were evaluated June 27-30 and harvested July 2, 2007. Results are presented in Table 2.

Table 2. Effect of fungicide treatment on smut disease, and other parameters on infected and non-infected seed of Mountain Brome-Garnet Germplasm.
Fall seeded trial-UCEPC-2007

Seed Quality	Fungicide	Percent Smutted seed[1]	Seed Yield (Lb/A)	Plant Height (cm)	Plant Stand
Clean Seed	**Control**	0	293.7	85.1	86.7
	Dividend	2.1	243.0	80.9	86.7
	Vitavax	1.1	244.7	85.7	86.0
Infected Seed	**Control**	64.7	252.1	80.8	81.7
	Dividend	11.7	357.6	80.8	78.3
	Vitavax	1.1	400.8	80.2	91.6
Mean		13.2	298.7	82.2	85.2
LSD (0.05)*		45.3	NS	NS	NS

1. Percent smutted seed was calculated by counting the number of smutted heads out of a total number of heads in a meter sample within each plot per three replications.
* Least significantly different (LSD) at P<0.05 for the interaction seed-quality by fungicide. NS = Not Significant different at P<0.05.

Results for 2008

The fall planted plots did not do very well this year due to an infestation of aphids that reduced seed production. Plots were sprayed twice with an insecticide; however, control was no sufficient to reduce the damage cause by the aphids. Despite the damage by the aphids the plots were harvested and evaluated. Table 3 presents the data collected for 2008.

Table 3. Effect of fungicide treatment on smut disease, and other parameters on infected and non-infected seed of Mountain Brome-Garnet Germplasm.
Fall seeded trial-UCEPC-2008

Seed Quality	Fungicide	Percent Smutted seed[1]	Seed Yield (Lb/A)	Plant Height (cm)	Plant Stand
Clean Seed	**Control**	0	81.6	46.8	68.3
	Dividend	0	121.0	52.3	73.3
	Vitavax	0	88.5	54.0	61.7
Infected Seed	**Control**	34.3	50.6	42.1	63.3
	Dividend	0.77	90.0	40.2	72.3
	Vitavax	0.27	85.8	46.1	77.8
Mean		5.9	86.3	46.9	69.4
LSD (0.05)*		NS	NS	NS	NS

1. Percent smutted seed was calculated by counting the number of smutted heads out of a total number of heads in a meter sample within each plot per three replications.
* Least significantly different (LSD) at $P<0.05$ for the interaction seed-quality by fungicide. NS = Not Significant different at $P<0.05$.

SUMMARY

Even though the seed yield was not statistically significantly different, for both years 2007 and 2008, one needs to keep in mind that once a field or plot is infected with the disease the seed produced from this field is going to be contaminated due to the action of the harvesting equipment which mixes all the seed. The degree of contamination will be dependent upon the incidence or percentage of the smut disease in the field. In addition, seed quality on contaminated seed results in lower percent pure live seed. The data indicates that smutted seed treated with Dividend or Vitavax can effectively control the disease, and using non contaminated seed is always better than using contaminated seed. Below are some recommendations.

Recommendations to control smut disease based on the findings of the study:

1. Plant in fields with no history of the disease
2. Use clean-uncontaminated fungicide treated seed with a good Pure Live Seed rating
3. Observe field sanitation by removing infected seed heads and plants as soon as they appear in the field.

Project COPMC-T-0702-UR
Final Report-2008
By: Manuel Rosales

Direct Seeding of Native Shrubs

OBJECTIVE

To determine success of direct seeding of some better performing shrubs under field conditions.

INTRODUCTION

Upper Colorado Environmental Plant Center (UCEPC) identified a number of native shrub species, with different conservation attributes such as wildlife habitat improvement, windbreaks, restoration, landscaping, riparian enhancement, etc., since its inception in 1975. Most of the shrubs planted in 1977 are still growing at UCEPC and produce viable seed. Most of these shrubs have potential for conservation use and could be released by UCEPC. However, there is still some information that is needed before completing their release and use by the general public. Propagation techniques are still lacking to grow the shrubs and provide a continuous supply of plant materials to our customers. This technology development study makes an effort to fulfill this gap.

EXPERIMENTAL DESIGN

The statistical design for the study is a randomized complete block with three replications

MATERIALS & METHODS

Sixteen native shrub species were direct-seeded on November 6, 2006. Most of the seed used for this study was harvested at UCEPC in previous years with the exception of a few species that were collected outside the center. Plots were planted with a hand-pushed belt seeder at the rate of 20 seeds per linear foot. Plot size is 20 feet long by three feet wide. The plots will be irrigated as needed. The study will be conducted for three years.

Table 1 lists the species and source, and Table 2 presents the plot plan for the study.

Table 1. Sixteen Native Shrub Species Direct Seeded at Upper Colorado Environmental Plant Center*

Common Name	Scientific Name	Accession No.	Seed Source	Year Harvested
Antelope Bitterbrush	*Purshia tridentata*	9038521	UCEPC 95-F21	1995
Apache Plume	*Fallugia paradoxa*	9024141	UCEPC 83-EPC	1983
Basin Big Sagebrush	*Artemisia tridentata* spp. tridentata		Tom Brown Site-00	2000
Black Chokecherry	*Prunus virginiana* var. melanocarpa	9024060	UCEPC 03-F18	2003

Common Name	Scientific Name	Accession No.	Seed Source	Year Harvested
Cliff Fendlerbush	*Fendlera rupicola*	9024143	UCEPC 04-EPC	2004
Fringed Sage	*Artemisia frigida*	9021471	UCEPC 06-EPC	2006
Golden Currant	*Ribes aureum*	9030913	UCEPC 99-F15	1999
Littleleaf Mock Orange	*Philadelphus microphyllus*	9024096	UCEPC 98-F15	1998
Red Barberry	*Berberis haematocarpa*	9024220	UCEPC 02-F15	2002
Rockspirea	*Holodiscus dumosus*	9024154	UCEPC 95-F15	1995
Silver Buffaloberry	*Shepherdia argentea*	9008027	UCEPC 03-F15	2003
Silver Sage	*Artemisia cana*	9070850	04-Cedar Springs	2004
Smith's Buckthorn	*Rhamnus smithii*	9024308	UCEPC 98-F15	1998
Squaw Apple	*Peraphyllum ramosissimum*	9007948	UCEPC 03-F15	2003
Utah Serviceberry	*Amelanchier utahensis*	9021438	UCEPC 97-F3	1997
Wyoming Big Sagebrush	*Artemisia tridentata* Nutt. ssp. *wyomingensis*		Tom Brown Site-00	2000

*Planting Date: November 6, 2006

Table 2. Plot Plan for Direct Seeded Shrub Trial

→N								
Block-III	Bush Oceanspray	Silver Buffaloberry	Apache Plume	Smith's Buckthorn	Squaw Apple	Cliff Fendlerbush	Red Barberry	Littleleaf Mock Orange
	Golden Currant	Fringed Sage	Antelope Bitterbrush	WY Big Sagebrush	Black Chokecherry*	Silver Sage	Utah Serviceberry	Basin Big Sagebrush
Block-II	WY Big Sagebrush	Silver Buffaloberry	Black Chokecherry*	Smith's Buckthorn	Littleleaf Mock Orange	Cliff Fendlerbush	Antelope Bitterbrush	Squaw Apple
	Apache Plum	Basin Big Sagebrush	Red Barberry	Fringe Sage	Bush Oceanspray	Utah Serviceberry	Golden Currant	Silver Sage
Block-I	Squaw Apple	Apache Plume	Red Barberry	Basin Big Sagebrush	Black Chokecherry*	Golden Currant	Fringe Sage	Silver Sage
	Antelope Bitterbrush	Smith's Buckthorn	Littleleaf Mock Orange	Utah Serviceberry	WY Big Sagebrush	Cliff Fendlerbush	Silver Buffaloberry	Bush Oceanspray
* Chokecherry seed with pulp or flesh								

RESULTS

Growing Season of 2007:

On May 23, 2007, the plots were checked for germination. Some plots had some shrubs that had germinated at this time with about two to three true leaves and about one to two inches tall. The grass hay used for mulching provided protection against frost heaving of clay soil, however, this also created a weed problem since hay had viable grass seed and germinated along with the shrubs. Plots were hand weeded at this time to control broadleaved weeds and an application of the herbicide "SELECT" which controls grassy weeds was also applied at the rate of one ounce per three gallons of water plus 1.5 ounces of oil.

On July 19, 2007, the trial was evaluated for plant stand. The herbicide "SELECT" stopped the growth of grassy weeds but did not completely kill them. Plots were hand weeded for the second time. The results are presented in the following table.

Table 3. Percent Plant Stand for 16 shrub species direct seeded at Upper Colorado Environmental Plant Center*.

Common Name	Scientific Name	Percent Plant Stand
Antelope Bitterbrush	*Purshia tridentata*	96.6 a **
Utah Serviceberry	*Amelanchier utahensis*	91.7 a
Fringed Sage	*Artemisia frigida*	90. 0 a
Squaw Apple	*Peraphyllum ramosissimum*	71.6 ab
Cliff Fendlerbush	*Fendlera rupicola*	55.0 bc
Golden Currant	*Ribes aureum*	43.3 cd
Silver Sage	*Artemisia cana*	41.7 cd
Silver Buffaloberry	*Shepherdia argentea*	21.7 de
Black Chokecherry	*Prunus virginiana var. melanocarpa*	11.7 e
Basin Big Sagebrush	*Artemesia tridentata spp. tridentata*	6.7 e
Red Barberry	*Berberis haematocarpa*	5 e
Smith's Buckthorn	*Rhamnus smithii*	1.7 e
Apache Plume	*Fallugia paradoxa*	0 e
Littleleaf Mock Orange	*Philadelphus microphyllus*	0 e
Rockspirea	*Holodiscus dumosus*	0 e
Wyoming Big Sagebrush	*Artemisia tridentata spp. wyomingensis*	0 e

* Planting Date: November 6, 2006
** Means followed by the same letters are not significantly different as determined by least significant difference test at $P<0.05$.

Project COPMC-T-0702-UR
Report-2008
By: Manuel Rosales

Growing Season of 2008:

The plots were evaluated for percent plant stand and plant height in July 30, 2008. The majority of species that performed well for the first growing season are still growing well for the second growing season. The entries that did not germinate in the first growing season remained the same with no additional plants. Table 4 presents the results for the 2008 growing season.

Table 4. Percent Plant Stand and Plant Height for 16 shrub species direct seeded at Upper Colorado Environmental Plant Center*.

Common Name	Scientific Name	Percent Plant Stand	Plant Height (cm)
Antelope Bitterbrush	*Purshia tridentata*	93.3 a	12.2
Utah Serviceberry	*Amelanchier utahensis*	93.3 a	10.1
Fringed Sage	*Artemisia frigida*	93.3 a	70.9
Squaw Apple	*Peraphyllum ramosissimum*	56.7 b	24.5
Silver Sage	*Artemisia cana*	53.3 b	86.8
Golden Currant	*Ribes aureum*	41.7 b	32.0
Cliff Fendlerbush	*Fendlera rupicola*	8.3 c	11.9
Silver Buffaloberry	*Shepherdia argentea*	4.3 c	7.6
Black Chokecherry	*Prunus virginiana var. melanocarpa*	3.7 c	18.0
Basin Big Sagebrush	*Artemisia tridentata spp. tridentata*	3.7 c	86.7
Smith's Buckthorn	*Rhamnus smithii*	1.7 c	3.1
Red Barberry	*Berberis haematocarpa*	0 c	0
Apache Plume	*Fallugia paradoxa*	0 c	0
Littleleaf Mock Orange	*Philadelphus microphyllus*	0 c	0
Rockspirea	*Holodiscus dumosus*	0 c	0
Wyoming Big Sagebrush	*Artemisia tridentata spp. wyomingensis*	0 c	0

* Planting Date: November 6, 2006
** Means followed by the same letters are not significantly different as determined by least significant difference test at $P<0.05$.

Project COPMC-T-0801-WL
Report-2008
By: Manuel Rosales

Establishment of Chokecherry (9024060) from Direct Seeding

OBJECTIVE

To determine establishment of chokecherry *Prunus virginiana* var. *melanocarpa* (accession number 9024060) from direct seeding of various seed lots.

INTRODUCTION

Chokecherry is a woody, native perennial, deciduous, large erect shrub or small tree. Chokecherries have many uses including food for human consumption, wildlife food, and habitat as well as for conservation plants. Accession 9024060 was collected in Rio Blanco County, Colorado, and has been growing at Upper Colorado Environmental Plant Center (UCEPC) since 1977. This technology and pre-release study will serve to gather more information to provide to growers and complete a release for this accession.

EXPERIMENTAL DESIGN

The statistical design for this study is a randomized complete block with three blocks.

MATERIALS & METHODS

Eight different seed lots of seeds collected at the UCEPC orchard were direct seeded on October 11, 2007. The plot size is 3 feet by 20 feet long. The seeds were planted with a hand operated one-row belt seeder at the rate of 18 seeds per linear feet of row. All seed lots used had the dry fruit pulp still attached.

Following is the plot plan for the study:

Plot Plan
West-↑

	Lot Nos.							
Block-III	97*	03	02	98	07	00	01	99
Block-II	99	07	00	02	03	01	98	97
Block I	02	98	99	00	01	97	03	07

- Seed lot year

The planting will be irrigated as needed.

RESULTS

The study was evaluated in July 30, 2008. Most of the seed lots performed well except for the seed lot from year 2000 which had no germination. Table-1 presents the results for the first growing season.

Table 1. Establishment of Chokecherry (Accession 90024060) from Direct Seeding. UCEPC-2008

Seed Lot (year)	Percent Plant Stand[1]	Plant Height (cm)
2007	45.0	22.0
2000	43.3	17.9
2001	38.3	26.0
1999	35.0	24.0
2003	23.3	11.3
1997	15.7	18.3
1998	11.3	15.1
2002	0	-----
Mean	26.5	16.8
LSD (0.05)[2]	21.0	11.2

Planting Date: October 11, 2007

1. Plant stand and plant height evaluated in July 30, 2008.
2. Least Significant difference (LSD) at P< 0.05.

Project COPMC-T-0802-RA
Report-2008
By: Manuel Rosales

Space planting of Salina Wildrye (9043501) *Leymus salinus*

OBJECTIVE

To determine the effects of plant spacing or density on seed production of Salina Wildrye accession number 9043501

INTRODUCTION

Salina wildrye has been identified as one of the most important grasses native to the Upper Colorado Region. It has been rated by the Upper Colorado Environmental Plant Center (UCEPC) Advisory Committee as a high priority for coal mined lands, roadside stabilization, surface disturbed areas, and areas of heavy use.

In 1993, vegetative samples for the accession 9043501 were sent to Utah State University for species confirmation. It was determined that accession 9043501 represents *Leymus salinus.*

Accession 9043501 has been under study at UCEPC for the past 20 years. It performed well in initial evaluations as well as in advanced evaluations, however, seed production in seed increase fields have been poor. Several studies have been conducted at UCEPC to enhance seed production but none have proven to solve the problem in order to release the accession. This study is another attempt to improve seed production of accession 9043501.

EXPERIMENTAL DESIGN

The statistical design for this study is a randomized complete block with four blocks.

MATERIALS & METHODS

On May 22, 2008, seed of accession 9043501 was started in plugs (containers) in the UCEPC greenhouse to later be transplanted in the space planting. Seven densities (treatments) were applied September 15-16, 2008. Single plots for the study consist of two rows at three-foot centers by 20 feet long. Table-1 presents the densities for the study.

Table1. Space Planting of Salina Wildrye (9043501)

Treatment(density)	Distance between Rows in feet	Distance within Rows in feet	Total Number of Plants/plot[1]	Plants/Acre
Density-1	3	1	40	14,520
Density-2	3	2	20	7,260
Density-3	3	3	14	5,082
Density-4	3	4	12	4,356
Density-5	3	5	10	3,630
Density-6	3	6	8	2,904
Density-7(Control)	3	30 PLS/foot*	1200	435,600

1. Plots are 6 x 20 feet with two rows/plot at three-foot centers

*Traditional way of seeding native seed for seed production; 30 Pure Live Seed/foot of row

Project COPMC-P-0802-RA
Report-2008
By: Manuel Rosales

Following is the plot plan for the study:

Plot Plan

↑North

Block-IV	**1**	**7**	**2**	**5**	**4**	**6**	**3**
Block -III	**2**	**1**	**7**	**4**	**6**	**3**	**5**
Block-II	**2**	**3**	**4**	**6**	**5**	**1**	**7**
Block I	**Density 4**	**5**	**2**	**7**	**1**	**3**	**6**

RESULTS

The study will be evaluated for the first growing season in the summer of 2009.

Project COPMC-S-0802-CR
Annual Report – December 2008
By: Terri Blanke

BRYCE CANYON NATIONAL PARK
COOPERATIVE AGREEMENT

INTRODUCTION - Upper Colorado Environmental Plant Center (UCEPC) signed Interagency Agreement 1211-04-004 with Bryce Canyon National Park, USDA Natural Resources Conservation Service, and NPS Denver Service Center in January 2004. The agreement, as amended in April 2007, called for the continued production of slender wheatgrass *Elymus trachycaulus* through 2008. The production and delivery of 7000 containerized grasses and 100 shrubs were to be produced under amendment number two. Amendment #3 was an extension for the production of the shrubs.

On July 15, 2008, a new agreement, IA No. 1211-08-010, was signed. This agreement is for the establishment of a 0.5 acre field of nodding brome *Bromus anomalus,* to be produced through September of 2011.

OBJECTIVE - The intent of the agreements and their amendments is for UCEPC to produce seed and plants of native, indigenous species for revegetation purposes on disturbances within Bryce Canyon National Park through 2008.

ACTIVITIES – On January 15, 2008, UCEPC received seed from Bryce Canyon National Park. On July 7, 2008, the 1.2 acre field of slender wheatgrass was harvested. That field produced 137 PLS pounds. On November 24th, 2008, the slender field was tilled under. On August 19, 2008, eighty-three containerized shrubs were delivered to the park by UCEPC employees. On July 3rd, 2008, Russ Haas delivered 35 lb of nodding brome *Bromus anomalus* seed to UCEPC. This seed had been previously grown by UCEPC in the year 2004. On August 21st, 2008, the 0.5 acre field of nodding brome was established from that seed.

PLANT PRODUCTION – Seed of seven species was received by UCEPC for cleaning and propagation as called for in Amendment 2. The table below identifies the amount of seed received and cleaned seed quantities by species, as well as the plants delivered.

Species	Collected Weight	Clean Weight 2007	Clean Wt. 2008	Plants Delivered 2008
Antelope bitterbrush	34.4 g	19 g		5
Black sagebrush	104.0 g	7 g	17 g	38
Bottlebrush squirreltail			8 g	
Douglas rabbitbrush			13 g	
Gray rabbitbrush			12 g	
Indian ricegrass	169.7 g	54 g		1
Long flowered rabbitbrush	1.1 g	< 1 g		No germination
Needle and thread	576.9 g	238 g		1
Parry's rabbitbrush	4.4 g	< 1 g		29
Three awn			4 g	
Yellow rabbitbrush	0.9 g	< 1 g	11 g	9

The targeted production quantities for the above species were identified by the amendment. In 2006, seed of field produced slender wheatgrass was easily produced for the containerized production target of 3500 plugs. At half the amount of slender wheatgrass, a target of 1750 each of needle and thread and Indian ricegrass were identified for revegetation needs with live plants for a total of 7000 grass plugs. As suspected, there was considerable dormancy in the Indian ricegrass seed that had been collected by Bryce personnel in 2005. Thirty grams of 54 grams were used in the first germination attempts with less than 1% germination. Our germination trials also included one trial with scarified seed. However, 86 grams of some old Bryce Indian ricegrass seed was on inventory at UCEPC from an agreement in 1990. This seed was used in an attempt to produce the 1750 targeted Indian ricegrass plugs. While the total Indian ricegrass number delivered was nearly 500 plants short of the target amount, slender wheatgrass and needle and thread were delivered in quantities exceeding the target amounts by nearly 1000 and 400 live plants respectively. In all, 950 plants above target were delivered to Bryce Canyon for revegetation work. Shrub production by species is being altered because of germination success of the cleaned species. Germination efforts have been conducted on each of the collected species.

Live Plant Production		
Species	**Target Quantities**	**Delivered Quantities**
Indian ricegrass	1750	1255
Needle and thread	1750	2158
Slender wheatgrass	3500	4520
Totals	**7000**	**7933**

SEED PRODUCTION -The following quantities of seed have been produced for Bryce Canyon:

Species	Scientific Name	Seed Production		Fiscal Year
Nodding brome	*Bromus anomalus*	185 lb	49 PLS	1999
		34 lb	9 PLS	2000
		Field plowed		2001
		2.4 lb	1 PLS	2002
		50 lb	33 PLS	2003
		138 lb	83 PLS	2004
		Field plowed		2005
	New Planting	0.5 Acre		2008
Slender wheatgrass	*Elymus trachycaulus*	30.5 lb	28 PLS	1999
		103 lb	78 PLS	2000
		246 lb	211 PLS	2001
		149 lb	120 PLS	2002
		240 lb	213 PLS	2003
		398 lb	232 PLS	2004
		189 lb	117 PLS	2005
		267 lb	230 PLS	2006
		499 lb	369 PLS	2007
		137 lb		2008
		Field Plowed		2008

DISCUSSION – Black sagebrush, antelope bitterbrush, and parry's rabbitbrush are being propagated in the greenhouse in order to finalize the second amendment of contract #1211-04-004. The nodding brome field will be maintained for optimum seed production. Bryce Canyon's current seed inventory, delivery, and laboratory analysis reports are available upon request.

Project COPMC-S-0803-CR
(IA No. 1211-08-03)
Annual Report 2008
By: Manuel Rosales

CANYON DE CHELLY NATIONAL MONUMENT
COOPERATIVE AGREEMENT

Project COPMC-S-0803-CR
(IA No. 1211-08-03)
Annual Report 2008
By: Manuel Rosales

INTRODUCTION – This report is in reference to sub agreement IA No-1211-08-003.
In February of 2008, an interagency agreement was signed between the National Park Service, Canyon de Chelly National Monument (CDCNM) of the U. S. Department of Interior and the Natural Resources Conservation Service (NRCS). The agreement calls for NRCS-Upper Colorado Environmental Plant Center (UCEPC) to produce seed of two native species (Indian ricegrass-*Achnatherum hymenoides* and western wheatgrass-*Pascopyrum smithii*) from seed stock collected at the monument. The agreement stipulates that that UCEPC will produce 50 pounds of Pure-Live-Seed (PLS) of Indian ricegrass and 50 PLS-pounds of western wheatgrass. This agreement will remain in effect until September 30, 2010.

ACTIVITIES – As per agreement, seed collections from the monument were insufficient to meet the required amounts necessary for field establishment. The seed that was received was cleaned and planted this year. A single field, 1.3 acres, of Indian ricegrass was planted October 8, 2008 which utilized the entire cleaned seed amount of 2.65 pounds. No seed of western wheatgrass was collected at the monument in 2008. Seed of both species will need to be collected in 2009 to establish the plantings as specified in the agreement.

RESULTS – The UCEPC staff planted 1.3 acres of Indian ricegrass in October 7, 2008. No western wheatgrass was planted this season.

Project COPMC-S-0804-IN
(IA No. F739008005)
Annual Report 2008

CANYON DE CHELLY NATIONAL MONUMENT
COOPERATIVE AGREEMENT

Project COPMC-S-0804-IN
(IA No. F739008005)
Annual Report 2008

INTRODUCTION – This report is in reference to sub agreement IA No-F739008005.
In June of 2008, an interagency agreement was signed between the National Park service, Canyon de Chelly National Monument (CDCNM) of the U. S. Department of Interior and the Natural Resources Conservation Service (NRCS). The agreement calls for NRCS-Upper Colorado Environmental Plant Center (UCEPC) to produce seed of two native species (Indian ricegrass-*Achnatherum hymenoides* & western wheatgrass-*Pascopyrum smithii*) from seed stock collected at the monument. The agreement stipulates that UCEPC will establish two acres of Indian ricegrass and one acre of western wheatgrass. This agreement will remain in effect until September 30, 2011.

ACTIVITIES – As per agreement, seed collected at the monument and cleaned at UCEPC resulted in 2.6 pounds, enough seed to plant about 1.3 acres of Indian ricegrass on October 7, 2008. No seed of western wheatgrass was collected at the monument in 2008 to initiate the planting as called for in the agreement. Seed of both species will need to be collected in 2009 to complete the plantings as specified in the agreement.

RESULTS
The UCEPC staff planted 1.3 acres of Indian ricegrass in October 7, 2008. No western wheatgrass was planted this season.

Project COPMC-S-0801-IN
Annual Report – December 2008
By: Dr. Gary L. Noller

DINOSAUR NATIONAL MONUMENT
COOPERATIVE AGREEMENT

INTRODUCTION - This report covers the activities conducted by Upper Colorado Environmental Plant Center for the Dinosaur National Monument Plant Materials Agreement in 2008. The agreement was initiated in September of 1996 and was most recently amended in 2008. These agreements involve collecting and increasing grass species native to Dinosaur National Monument. One grass seed field (western wheatgrass 9070955) was removed in 1999 and a new planting of the same species (9092278) was planted in 2008. These grasses will be used for restoration and to prevent non-indigenous weedy plants from invading. Personnel from Dinosaur National Monument came to the plant center in 2008. Seed fields were observed and the seed stored for Dinosaur was reviewed. At that time a decision was made to remove the alkali sacaton field and plant a new western wheatgrass field. Seed was harvested from all seed fields in 2008. Germination was updated on three seed materials and provided to Dinosaur along with the test results of the 2007 bluebunch wheatgrass so they could be used for fall plantings. An amendment to the agreement was prepared in 2008.

TARGETED SPECIES OF GRASS

Common Name	**Number**	**Scientific Name** (Old)
Alkali sacaton	9070954	*Sporobolus airoides*
Bluebunch wheatgrass	9070952	*Pseudoroegneria spicata ssp. spicata* (*Agropyron spicatum)*
Great basin wildrye	9070951	*Leymus cinereus* (*Elymus cinereus)*
Indian ricegrass	9070953	*Oryzopsis hymenoides*
Western wheatgrass	9070955 9092278 (2008)	*Pascopyrum smithii* (*Agropyron smithii*)

SEED COLLECTION AND CONDITIONING INFORMATION

INTRODUCTION - No additional seed was received from Dinosaur National Monument for seed production at the plant center in 2008.

SEED PRODUCTION

INTRODUCTION - Seed fields were planted on November 5 and 6, 1997, and one additional field was added on July 20, 1998. In addition, one seed field (western wheatgrass) was removed in 1999, reducing the number of seed fields to four. Two seed fields (Indian ricegrass and alkali sacaton) were interseeded in 1999, to improve stands. An additional planting of bluebunch wheatgrass was planted in 2001 due to the poor appearance of the field and no seed production in 2001. The original planting of bluebunch wheatgrass was removed after harvest in 2005. A

new planting of western wheatgrass (9092278) was planted in 2008. Table 1 lists the seed from Dinosaur National Monument stored at the plant center. The following updates the seed fields through 2008.

1. Indian ricegrass - November 5, 1997 - planted 8 rows (0.24 acre) - field 4 - planted at rate of about 30 seeds per foot of row - total seed lot (1.42 lb) used. Harvested light seed crop (52.0 g), September 8, 1998 - moderate to good stand November 20, 1998. Harvested July 14, 1999, produced 1.24 lb clean seed. Harvested July 3, 2000, produced 0.97 lb clean seed. Harvested July 9, 2001, produced 0.97 lb clean seed. Harvested July 2, 2002, produced 3.6 lb clean seed. Harvested July 11, 2003, produced 8.0 lb of clean seed. Harvested July 8, 2004, produced 10.0 lb of clean seed. Harvested July 12, 2005, produced 12.0 lb clean seed. Harvested July 3, 2006, produced 5.6 lb of clean seed. Harvested June 28 – July 13, 2007, produced 8.0 lb of clean seed. Harvested July 10, 2008, produced 6.6 lb clean seed.

2. Bluebunch wheatgrass - November 5, 1997 - planted 8 rows (0.24 acre) - field 1 - planted at rate of about 30 seeds per foot of row - had few seed heads 1998, no harvest - good stand November 20, 1998. Harvested July 20, 1999, produced 16.5 lb clean seed. Harvested July 12, 2000, produced 1.4 lb clean seed. Not harvested in 2001. November 16, 2001, planted 6 rows (0.18 acre) at a rate of about 30 seeds per foot of row (0.35 lb planted), field 1, just south of original planting. New planting had good stand 2002, no harvest. Harvested old stand July 12, 2002, produced 300 g clean seed. Harvested both plantings July 16, 2003, produced 32.0 lb clean seed. Harvested July 14, 2004, produced 25.5 lb clean seed. Harvested July 20 and 21, 2005, produced 13.0 lb of clean seed. The original 8 rows of this planting were removed after 2005 harvest due to off types. Field now 0.18 ac – Harvested July 5, 2006, produced 10.8 lb of clean seed. Harvested July 9 – 13, 2007, produced 18.0 lb of clean seed. Harvested July 16, 2008, produced 18.5 lb clean seed.

3. Western wheatgrass - November 6, 1997 - planted 8 rows (0.24 acre) - field 6A - planted at rate of about 20 seeds per foot of row, due to small quantity of seed and rhizomatous habit of species. Noted some off type plants in 1998, will rouge these out in 1999 - few seed heads 1998, no harvest - excellent stand with numerous sprouts November 20, 1998. Field had numerous off type plants 1999, field plowed.

4. Basin wildrye - November 6, 1997 - planted 8 rows (0.24 acre) - field 8A - planted at rate of about 30 seeds per foot of row. Few seed heads fall 1998, no harvest - excellent stand November 20, 1998. Harvested August 5, 1999, produced 29.0 lb clean seed. Harvested July 25, 2000, produced 5.5 lb of clean seed. Harvested July 17, 2001, produced 10.8 lb of clean seed. Harvested July 23, 2002, produces 25.0 lb. clean seed. Harvested July 25, 2003, produced 52.0 lb clean seed. Harvested July 28, 2004, produced 43.0 lb of clean seed. Harvested August 4 and 5, 2005, produced 37.0 lb of clean seed. Harvested July 24, 2006, produced 74.0 lb of clean seed. Harvested July 21, 2007, produced 83.0 lb of clean seed. Harvested July 28, 2008, produced 36.0 lb of clean seed.

5. Alkali sacaton - July 20, 1998 - planted 6 rows (0.18 acre) - field 4 - planted at a rate of about 30 seeds per foot of row - noted seedlings on September 2, 1998 - fair stand

November 20, 1998. Harvested September 1, 1999, produced 99 g of clean seed. Harvested two seed crops in 2000 (July 12 and September 11), produced 2.4 lb clean seed. Harvested two seed crops in 2001 (July 18 and September 14), produced 13.0 lb of clean seed. Harvested two seed crops 2002 (July 17 and September 10), produced 6.2 lb clean seed. Harvested only once on August 4, 2003, produced 6.0 lb clean seed. Harvested two seed crops July 16 and September 10, 2004, produced 8.0 lb clean seed. Harvested August 9, 2005, produced 2.0 lb of clean seed. Harvested July 18, 2006, produced 88.0 g of clean seed. Harvested July 13 – 19, 2007, produced 354.0 g of clean seed. Harvested July 18, 2008, produced 160.0 g of clean seed. Field to be removed.

6. Western wheatgrass (9092278) – September 8, 2008, planted 12 rows (0.30 acre) – field 7 – 7A, planted at a rate of approximately 30 seeds per foot of row.

SEED SHIPMENTS

No seed was provided to Dinosaur in 2008.

SUMMARY

1. A cooperative agreement between Dinosaur National Monument and Upper Colorado Environmental Plant Center was initiated in September of 1996 and most recently amended in 2008.

2. The agreement involved the collection, evaluation, and increase of grasses native to Dinosaur National Monument. Four seed fields are now grown for seed production.

3. Seed fields were planted in November 1997 for four contract species and the final seed field (alkali sacaton) was added in July 1998.

4. The western wheatgrass seed field was plowed in 1999, due to numerous off type plants.

5. Two seed fields (Indian ricegrass and alkali sacaton) were interseeded in 1999, to improve stands.

6. A new planting of bluebunch wheatgrass was planted in 2001, and had a good stand in 2002, but was not harvested. The original planting did produce seed in 2002. Both plantings were harvested in 2003, 2004, and 2005. The original eight rows were removed after the 2005 harvest. The planting now has 0.18 ac.

7. Dinosaur personnel came to the plant center in 2008. Seed fields and seed stored for Dinosaur were reviewed. A decision was made to remove the alkali sacaton field and to plant a new field of western wheatgrass.

8. Seed crops were harvested from all seed production fields in 2008.

Table 1. A listing of seed from Dinosaur National Monument by species and year of harvest stored at the plant center. * Germination was updated on these materials in 2008.

SPECIES	YEAR	BULK	PLS
Alkali Sacaton	1999 harvest	99.00 g	no test
	2000 2-harvests	2.40 lb	0.70 lb
	2001 " "	13.00 lb	1.50 lb
	2002 " "	6.20 lb	4.50 lb
	2003 1-harvest	6.00 lb	2.40 lb
*	2004 2-harvests	8.00 lb	2.92 lb
	2005 1-harvest	2.00 lb	0.08 lb
	2006- " "	88.00 g	no test
	2007- " "	354.00 g	no test
	2008- " "	160.00 g	no test
Basin wildrye	1997 (park collected)	10.69 lb	8.60 lb
	1999 harvest	29.00 lb	25.70 lb
	2000 "	5.50 lb	4.00 lb
	2001 "	10.80 lb	7.40 lb
	2002 "	25.00 lb	17.60 lb
	2003 "	52.00 lb	42.60 lb
	2004 "	43.00 lb	31.10 lb
*	2005 "	37.00 lb	24.36 lb
	2006 "	74.00 lb	30.30 lb
	2007 "	83.00 lb	55.00 lb
	2008 "	36.00 lb	no test
Bluebunch wheatgrass	1997 (park collected)	0.46 lb	no test
	1999 harvest lot 1	10.50 lb	8.40 lb
	lot 2	6.00 lb	3.60 lb
	2000 harvest	1.40 lb	0.80 lb
2001 no harvest	2002 (old planting)	300.00 g	215.00 g
	2003 (both plantings)	32.00 lb	25.90 lb
	2004 (both plantings)	25.50 lb	21.62 lb
	2005 (both plantings)	13.00 lb	9.50 1b
	2006 (new planting)	10.80 lb	9.10 lb
	2007 (new planting)	18.00 lb	15.32
	2008 (new planting)	18.50 lb	no test
Indian ricegrass	1997 (park collected)	8.00 g	no test
	1999 harvest	1.24 lb	0.80 lb
	2000 "	0.97 lb	0.30 lb
	2001 "	0.97 lb	0.50 lb
	2002 "	3.60 lb	1.15 lb
	2003 "	8.00 lb	3.60 lb
	2004 "	10.00 lb	3.80 lb
*	2005 "	12.00 lb	5.23 lb
	2006 "	5.60 lb	3.80 lb
	2007 "	8.00 lb	4.97 lb
	2008 "	6.60 lb	no test

Project COPMC-S-0704-CR
Annual Report 2008
By: Steve Parr

GRAND TETON NATIONAL PARK
COOPERATIVE AGREEMENT

INTRODUCTION - This report covers the activities related to the cooperative agreement between Upper Colorado Environmental Plant Center (UCEPC) and Grand Teton National Park. The fully executed agreement, Interagency Agreement 1211-07-002, was formally signed in April of 2007. The agreement calls for the production of a single species, slender wheatgrass, for 2007 and 2008.

ACTIVITIES – A field was established on August 23, 2005, as part of a previous agreement. After completing the previous agreement, it was decided to extend the production of the crop through the execution of a new agreement, which is referenced above. This field produced 617 clean pounds of seed in 2007, and 449 clean pounds in 2008.

There has been interest in extending the production of this field through 2009, but no formal amendment has been signed at this time.

There remains on inventory seed of five previously produced species under a separate agreement. The table below identifies the clean seed quantities. Additionally, the seed production of slender from the present agreement is not counted in the inventory amounts provided below. A new germination test would be necessary to provide pure live seed amounts for each seed lot.

SPECIES	# of SEED LOTS	CLEAN POUNDS OF SEED
Basin wildrye	6	588
Bluebunch wheatgrass	2	136
Blue wildrye	3	196
Mountain brome	1	67
Slender wheatgrass	3	903

The mountain brome seed is the oldest, being produced in 2000. The remainder of the materials were produced from 2001 through 2005 and should be used before substantial loss of germination occurs.

Project COPMC-S-0307-CR
Annual Report 2008
By: Manuel Rosales

GREAT SAND DUNES NATIONAL PARK AND PRESERVE COOPERATIVE AGREEMENT

INTRODUCTION - This report updates the activities of Upper Colorado Environmental Plant Center (UCEPC) up to 2008, as they relate to Interagency Project Number IA1211-03-001 for the production of seed materials for Great Sand Dunes National Park and Preserve. This agreement was signed into effect in February of 2003, and called for the production of two materials (blue grama and Indian ricegrass) through 2005 for revegetation uses within the park. In addition, an amendment to the above interagency agreement was signed in 2004. The amendment stipulated that UCEPC would establish two-tenths of an acre for seed increase of ring muhly. In 2006, a second amendment was added to the agreement. The second amendment provided for an extension of the agreement through 2008 and reimbursement to UCEPC for cost incurred in
FY06, while a third amendment was added to cover production and reimbursement for 2007.

ACTIVITIES (2005-2008) – The re-plantings of blue grama and ring muhly done in 2005 germinated well and were progressing very well during the growing season of 2005. However, during the winter of 2005-2006, ring muhly and blue grama suffered severe winter damage by frost heaving to the point that we thought we had lost them. Most plants were uplifted from the ground. However, despite their bad appearance, both plantings survived and produced some seed (see Results). In addition, six more rows of blue grama were replanted on August 2, 2006.

The 0.5 acre field of Indian ricegrass had done so well in 2006 that it was harvested twice this year.

On July 12, 2006, Fred Bunch, Phyllis Bovin, Ola Bovin, Jessica Hendrix, and Russ Hass were at the UCEPC to visit the production fields for the Great Sand Dunes National Park and Preserve. Park personnel were pleased with the production fields.

On November 16, 2006, a mixture of 18.1 pounds of pure live seed of Indian ricegrass (all the seed harvested in 2006) and 10.9 pounds of pure live seed of 'San Luis' slender wheatgrass were delivered to the park to re-vegetate a four acre field. In addition, personnel from UCEPC delivered 25 straw bales of 'San Luis' slender wheatgrass to the park.

Growing season-2007; Standard cultural practices were applied to the production fields, such as fertilizing, watering, weeding, etc. In addition, on August 21, about 500 plugs of blue grama were hand-transplanted to fill gaps in the original blue grama field. Also, on September 4, five rows of blue grama were inter-seeded to fill the gaps in the north side of field.

Growing season-2008; The fields of blue grama, Indian ricegrass and ring muhly were maintained as in previous years. Ring muhly and blue grama were maintained at no cost to the park.

RESULTS

2006-Growing Season: Despite the damage incurred during the winter, we were able to harvest and clean 20 pounds of blue grama, 14 grams of ring muhly and 31 pounds of Indian ricegrass for the 2006 growing season.

Seed from Indian ricegrass and blue grama collected at the park and sent for cleaning at UCEPC during 2006, resulted in 4.2 pounds of clean seed for Indian ricegrass and **no seed** for blue grama (seed heads were empty or had immature seed).

2007-Growing Season: Thrips (Insects that feed in plants by sucking out the cell contents) were found on the seed heads of some of the blue grama seed. The blue grama field will be monitored closely during the growing season of 2008, since thrips can weaken the plants and reduce the amount of seed produced. The following table presents seed production by species for 2007.

Species	Scientific name	Establishment Acres	Harvest Date	Clean Seed Weight
Blue grama	*Bouteloua gracilis*	1.0	10/9	17 lb
Indian ricegrass	*Achnatherum hymenoides*	0.5	7/5	38 lb
Ring muhly	*Muhlenbergia torreyi*	0.2	10/10	0.8 lb

Seed from Indian rice grass and blue grama collected at the park and cleaned at UCEPC during 2007, resulted in 3.5 pounds of clean seed for Indian rice grass and 27 grams for blue grama.

2008-Growing Season: Despite the late start for the growing season of 2008 due to the snow covered fields, the center managed to harvest the fields of ring muhly and Indian rice grass for 2008; however, no seed was produced in the field of blue grama. Seed production for 2008 is presented in the following table.

Species	Scientific name	Establishment Acres	Harvest Date	Clean Seed Weight
Blue grama	*Bouteloua gracilis*	1.0	No harvest	
Indian ricegrass	*Achnatherum hymenoides*	0.5	7/21/08	9.5
Ring muhly	*Muhlenbergia torreyi*	0.2	10/8/08	14.0

Project COPMC-S-0703-CR
Annual Report – December 2008
By: Terri Blanke

MESA VERDE NATIONAL PARK
COOPERATIVE AGREEMENT

Project COPMC-S-0703-CR
Annual Report – 2008

INTRODUCTION - Upper Colorado Environmental Plant Center (UCEPC) signed an agreement with Mesa Verde National Park on February 2, 2000. IA No. 1211-00-003 was implemented for the development of seed and plants to revegetate the area disturbed by road construction into the park. Two amendments were later added increasing the numbers for production of containerized trees and shrubs. Mesa Verde's new housing and CCC Camp revegetation contracts increased that number again. A total of 4500 plants were to be provided to Mesa Verde in order to complete the above contracts. The table below shows contract species, targeted quantities and UCEPC delivered quantities. In addition to the above, a new contract has been initiated. An agreement between Mesa Verde National Park and UCEPC was signed on August 27, 2007. Agreement No. 1211-07-006 calls for the propagation of approximately 415 PLS pounds of seed from the following species; muttongrass *Poa fendleriana,* slender wheatgrass *Elymus trachycaulus,* western wheatgrass *Pascopyrum smithii,* salina wildrye *Leymus salinus,* Indian ricegrass *Achnatherum hymenoides,* needle and thread *Hesperostipa comata,* yarrow *Achillea millefolium,* and Louisiana sage *Artemisia ludoviciana.* Productions for this agreement will continue through September 30, 2009.

Contract Species with Delivered Quantities

Common Name	**Scientific Name**	**Target Qty.**	**Del. Qty.**
Bitterbrush	*Purshia tridentata*	20	35
Chokecherry	*Prunus virginiana*	270	317
Douglas fir	*Pseudotsuga menziesii*	100	39
Fendlerbush	*Fendlera rupicola*	150	489
Fourwing saltbush	*Atriplex canescens*	120	340
Gambel oak	*Quercus gambelii*	875	1166
Mt. mahogany	*Cercocarpos montanus*	260	237
Penstemon	*Penstemon linarioides*		7
Pinyon pine	*Pinus edulis*	45	59
Rabbitbrush	*Chrysothamnus nauseosus*	160	310
Rocky Mt. juniper	*Juniperus scopulorum*	20	
Snowberry	*Symphoricarpos oreophilus*	900	330
Squaw apple	*Peraphyllum ramosissima*	135	85
Utah juniper	*Juniperus utahensis*	35	34
Utah serviceberry	*Amelanchier utahensis*	875	574
Woods' rose	*Rosa woodsii*	330	144
Yucca	*Yucca baccata*	205	309
	Total	**4500**	**4475**

OBJECTIVE – Work continues on the main entrance road to Mesa Verde National Park. The objective of this agreement is for UCEPC to produce quality plants of the target numbers by species for restoration work after road construction. The addition of containerized shrubs to the revegetation work will contribute to the overall appearance and aesthetic appeal of the construction work once completed. The indigenous grasses that have adapted to the area's poor soil will be helpful in improving the drainage and erosion problems, thereby protecting the new pavement.

ACTIVITIES - UCEPC initiated production on the above containerized species in 2003. UCEPC utilized four different types of containers to optimally match root structure with container in terms of shape and size. Six cell "Tubepacks", four cell "Bookplanters", ten cubic inch "Conetainers" and thirty two cubic inch "Zipsets" were all used for production. A standard soil mix of vermiculite, perlite, and peat moss was used in each container type for propagation. In most cases, materials were planted as they germinated after and during cold moist treatment.

The table below shows targeted species, contracted quantities, acreage planted in 2007 and seed production in 2008. The Yarrow and Louisiana sage fields were replanted on August 21, 2008, due to poor establishment. All the fields received a fertilizer application of 30-10-0. The application rate was 330 lb to the acre. The UCEPC irrigation occurs May to October as needed.

Common Name	**Scientific Name**	**2007 Planting**	**2008 Planting**	**Contract Qty**	**2008 Production**
Indian ricegrass	*Achnatherum hymenoides*	*NA*	NA	50 PLS	-
Louisiana sage	*Artemisia ludoviciana*	*0.02*	Replant	5 PLS	-
Muttongrass	*Poa fendleriana*	*0.5*	Est.	5 PLS	-
Needle and thread	*Hesperostipa comata*	*NA*	NA	Hay bales	-
Salina wildrye	*Leymus salinus*	*0.5*	NA	50 PLS	-
Slender wheatgrass	*Elymus trachycaulus*	*0.5*	Est.	100 PLS	618 Grams
Western wheatgrass	*Pascopyrum smithii*	*1.0*	Est.	200 PLS	343 Grams
Yarrow	*Achillea millefolium*	*0.02*	Replant	5 PLS	-
Total		**2.54acres**		**415 PLS**	

RESULTS – The 0.5 acre of slender wheatgrass was swathed on July 7 and produced 618 grams of seed. Twenty five additional slender wheatgrass plants were propagated in the greenhouse for germination tests and transferred later into that field for increase. The acre of western wheatgrass was hand harvested on August 12 and 343 grams of seed were collected. The 0.5 acre of muttongrass did not produce seed this year. The field has a good stand and looks promising for 2009. Due to the small amounts of seed collected from Mesa Verde in 2007, the Indian ricegrass field (185 cleaned grams) and Stipa comata field (63 cleaned grams) were never initiated. The salina wildrye field never established, possibly from dead seed. The Woods' rose *Rosa woodsii,* which is planted in the UCEPC compound yard, continues to grow for rooting stock. Propagation of several species of shrubs continues to complete the terms of agreement No. 1211-00-003.

SUMMARY – Production of containerized materials will continue into 2009 to make up for the shortfall of approximately 25 plants. The slender wheatgrass, western wheatgrass and muttongrass fields have been established and are producing. We will evaluate the new plantings of yarrow and Louisiana sage this spring. The salina wildrye will not be grown at UCEPC because of inadequate seed for field establishment. It is a possibility that the Indian ricegrass and Stipa comata can be propagated in the greenhouse and then transferred to the fields for their establishment, but that has not been agreed to at this point. Mesa Verde live seed and plant inventory are available upon request.

Project COPMC-S-0308-CR
Annual Report - December 2008
By: Steve Parr

ROCKY MOUNTAIN NATIONAL PARK
COOPERATIVE AGREEMENT

INTRODUCTION - Upper Colorado Environmental Plant Center (UCEPC), Rocky Mountain National Park (ROMO), and the USDA Natural Resources Conservation Service (NRCS), signed a cooperative plant materials agreement (IA Project No. 1211-08-001) in May 2008. This agreement adds two species for seed increase activities to previously produced materials from an earlier agreement between these same entities. This agreement involves seed production of five forbs and five grass species for revegetation of the Bear Lake Road Project. The Bear Lake Road Project involves widening Bear Lake Road by two feet for ten miles, adding pullouts and retaining walls, widening switchbacks, and expanding some of the parking lots. This will amount to 20 acres of disturbance with an elevation change of 1500 feet. The first of two phases was completed in December 2005. Seed production of the same species has been identified for use in the second phase along with the addition of two new species in 2008.

Bear Lake Road Project

Common Name	Scientific Name	Symbol	Accession
Grasses			
Blue grama	*Bouteloua gracilis*	BOGR	9070991
Bottlebrush squirreltail	*Elymus elymoides*	ELEL	
Junegrass	*Koeleria macrantha*	KOCR	9070962
Mountain muhly	*Muhlenbergia montana*	MOMU	9070957
Needle and thread	*Stipa comata*	STCO	9070977
Forbs/Legumes			
Pussytoes	*Antennaria sp*	ANSP	
Fringed sage	*Artemisia frigida*	ARFR	9070993
Hairy goldenaster	*Heterotheca villosa*	HEVI	9070992
Purple locoweed	*Oxytropis lambertii*	OXLA	9070989
Spreading goldenbanner	*Thermopsis divaricarpa*	THDI	9070990

ACTIVITIES - This year, six of the eight established materials were harvested for use in the revegetation of the Bear Lake Road Project. Three forbs, hairy goldenaster, purple locoweed, and fringed sage all produced good quantities of seed and accounted for 39.5 pounds of clean seed. A fourth forb, golden banner, produced just 1.2 pounds of seed. There were five nights of freezing temperatures recorded in mid June that definitely affected the bloom period of the flowering plants. Below freezing temperatures were recorded June 9, 10, 12, 13 and 16. We believe this affected seed formation and set as the plants were in full bloom at the time. The four grasses produced 39.5 clean pounds of seed, with no production of blue grama this year. Ten point two pounds of seed were harvested from needle-and-thread, 4.3 pounds of prairie Junegrass and 14 pounds of mountain muhly. Fringed sage continues to be a good producing species. This year, UCEPC harvested 7.8 clean pounds of seed from a plot. Also productive in volume in 2008 was hairy goldenaster with 27.5 clean pounds of seed.

On August 22, a 0.017 acre plot of pussytoes was planted in field 20. There were only 23 grams collected, but our seed germination trial in the greenhouse resulted in an 86 percent germination. As a result, we decided to direct seed the project. Very minor establishment was noted in the fall. This material will likely need to be increased through greenhouse propagation with the remaining two grams.

On October 10, 493 clean grams of bottlebrush squirreltail were planted for increase with the Bear Lake project. After a request for seed of bottlebrush from a collection on the west side of the park by Lonnie Pilkington, it was discovered that UCEPC had records of only cleaning seed from the Bear Lake Road side. Because we could not find seed or records of cleaning the collection from the west side, it is assumed that seed from both collections were cleaned together, since that is how they were shipped, and planted as a single lot. Because of the mixed planting, the field will be destroyed. A new bottlebrush field will be established using seed collected from the Bear Lake project in 2008. Because there is not enough collected seed to plant 2.5 acres of bottlebrush, the Bear Lake project field will be produced from plugs. If necessary, additional plug production will be used to supplement a separate project for Rocky Mountain National Park where bottlebrush has been identified, as an increase species.

Plug production continued in 2008 as a supplemental activity to fill in blank spots in fields of three grasses. On June 11, needle and thread plugs (116) were planted and 256 Junegrass plugs were planted on June 25 and 26. On July 2, we planted 150 plugs of the warm season mountain muhly.

On August 26, Lonnie Pilkington and Jim Cheatham visited the plant center for a tour of general operations and to see the seed production fields for Rocky Mountain National Park. Discussions were conducted on the future needs of this and other projects in the park.

Production Fields and Goaled Production Quantities
The following table includes actual seeded(s) or transplanted(t) plot size at UCEPC with germplasm received from Rocky Mountain National Park.

Common Name	Scientific Name	Goaled PLS Amt	Proposed Acres	Planted Acres
Grasses				
Blue grama	*Bouteloua gracilis*	40	1.1	1.2 (t)
Bottlebrush squirreltail	*Elymus elymoides*	20	0.5	*
Junegrass	*Koeleria macrantha*	10	0.25	0.25 (t)
Mountain muhly	*Muhlenbergia montana*	20	0.5	0.5 (s) (t)
Needle and thread	*Hesperostipa comata*	20	0.5	0.5 (t)
Forbs/Legumes				
Pussytoes	*Antennaria sp*	2	0.02	0.017 (s)
Fringed sage	*Artemisia frigida*	8	0.02	0.02(t)
Hairy goldenaster	*Heterotheca villosa*	20	0.8	0.8 (s) (t)
Purple locoweed	*Oxytropis lambertii*	20	0.5	0.5 (s) (t)
Spreading goldenbanner	*Thermopsis divaricarpa*	20	2.0	2.0 (s)
	Total:	**180 lb**	**6.19**	**5.79**

* As explained above, the planted bottlebrush field will be removed and a new field established from plug propagation in the spring of 2009.

No seed was shipped to the park this year.

RESULTS – Seed harvest was conducted for eight Rocky Mountain National Park materials in 2006. Seed production was better than expected for blue grama and mountain muhly, but less than expected for needle and thread and prairie Junegrass. Forb harvests were about as good as might be expected with the exception of a lack of harvestable goldenbanner seed.

SPECIES	DATE	QTY	PROCESS	
Blue grama				
Field Establishment:	August 27, 2003	Approx. 15,000 transplants	Transplanter	1.2 acres
	June 9, 2004	Approx. 4000 transplants	Hand transplant	Interplanted
	August 1, 2005	5500	Hand transplant	Interplanted
Harvest:	October 7, 2004	7 lb bulk	Hand harvest	
	September 2, 2005	10.4 lb bulk	Large combine	
	Aug. 8 and 17, 2006	28.5 lb bulk	Hege and by hand	
	August 29, 2007	13 lb	Flail-Vac	
	No Harvest for 2008			
Shipments:	October 5, 2005	2549 g and 10.4 lb		
	September 15, 2006	28.5 lb		
Fringed sage				
Field Establishment:	September 4, 2003	600 transplants	Transplanter	0.02 acres
Harvest:	September 10, 2004	3.5 lb bulk	Hand harvest	
	October 18, 2005	1.8 lb bulk	Hege combine	
	September 18, 2006	7.6 lb	Hege combine	
	September 12, 2007	2.4 lb	Hand harvest	
	September 15, 2008	7.8 lb	Hand harvest	
Shipment	October 5, 2005	3.5 lb bulk		
Goldenaster				
Field Establishment:	May 29, 2003	203 PLS g	Planet Junior	0.8 acres
	August 5, 2005	2000 transplants	Hand transplant	Interplanted
Harvest:	September 1, 2005	20.5 lb bulk	Hege combine	
	August 7, 2006	60.6 lb	Hege combine	
	August 8, 2007	11 lb	Flail Vac	
	August 21, 2008	27.5 lb	Flail Vac and hand	
Shipments	October 5, 2005	20.5 lb bulk		
	September 15, 2006	60.6 lb bulk		
Goldenbanner				
Field Establishment:	May 28, 2003	11.7 lb planted	Planet Junior	2.0 acres
Harvest:	July 7, 2004	2.5 lb bulk	Hand harvest	
	July 18-19, 2005	21 lb bulk	Hege and hand	
	July 13, 2006	142 grams bulk	Hand	
	July 12, 2007	7 lb	Combine	
	July 12, 2008	1.2 lb		

SPECIES	DATE	QTY	PROCESS	
Shipments	October 5, 2005	23.4 lb bulk		
	September 15, 2006	142 grams		
Mountain muhly				
Field Establishment:	May 28, 2003	59 PLS g	Planet Junior	0.5 acres
	August 3, 2005	2500 transplants	Hand transplant	Interplanted
	July 2, 2008	150 transplants	Hand transplant	Interplanted
Harvest:	October 21, 2004	29 g	Hand harvest	
	October 17, 2005	443 g	Hand harvest	
	September 19, 2006	20.5 lb	Hege combine	
	September 13, 2007	13 lb	Swather	
	September 23, 2008	14 lb	Swather	
Shipment	October 5, 2005	70 g		
Needle and thread				
Field Establishment:	September 4, 2003	600 transplants	Transplanter	0.07 acres*
	September 14, 2004	4000 transplants	Transplanter	0.20 acres
	June 30, 2005	5500 transplants	Transplanter	0.30 acres
	June 11, 2008	116 transplants	Hand transplant	Interplanted
Harvest:	June 30, 2005	14 g	Hand harvest	
	June 22, 2006	2.1 lb		
	June 27, 2007	10 lb	Flail Vac	
	July 8, 2008	10.2 lb	Flail Vac	
Shipments	October 5, 2005	1,080 g		
	September 15, 2006	2.1 lb		
Prairie Junegrass				
Field Establishment:	May 29, 2003	28 g	Planet Junior	0.2 acres*
	September 15, 2004	4000 transplants	Transplanter	0.2 acres
	June 25, 2008	256 transplants	Hand transplant	Interplanted
Harvest:	July 12, 2006	3.5 lb	Hege combine	
	July 12, 2007	5 lb	Swather	
	July 23, 2008	4.3 lb	Swather	
Shipment	September 15, 2006	3.5 lb		
Purple locoweed				
Field Establishment:	May 28, 2003	203 g	Planet Junior	0.5 acres
	May 2004	100 g	Hoe	Interplanted
	September 15, 2005	45 transplants	Hand transplant	Interplanted
Harvest:	July 14, 2005	5.8 lb bulk	Hege combine	
	July 6, 2006	15 lb bulk	Hege combine	
	July 18, 2007	10 lb	Hand clipped	

SPECIES	DATE	QTY	PROCESS	
	July 15, 2008	3 lb	Hand clipping	
Shipments	October 5, 2005	290 g and 5.8 lb		
	September 15, 2006	15 lb		

The table above provides a complete recap of the activities conducted by UCEPC as outlined in the cooperative agreement. Six of the eight contract materials have taken two or more years to establish. Three materials took three years of supplemental planting while three other products took two years of plug transplanting to establish fully productive fields. In fact, in 2005, over 15,000 transplants were produced and interplanted into five different production fields to increase production for 2006 and beyond. In 2007, approximately 2000 transplants of blue grama and 1000 plugs of mountain muhly were added to the fields for stand improvement. In 2008, 472 plugs were added to the fields to fill in gaps.

CONCLUSION – This year signifies the first year of the two year agreement. Discussions to extend the production of the established materials are underway. No formal agreement extension or amendment has been drafted at this time. Because the established eight ROMO crops are producing seed, they will likely remain in production unless there is more hard freezing during bloom of the goldenbanner. This species was identified as the most important product for Bear Lake Road revegetation. However, hard freezes in late May through mid June at the peak of flowering have occurred the last three years. Goldenbanner produced much less than is expected from a field this size, but the plants in the field look fine with reasonable vigor, height, and color that indicates something else is a major factor limiting seed production.

This year, UCEPC staff also added bee boards to an existing bee shelter near the field as an attempt to promote pollination activity. Freezing during bloom has been our most likely reason for limited production of goldenbanner seed over the past five years. We will continue with the effort in 2009, but if we have the same results as the previous three years, it will be recommended to remove the field.

If funding for the project continues or an additional amendment is made to extend the agreement, seed production will be conducted beyond 2009 for rose pussytoes and bottlebrush squirreltail, and the existing products will all be reviewed for continued production.

Project COPMC-S-0805-CR
Annual Report - December 2008
By: Steve Parr

ROCKY MOUNTAIN NATIONAL PARK
COOPERATIVE AGREEMENT

Project COPMC-S-0805-CR
Annual Report - December 2008
By: Steve Parr

INTRODUCTION - Upper Colorado Environmental Plant Center (UCEPC), Rocky Mountain National Park (ROMO), and the USDA Natural Resources Conservation Service (NRCS), signed a cooperative plant materials agreement (IA Project No. 1211-07-009) in August 2008. The agreement calls for the production of native plant materials indigenous to the west side of Rocky Mountain National Park for a restoration project. The project will remove an overhead power line and install the power transmission lines underground. The project is estimated to disturb between 10 and 15 acres, with power pole removal slated for this winter. The estimated disturbance will require a production target of 210 pounds of seed, however, the species and production acreage has changed since the agreement was written, and an amendment is necessary to identify those species actually in production and document the size of the production fields.

Colorado River District Powerline Project

Common Name	Scientific Name	Symbol
Grasses		
Blue wildrye	*Elymus glaucus*	ELGL
Nodding brome	*Bromus anomalus*	BRAN
Forbs/Legumes		
Beauty cinquefoil	*Potentilla pulcherrima*	POPU

On June 21, 2007, we received an email that explained that the funding for this project was a line item that would secure the use of year end funds for 2007, but that no funds had been secured for 2008 and 2009. For that reason, a quick scoping trip by Russ Haas, Pat Davey, Lonnie Pilkington, and Jim Cheatham was conducted on June 26 along the area of projected disturbance to identify species for increase. As the year progressed, a number of species were collected by Lonnie Pilkington and his crews from Rocky Mountain National Park, and a decision on what materials to plant for the project were finalized July 27, 2008.

ACTIVITIES – After receiving the collected seed the fall of 2007, the materials were cleaned and some of the larger collections were sent to Colorado State University Seed Laboratory for analysis, while other materials were germinated at UCEPC to determine viability. Below is the list of collected materials for potential use on the powerline project and the clean seed quantities:

CRD Power Line Seed Collection Totals as of 9/27/07		
Primary Species	**Unclean Pounds Collected**	**Clean Seed**
Festuca rubra	44.90	20 lb
Bromus anomalus	19.05	11.4 lb
Elymus glaucus	1.66	227 g
Poa wheeleri	0.00	0
Secondary Species		
Potentilla pulcherrima	21.73	637 g
Eriogonum subalpinum or jamesii	4.57	317 g
Antennaria sp.	1.67	23 g *
Achnatherum lettermannii	1.39	345 g
Elymus elymoides	0.75	493 g *
Solidago sp.	0.06	< 1
* Bear Lake Road Products		

Production Fields and Goaled Production Quantities
The following table includes actual seeded(s) or transplanted(t) plot size at UCEPC with germplasm received from Rocky Mountain National Park.

Common Name	**Scientific Name**	**Goaled PLS Amt**	**Proposed Acres**	**Planted Acres**
Grasses	Elymus glaucus (s)	50	0.25	0.26
	Bromus anomalus (s)	150	1.2	1.2
Forbs/Legumes	Beauty cinquefoil (t)	10	0.1	0.17
	Total	**210**	**1.55**	**1.63**

UCEPC staff produced plugs of the beauty cinquefoil for field establishment after determining that germination could be challenging in a direct seeding in the field, and we had limited seed to work with. But after several attempts, germination efforts were successful and a 0.17 acre field was established utilizing greenhouse produced plugs on June 26, 2008. On August 5, 2008, a 0.26 acre field of blue wildrye was planted and the following day, August 6, a 1.2 acre field of nodding brome was planted. The brome seed was treated with a fungicide, Dividend, as a water bath solution to reduce or prevent the transmission of head smut to the produced seed.

RESULTS – All fields established in 2008, and should produce seed in 2009. Because the agreement was signed in 2007, and year end funds were used to pay UCEPC in 2007, production will be conducted through 2010, and 2009 will represent the first year of production and only the second year of the project. On August 26, Lonnie Pilkington and Jim Cheatham visited the plant center for a tour of general operations and to see the seed production fields for Rocky Mountain National Park. Discussions were conducted on the future needs of this and other projects in the park.

All materials were established at the time of the visit, but we had a killing frost on September 2 which made for a 2008 growing season of only 75 days. We anticipate good seed production in 2009 and 2010.

CONCLUSION – The first year of field activities was very successful and should reap healthy seed production fields for 2009 and beyond. While each collection of a given species is in itself unique relative to production, the generalized view is that the products being produced for the agreement are suited to providing good seed quantities at a reasonable price for immediate restoration uses.

Live Plant Production - 2008

Upper Colorado Environmental Plant Center

By Dr. Gary L. Noller

INTRODUCTION

Only two live plant shipments were provided by Upper Colorado Environmental Plant Center in 2008, except for materials that were grown for **special contracts**. One request was for silver buffaloberry for a field test in the Gunnison field office area. The other shipment was for a riparian shrub project in Wyoming. The Distribution and Deliver Records (D&Ds) are attached.

SCS-ECS-596a

DISTRIBUTION AND DELIVER RECORD
MEEKER, COLORADO ENVIRONMENTAL PLANT CENTER

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ORDER NUMBER CO PMC-08-06 Plants

D & D TO: SOIL CONSERVATION SERVICE
ATTN: PAT DAVEY
655 PARFET STREET
LAKEWOOD, CO 80215

SHIP TO: Jason Turner
Gunnison Field Office

CC : Russ Haas

Order Date: June 26th, 2008 **Ship Date:** **Ship via:** P/U by Ed Nielson

PM-1 No: 40 Live Plants

ACCESSION	COMMON NAME SCIENTIFIC NAME	LOT NUMBER STORAGE LOC	QUANTITY SHIPPED BULK	 PLS	 U/M
9008027	Silver Buffaloberry *Shepherdia argentea*				1- 1gal. pot 1 - 3 gal. pot 2 - 6 x 16" Tree Piot 7 - 2" x 12" Cone 18 2"x 2"x 11" Tree pot 11 4" x4"x14" Tree Pot

For: Field Test Sites

****

PLEASE SIGN AND RETURN ONE COPY TO:
UCEPC
5538 RBC #4
Meeker, CO 81641

****

Ordered by: Jason Turner **Order filled by:** Terri Blanke

Received by Ed Nielson **Approved by** Terri Blanke

Title Resource Conservationist **Name/Title** _____

Date 7-26-2008 **Date** 7/22/2008

Billed To: _____

SCS-ECS-596a

DISTRIBUTION AND DELIVER RECORD
MEEKER, COLORADO ENVIRONMENTAL PLANT CENTER

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ORDER NUMBER: CO PMC-08-07 Plants

D & D TO: SOIL CONSERVATION SERVICE
ATTN: PAT DAVEY
655 PARFET STREET
LAKEWOOD, CO 80215

SHIP TO: Bureau of Land Management
Atten: Andy Warren
P.O. Box 2407
Rawlins, Wyoming 82301

CC :

Order Date: September 1, 2008 **Ship Date:** September 9, 2008 **Ship via:** Megan

PM-1 No: **Number of Packages:** 334

ACCESSION	COMMON NAME SCIENTIFIC NAME	LOT NUMBER STORAGE LOC	CERT CLASS TYPE	QUANTITY SHIPPED BULK	 PLS	 U/M
9030913	Golden currant *Ribes aureum*			76.00		Plants
BLM collection	Waterbirch *Betula occidentalis*			125.00		Plants
COPMC	Redosier Dogwood *Cornus sericia*			133.00		Plants

FOR: Riparian shrub project

****

PLEASE SIGN AND RETURN ONE COPY TO:

UCEPC
5538 RBC #4
Meeker, CO 81641

****

Ordered by: Andy Warren **Order filled by:** Johnny Barton

Received by _____ **Approved by** Steve Orr

Title _____ **Name/Title** Manager

Date _____ **Date** 10/31/2008

Billed To: _____

Seed Production - 2008
Upper Colorado Envronmental Plant Center
by Dr. Gary L. Noller

INTRODUCTION

The following plant materials had seed harvested in 2008. This report does not include seed produced for special contracts. Species and planting information can be requested from the UCEPC.

Common Name/ Variety	Scientific Name	Project No.	Accession No.	Year	Acres	Harvest Date	Field No.	Cleaned Weight
GRASSES								
Smooth Brome	*Bromus inermis*	08S229	9030693	1996	0.01	7/22	25	2.19 lb
'Liso'				1997	0.01	7/26	25	1.10 lb
				1998	0.01	8/12	25	1.25 lb Heavy shatter
				1999	0.01	No harvest	25	--
				2000	0.01	No harvest	25	--
				2001	0.01	No harvest	25	--
				2002	0.01	No harvest	25	--
				2003	0.01	7/16	25	256.00 g
				2004	0.01	No harvest	25	--
				2005	0.01	No harvest	25	--
				2006	0.01	No harvest	25	--
				2007	0.01	No harvest	25	--
				2008	0.01	No harvest	25	--
Mountain Brome	*Bromus marginatus*	08S217	9005308	1989	0.20	--	17	--
Garnet - tested class				1990	0.20	--	17	75.00 lb
				1991	0.20	--	17	92.00 lb
				1992	0.20	--	17	104.00 lb
				1993	0.20	--	17	6.20 lb
				1994	1.00	--	6	1235.00 lb
				1995	1.00	--	6	1266.00 lb
				1996	1.00	7/8	6	610.00 lb
				1997	1.00	7/8	6	473.00 lb
				1998	1.00	7/12	6	479.00 lb
				1999	1.00	7/8 - 7/9	6	607.00 lb
				2000	1.00	6/28	6	6.60 lb
				2000	--	Plowed 26 rows	6	

Common Name/ Variety	Scientific Name	Project No.	Accession No.	Year	Acres	Harvest Date	Field No.	Cleaned Weight
				2000	0.18	6 rows not plowed	6	
				2001	0.18	6/27	6	43.00 lb
				2002	0.18	6/5	6	10.00 lb
				2003	0.18	7/1	6	41.00 lb
				2004	0.18	7/1	6	95.00 lb
				2004	1.10	New planting	6	
				2005	0.18	7/8	6	33.00 lb
				2005	1.10	7/8	6	37.00 lb
				2006	0.18	6/26	6	16.50 lb
				2006	1.10	6/26	6	112.00 lb
				2007	0.18	6/29	6	95.00 lb
				2007	1.10	6/30	6	287.00 lb
				2008	0.18	7/9	6	85.00 lb
				2008	1.10	7/9	6	222.50 lb
Purple reedgrass	*Calamagrostis purpurascens*		9070968	2005	plot	Planted	20	
				2006	plot	7/26	20	1.00 g
				2007	plot	7/31	20	5.00 g
				2008	plot	8/12	20	471.00 g
Bottlebrush Squirreltail	*Elymus elymoides*		9040189	2005	1.00	New planting	18	
Wapiti - selected class			Poor stand	2006	1.00	No harvest	18	--
				2007	1.00	7/20 - 8/8	18	24.00 lb
				2008	1.00	7/27	18	29.50 lb
Bottlebrush Squirreltail	*Elymus elymoides*		9040187	2006	0.50	New planting	18	
Pueblo - selected class	harvest	from	demo plot	2007		8/10	20	422.00 g
				2008	0.50	7/31	18	1.25 lb
'Peru creek'	*Deschampsia caespitosa*		9024403	2006	plot	7/26	20	13.00 g
Foundation				2007		7/30	20	57.00 g
				2008		7/29	20	153.00 g
					plot			
					plot			
Pubescent wheatgrass	*Elytrigia intermedia*	08S216	106831	1993	1.00	--	11	
'Luna'				1994	1.00	--	11	379.00 lb
Foundation				1995	1.00	9/30	11	335.00 lb
				1996	1.00	8/15	11	150.00 lb
				1997	1.00	8/20	11	161.00 lb

Common Name/ Variety	Scientific Name	Project No.	Accession No.	Year	Acres	Harvest Date	Field No.	Cleaned Weight	
				1997	0.66	Planted 6/6	11		
				1998	1.66	8/26	11	353.00 lb	
				1999	0.66	Removed 1993 planting	11	121.50 lb	
				2000	0.66	No harvest	11	--	
				2001	0.66	8/16	11	24.50 lb	
				2002	0.66	Field plowed	11		
				2002	0.70	Planted 7/18	11		
				2003	0.70	9/8	11	43.00 lb	
				2004	0.70	8/24	11	213.00 lb	
				2005	0.70	8/15	11	138.00 lb	
				2006	0.70	9/27	11	10.00 lb	
				2006	1.30	July (New planting)	11		
				2007	1.30	8/7	11	637.00 lb	
				2008	1.30	8/12	11	314.50 lb	
Arizona fescue	*Festuca arizonica*	08S214	469218	1994	1.00	--	6		
'Redondo'				1995	1.00	8/7	6	191.50 lb	
Foundation				1996	1.00	8/1	6	97.00 lb	
				1997	1.00	8/11	6	111.00 lb	
				1998	1.00	8/8	6	89.00 lb	
				1999	1.00	8/3	6	33.50 lb	
				2000	1.00	7/21	6	57.00 lb	
				2001	1.00	8/1	6	45.00 lb	
				2002	1.00	7/30	6	54.00 lb	
				2003	1.00	No harvest	6	--	Reduced to .18 ac
				2004	1.00	New planting	18		
				2005	0.18	7/28	6	9.00 lb	
				2005	1.00	No harvest	18	--	Replant
				2006	0.18	No harvest	6	--	
				2006	1.00	No harvest	18	--	
				2007	0.18	7/27	6	1.00 lb	
				2008	0.18	7/30	18	18.50 lb	
Thurber fescue	*Festuca thurberi*		9024002	2007	plot	7/11	20	190.00 g	
				2008	plot	7/11	20	1.95 lb	
Big bluegrass	*Poa secunda*	08S244	9092261	2002	1.00	Planted 7/16/02	11A		
Name changed	Not released			2003	1.00	7/17	11A	47.00 lb	
				2004	1.00	7/7	11A	221.00 lb	

Common Name/ Variety	Scientific Name	Project No.	Accession No.	Year	Acres	Harvest Date	Field No.	Cleaned Weight	
				2005	1.00	7/13	11A	100.00 lb	
originally called				2006	1.00	7/1	11A	120.00 lb	
Prairie junegrass	*Koeleria cristata*			2007	1.00	7/2	11A	134.00 lb	
				2008	1.00	No harvest	11A		
Salina wildrye	*Leymus salinus*	08S213	9043501	1996	0.02	7/22	Hqts.	154.00 g	
				1996	0.10	7/22	4	-- 631.00 g	
				1996	0.20	Planted	4	No harvest	Breeders
				1997	0.02	Field plowed	Hqts.	No harvest	Foundation
				1997	0.10	7/21	4	2.96 lb	Breeders
				1997	0.20	7/21	4	5.32 lb	Foundation
				1998	0.10	8/4	4	4.00 lb	Breeders
				1998	0.20	8/4	4	9.00 lb	Foundation
				1999	0.10	7/15	4	22.00 g	Breeders
				1999	0.20	7/15	4	32.00 g	Foundation
				2000	0.10	No harvest	4	--	Foundation
				2000	0.20	7/7	4	6.00 g	Breeders
				2001	0.20	7/9	4	174.00 g	Breeders
				2001	0.10	7/9	4	227.00 g	Foundation
				2002	0.10	7/11	4	7.00 g	Breeders
				2002	0.20	7/11	4	23.00 g	Foundation
				2003	0.10	7/9	4	1.69 lb	Breeders
				2003	0.20	7/9	4	0.60 lb	Foundation
				2004	0.10	7/9	4	19.00 g	Foundation
				2004	0.20	7/9	4	146.00 g	Breeders
				2004	0.10	New planting	4		Foundation
				2005	0.10	7/13	4	1.40 lb	Foundation
				2005	0.30	7/13	4	302.00 g	Breeders
				2006	0.30	7/13	4	83.00 g	Foundation
				2006	0.10	7/13	4	2.00 g	Breeders
				2007	0.30	7/11	4	5.50 lb	Foundation
				2007	0.10	7/13	4	296.00 g	Breeders
				2008	0.10	7/28	4	1.17 lb	Breeders
				2008	0.30	7/28	4	1.27 lb	Foundation
Western wheatgrass	*Pascopyron smithii*	08S226	432402	1996	1.00	Planted	4		
'Arriba'				1997	1.00	8/14	4	640.00 lb	
Foundation				1998	1.00	8/22	4	238.00 lb	
				1999	1.00	8/26	4	87.00 lb	

Common Name/ Variety	Scientific Name	Project No.	Accession No.	Year	Acres	Harvest Date	Field No.	Cleaned Weight
				1999	0.80	New planting 10/6	6A	
				2000	0.80	No harvest	6A	--
				2000	1.00	Field plowed	4	
				2001	0.80	8/3	6A	173.00 lb
				2002	0.80	8/14	6A	100.00 lb
				2003	0.80	8/22	6A	126.00 lb
				2004	0.80	No harvest-plowed	6A	
				2004	1.30	New planting	4	
				2005	1.30	8/27	4	35.00 lb
				2006	1.30	7/28	4	273.00 lb
				2007	1.30	8/5	4	108.00 lb
				2007	1.30	Fall plowed	4	
				2007	1.13	New planting - 8/9	1A	34 rows
				2008	1.13	8/11	1A	41.00 lb
Crested wheatgrass 'Hycrest' Foundation	*Agropyron cristatum X* desertorum		9028605	2007	0.30	planted 8/10	17	17 rows
				2008	0.30	8/19	17	59.00 lb
FORBS								
Fringed sage	*Artemisia frigida*		9021471	2006	plot	9/26	20	2.45 lb
				2007	plot	9/27	20	539.00 g
				2008	plot	9/16	20	277.00 g
Louisiana sage 'Summit' Foundation	*Artemisia ludoviciana*	08S109	9021474	1984	0.25	--	2	
				1985	0.25	No harvest	2	--
				1986	0.25	10/6	2	2.44 g
				1987	0.25	9/14	2	0.96 g
				1988	0.25	10/5	2	0.10 g
				1989	0.25	10/11	2	4.00 g
				1990	0.25	No harvest	2	--
				1991	0.25	9/10	2	3.43 lb
				1992	0.25	9/2	2	57.00 g
				1993	0.25	9/15	2	4.39 lb
				1994	0.35	9/8	2	4.38 lb
				1995	0.35	9/11	2	28.00 lb
				1996	0.35	9/10	2	0.78 lb

Common Name/ Variety	Scientific Name	Project No.	Accession No.	Year	Acres	Harvest Date	Field No.	Cleaned Weight
				1997	0.35	9/8	2	0.90 lb
				1998	0.35	Stand dead-field plowed	2	
				1998	0.06	New planting	2	No harvest
				1999	0.06	Field plowed	--	
				1999	0.10	New planting	25	
				2000	0.10	No harvest	25	--
				2001	0.10	No harvest	25	--
				2002	0.10	No harvest	25	--
				2003	0.10	No harvest	25	--
				2004	0.10	No harvest	25	--
				2005	0.10	No harvest	25	--
				2006	0.10	No harvest	25	--
				2007	0.10	No harvest	25	--
				2007	plot	New planting	Hdqtrs	
				2008	plot	No harvest	Hdqtrs	--
Utah sweetvetch	*Hedysarum boreale*		9024375	2005	1.00	New planting	1	
'Timp'				2006	1.00	Poor stand	1	No harvest
Foundation				2007	1.00	Late July	1	45.00 g
				2008	1.00	7/17	1	1.80 lb
Rocky Mtn penstemon	*Penstemon strictus*		9004712	2004	0.10	New planting	8A	
'Bandera'				2005	0.10	No harvest	8A	--
Foundation				2006	0.10	deer used heavily	8A	
				2007	0.10	8/24	8A	No harvest
				2008	0.10	9/24	8A	14.50 lb
SHRUBS								
Serviceberry	*Amelanchier alnifolia*	08S078Z	9021438	1984	0.25	--	3	
Long ridge				1993	0.25	--	3	2.88 lb
selected class				1994	0.25	--	3	0.88 lb
				1995	0.25	--	3	1.77 lb
				1996	0.25	No harvest	3	--
				1997	0.25	--	3	131.00 g
				1998	0.25	7/30	3	0.18 lb
				1999	0.25	No harvest	3	--
				2000	0.25	7/20 - 8/9	3	283.00 g

Common Name/ Variety	Scientific Name	Project No.	Accession No.	Year	Acres	Harvest Date	Field No.	Cleaned Weight	
				2001	0.25	No harvest	3	--	
				2002	0.25	No harvest	3	--	
				2003	0.25	7/10 - 8/13	3	2.64	lb
				2004	0.25	No harvest	3	--	
				2005	0.25	No harvest	3	--	
				2006	0.25	1/6	3	0.80	lb
				2007	0.25	8/2	3	449.00	g
				2008					
	not sure of harvest								
Mountain mahogany	*Cercocarpus montanus*	08S035Z	477976	1979	0.02	--	17		
'Montane'				1984	0.02	9/24	17	43.00	g
Foundation				1985	0.02	9/11	17	286.00	g
				1986	0.02	10/7	17	37.00	g
				1987	0.02	8/31 - 9/15	17	2.47	lb
				1988	0.02	9/1 - 9/13	17	2.05	lb
				1989	0.02	9/15	17	0.20	lb
				1990	0.02	No harvest	17	--	
				1991	0.02	10/17	17	285.00	g
				1992	0.02	9/21	17	0.83	lb
				1993	0.02	9/15	17	2.44	lb
				1994	0.02	8/12	17	2.30	lb Not all harvested
				1995	0.02	No harvest	17	--	
				1996	0.02	--	17	0.82	lb Not all harvested
				1997	0.02	No harvest	17	--	
				1998	0.02	11/2	17	0.86	lb
				1999	0.02	No harvest	17	--	
				2000	0.02	No harvest	17	--	
				2001	0.02	No harvest	17	--	
				2002	0.02	No harvest	17	--	
				2003	0.02	No harvest	17	--	
				2004	0.02	No harvest	17	--	
				2005	0.02	No harvest	17	--	
				2006	0.02	No harvest	17		
				2007	0.02	No harvest	17		
				2008	0.02	No harvest	17		
								--	
								--	
Bitterbrush	*Purshia tridentata*	08A073J	9038521	1995	0.01	7/29	21	-- 239.00	g
Fire tolerant				1996	0.01	8/15	21	66.00	g

Common Name/ Variety	Scientific Name	Project No.	Accession No.	Year	Acres	Harvest Date	Field No.	Cleaned Weight
				1997	0.01	No harvest	21	--
				1998	0.01	No harvest	21	--
				1999	0.01	8/6	21	27.00 g
				2000	0.01	7/18	21	153.00 g
				2001	0.01	7/19	21	159.00 g
				2002	0.01	No harvest	21	--
				2003	0.01	No harvest	21	--
				2004	0.01	No harvest	21	--
				2005	0.01	No harvest	21	
				2006	0.01	No harvest	21	--
				2007	0.01	No harvest	21	--
				2008	0.01	7/29	21	367.00 g
Chokecherry	*Prunus virginiana*	08S235	9024060	1997	0.01	8/15	18	11.90 lb
			EPC229	1998	0.01	8/25-8/27	18	115.00 lb
				1999	0.01	8/20	18	9.00 lb
				2000	0.01	7/28	18	30.50 lb
				2001	0.01	--	18	21.92 lb
				2002	0.01	July - Aug.	18	Few grams
				2003	0.01	8/4	18	4.80 lb
				2004	0.01	No harvest	18	--
				2005	0.01	No harvest	18	--
				2006	0.01	No harvest	18	--
				2007	0.01	8/10	18	47.00 g
				2008	0.01	8/18	18	36.50 lb
Silver buffaloberry	*Shepherdia argentea*	08S235	9008027	1998	0.01	9/1	18	13.00 g
			EPC476	1999	0.01	No harvest	18	--
				2000	0.01	No harvest	18	--
				2001	0.01	No harvest	18	--
				2002	0.01	No harvest	18	--
				2003	0.01	8/10	18	238.00 g
				2004	0.01	No harvest	18	--
				2005	0.01	No harvest	18	--
				2006	0.01	No harvest	18	--
				2007	0.01	Mid August	18	751.00 g
				2008	0.01	8/19	18	2.60 lb

Common Name/ Variety	Scientific Name	Project No.	Accession No.	Year	Acres	Harvest Date	Field No.	Cleaned Weight
Thinleaf alder	*Alnus tenuifolia*		9070975	2000	0.25	10/4	3	558.00 g
				2001	0.25	10/2-10/3	3	2.13 lb
				2002	0.25	No harvest	3	--
				2003	0.25	No harvest	3	--
				2004	0.25	No harvest	3	--
				2005	0.25	No harvest	3	--
				2006	0.25	No harvest	3	
				2007	0.25	No harvest	3	
				2008	0.25	No harvest	3	
								--
Bitterbrush Maybell select class	*Purshia tridentata*		9024373	2008		from Maybell site 7/30	N/A	-- 5.40 lb --

UPPER COLORADO ENVIRONMENTAL PLANT CENTER
WEATHER SUMMARY FOR 2008

Prepared by Dr. Gary L. Noller

PRECIPITATION

In 2008, 15.99 inches of precipitation was measured at the plant center (Table 1). That is slightly below (1.2%) the longtime average of 16.19 inches. Precipitation was recorded on 94 recording dates during the year. This year, 2008, was the first year since 2004 that we have not exceeded the longtime average (Table 1). Four months in 2008 were considered wet (January – 1.90, May – 2.18, September – 2.34, and December – 1.56 inches) with substantially above average precipitation. During these four months, 7.98 inches, 49.9 percent of the precipitation for the year was recorded. In addition, four months (March – 0.99, July - 0.16, October – 0.57, and November – 0.90) were dry. In this four month period, only 16.4 percent (2.62 inches) of the precipitation for the year was received. The driest month of July since precipitation records were kept in 1976, was recorded in 2008

SNOW

Snowfall in 2008 measured 94.0 inches (Table 2) and exceeded the amount measured in 2007 (78.0 inches). Snow in 2008 measured 6.85 inches of moisture or 42.8 percent of the total precipitation for the year, when considering the times, only snow was recorded and not when snow and rain occurred together in the same event.

GROWING SEASON

The frost-free growing season in 2008 measured only 75 days. This represents the period from June 16 to September 2. This was a very short growing season since it generally measures about 90 days. Precipitation during this important period measured only 2.11 inches and represents only 13.2 percent of the total for the year.

TEMPERATURES

Temperatures in 2008 did not exhibit extremes of heat or cold. Lows below 0°F were recorded on 27 recording dates and a high failed to reach 32°F or above on 18 recording dates (Table 2). A maximum temperature of 85°F or above was recorded on 39 recording dates. The highest average monthly maximum temperature (87.8°F) was recorded in July and the lowest average monthly minimum (-3.4°F) was recorded in January.

Table 1. Monthly and Total Yearly Precipitation in Inches

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Longtime Avg. Over 50 Yrs.	**1.15**	**1.00**	**1.50**	**1.56**	**1.45**	**1.06**	**1.51**	**1.82**	**1.43**	**1.49**	**1.10**	**1.12**	**16.19**
1976 *	0.47	0.74	1.37	1.25	1.44	1.43	2.03	1.18	1.14	0.37	0.11	0.17	**11.70**
1977 *	0.37	0.49	0.74	0.70	1.11	0.25	1.76	3.04	0.66	0.82	0.74	0.63	**11.31**
1978 +	1.58	0.82	1.69	1.77	1.32	0.30	0.44	0.72	1.25	0.14	1.31	1.47	**12.81**
1979 +	0.82	0.89	0.97	1.19	3.25	0.49	0.54	1.05	0.34	1.20	1.15	0.24	**12.13**
1980 +	1.63	1.75	1.74	0.67	2.36	0.01	2.22	1.53	0.38	1.58	0.63	0.13	**14.63**
1981 +	0.24	0.46	1.56	0.27	3.15	1.58	3.50	0.99	0.61	4.47	0.79	1.40	**19.02**
1982 +	0.78	0.32	0.56	0.59	1.79	0.04	1.64	2.81	2.91	1.81	0.97	0.62	**14.84**
1983 +	0.50	1.32	0.84	0.98	2.29	2.52	1.83	1.05	0.75	1.83	1.90	3.00	**18.81**
1984 +	0.70	0.24	1.62	2.00	0.93	4.22	2.20	3.24	1.65	2.78	0.34	0.71	**20.63**
1985 +	1.13	0.45	1.49	2.80	1.70	1.65	1.77	0.48	1.39	3.10	2.27	0.83	**19.06**
1986 +	0.65	1.76	1.48	1.44	0.73	1.16	3.45	1.99	2.36	1.70	1.65	0.57	**18.94**
1987 +	0.67	1.10	1.51	0.76	2.63	0.90	1.72	3.22	0.50	1.15	1.31	1.20	**16.67**
1988 +	1.31	0.82	1.26	1.23	1.45	0.50	0.79	3.39	2.52	0.17	1.69	0.99	**16.12**
1989 +	1.24	1.75	0.96	1.10	0.54	0.91	1.16	1.49	1.50	0.66	0.62	0.39	**12.32**
1990 +	0.28	1.27	0.46	1.28	1.29	0.93	1.29	0.41	2.18	2.12	0.82	0.55	**12.88**
1991 +	1.28	0.35	1.98	1.48	0.75	1.16	3.54	2.13	1.30	2.25	1.65	0.70	**18.57**
1992 +	0.52	1.09	1.45	1.37	3.03	1.10	3.28	1.21	1.20	0.57	2.85	0.73	**18.40**
1993 +	1.27	1.07	1.91	2.32	2.11	1.08	0.31	1.14	0.52	1.63	1.31	0.50	**15.17**
1994 +	0.32	0.62	0.66	1.50	0.82	0.89	0.41	1.08	1.64	1.65	1.55	0.75	**11.89**
1995 +	0.83	0.84	0.99	2.87	5.72	2.40	1.68	1.29	2.11	2.17	0.95	0.94	**22.79**
1996 +	1.98	2.01	0.57	1.36	1.46	1.12	0.86	0.86	2.13	2.21	2.34	1.38	**18.28**
1997 +	2.04	0.72	0.34	3.04	1.82	1.05	1.02	2.93	5.42	2.37	0.76	0.61	**22.12**
1998 +	0.79	1.20	1.87	1.65	0.45	3.58	1.79	0.64	0.87	1.63	1.03	0.92	**16.42**
1999 +	0.99	0.73	0.59	3.57	2.24	1.09	2.60	1.49	0.89	0.70	0.50	1.08	**16.47**

* From the National Oceanic and Atmospheric Administrations Climatic Summary of the United States.

\+ From the weather instruments located at the UCEPC.

Note: Some precipitation was not recorded in Oct. 2003.

Table 1. Monthly and Total Yearly Precipitation in Inches

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Longtime Avg. Over 50 Yrs.	**1.15**	**1.00**	**1.50**	**1.56**	**1.45**	**1.06**	**1.51**	**1.82**	**1.43**	**1.49**	**1.10**	**1.12**	**16.19**
2000 +	0.84	0.99	1.98	0.69	1.32	0.78	0.54	2.98	2.38	0.90	1.30	0.74	**15.44**
2001 +	0.49	1.03	0.45	0.53	1.53	0.79	0.78	1.56	0.92	1.57	0.91	0.70	**11.26**
2002 +	0.92	0.18	0.96	0.41	0.09	0.81	1.31	1.19	1.93	1.77	0.81	0.63	**11.01**
2003 +	0.72	1.41	0.98	1.30	1.71	1.77	0.52	0.65	1.31	0.04	0.77	1.37	**12.55**
2004 +	0.21	0.50	0.53	2.23	0.97	1.05	1.29	1.17	1.99	1.09	1.58	0.62	**13.23**
2005 +	1.61	0.97	1.26	1.76	1.51	3.55	0.58	1.83	1.74	2.56	1.60	0.93	**19.90**
2006 +	0.87	1.05	1.70	0.76	0.49	0.03	1.63	3.00	2.86	3.49	0.79	0.69	**17.36**
2007	1.08	1.16	0.69	0.59	1.39	0.20	0.93	2.35	3.49	2.58	0.43	2.52	**17.41**
2008	1.90	1.18	0.99	1.29	2.18	1.31	0.16	1.61	2.34	0.57	0.90	1.56	**15.99**

* From the National Oceanic and Atmospheric Administrations Climatic Summary of the United States.

\+ From the weather instruments located at the UCEPC.

Note: Some precipitation was not recorded in Oct. 2003.

Weather Data

Table 2.

2008	Precip.	% of Total	Snow Inches	With Precip.	Below 0ºF	High Less Than 32ºF	High 85ºF or Above	Avg. Min. Temp. Fah.	Avg. Max. Temp. Fah.
				Recording Dates *					
Jan	1.90	11.9	25.0	13	15	11	0	-3.4	29.5
Feb	1.18	7.4	14.5	11	6	4	0	7.6	39.7
Mar	0.99	6.2	9.5	8	1	0	0	12.0	46.2
Apr	1.29	8.1	15.5	8	0	0	0	20.1	56.8
May	2.18	13.6	7.5	11	0	0	0	32.2	66.5
Jun	1.31	8.2	0.0	7	0	0	7	39.6	77.9
Jul	0.16	1.0	0.0	4	0	0	18	49.2	87.8
Aug	1.61	10.0	0.0	7	0	0	13	47.5	85.2
Sep	2.34	14.6	0.0	5	0	0	1	37.7	76.5
Oct	0.57	3.6	0.0	3	0	0	0	26.8	66.5
Nov	0.90	5.6	8.0	6	1	0	0	19.4	54.4
Dec	1.56	9.8	14.0	11	4	3	0	10.0	40.2
Total	15.99	-	94.0	94	27	18	39	-	-

Weather instruments are not read on weekends.

*

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Meeker Station Report for 2008

In collaboration with Steve Parr, Upper Colorado Environmental Plant Center (UCEPC), Meeker, CO, research plots with two grass species and wheat were established to study the ecology of four Diuraphis spp. Wheat, Canada wildrye and Teton mountain brome were planted in the summer of 2007 but only the wild grass species survived the winter. However, other grasses that were already planted at this station served as good replacements to determine the occurrence of *D. mexicana*, *D. tritici*, *D. frequens* and the Russian wheat aphid, *D. noxia*. All species except *D. noxia* are known to overwinter as eggs in the Colorado Plateau area but their ecology and life history has received little study. Our objective was to determine if *D. noxia*, a serious pest of wheat in Colorado, was able to produce a sexual generation in the fall and produce overwintering eggs. *D. noxia* and *D. mexicana* occurred in mtn. brome in the fall of 2007 but only *D. mexicana* produced overwintering eggs. Samples collected by Steve Parr in mid-April and sent to Stillwater, OK, contained *D. mexicana* and eggs that had just begun to hatch. *D. noxia* was not present in the spring and was not able to overwinter as adults. D. noxia was present on Canada wildrye and crested wheat grass in the Fall of 2008. The information gathered at UCEPC will be used to describe the ecology of all *Diuraphis* spp in Colorado. Further sampling in the 2009 season will help determine if other *Diuraphis* spp. are present and if *D. noxia* can overwinter as adults or as eggs.

Summary of Regional PMC Tall Wheatgrass Bio-Fuel Feedstock Trials 2007-2008

Summary by Jim Briggs, Plant Materials Specialist, NRCS, Portland, OR**; Research and appendices by (alphabetic order): Ramona Garner,** PMC Manager, NRCS, Tucson, AZ**; Roger Hybner,** PMC Manager, NRCS, Bridger MT; **John Leif,** PMC Manager, NRCS, Roselake MI**; Manuel Rosales,** Conservation Agronomist, NRCS, Meeker CO**; Paul Salon,** Plant Materials Specialist, NRCS, Syracuse, NY; **Loren St. John,** Team Leader, NRCS, Aberdeen , ID; **Christina Smith,** Agronomist, NRCS, Lockeford, CA**; Mark Stannard,** PMC Manager, NRCS, Pullman, WA**; Joe Williams,** PMC Manager, NRCS, Corvallis OR**; R. Jay Ugiansky,** Resource Conservationist, NRCS, Beltsville MD

Abstract

The cultivar 'Largo' appears to be best suited to bio-fuel applications over the widest geographic area. 'Largo' and 'Alkar' were the best performers among tall wheatgrass entries in both stand establishment and vigor in calendar year 2008. Significant differences in yield among tall wheatgrass entries at most locations was not evident, however 'Largo' yields trended towards the best.. Among PMC's with different seeding rates no statistical differences in yield were evident between 20 and 40 lbs/acre seeding rates. In New York trials yield trended higher at the 20 lb/acre seeding rate. Washington trials were installed with 6 and 12 inch row spacing. No significant differences in yield were evident. Intermediate wheatgrass produced the greatest yields in trials where included (MD,NY,MI). The Hungarian 'Szarvasi-1' "energy grass" performance was generally ranked poorer than the other tall wheatgrass entries although this may be due to seed quality.. New York germination analysis indicated actual germination was well below the stated level which suggests that the received seed of 'Szarvasi-1' was of poor quality. Chemical analysis at 1 trial site indicated that 'Largo','Szarvasi-1', and 'Alkar' may have superior characteristics for bio-fuel applications among tall wheatgrass cultivars tested, however the species generally appears inferior to switchgrass and other typical biofuel crops such as poplar.

Introduction

The objective of this study is to comparatively evaluate four commercially available plant releases of tall wheatgrass (*Thinopyrum ponticum* [Podp.] Z.-W. Liu & R.-C. Wang). for potential use as a biofuel crop in the cool season grass ecosystems of the west and northeast. Tall wheatgrass releases included in this study are from the US and one from Hungary. This report summarizes 2008 results of the work conducted at participating Plant Materials Centers (PMCs).

The study was begun because of recent efforts now underway to develop grass bio-feedstocks for various biofuel applications. Much attention has been given to switchgrass (*Panicum virgatum* L.)for this effort. In the Northeast and other moist and cooler environments there is still a question about the long term competitiveness and production potential of switchgrass to other more adapted cool season grasses and weeds.
Tall wheatgrass was identified as a species of interest due to its wide range of adaptability, and reported large biomass yields, and commercially available cultivars.. Additionally a tall wheatgrass cultivar from Hungary, 'Szarvasi-1' Energy Grass, was brought to our attention which increased our interest in this species. Synonyms for tall wheatgrass found in the Literature include: *Elytrigia elongatum* (Host) Nevski , *Elymus elongatus* (Host) Runemark, *Agropyron elongatum* (Host) Beauv. (Plants Database, 2006). Tall wheatgrass is a perennial, decaploid (2n=70) cool-season bunchgrass from southern Europe and Asia Minor where its habitat includes areas with saline or alkaline soils (Vogel and Moore, 1998). Tall wheatgrass is a bunchgrass with a rapid growth rate with a mature height of 5 feet, and a moderate lifespan. The species is adapted to coarse, fine and medium textured soils and has low anaerobic tolerance. There are an estimated 75,320 seeds /lb. Tall wheatgrass is known for high seedling vigor and a slow rate of spread via seed. (Plants Database, 2006)

In addition to 'Szarvasi-1' The three other tall wheatgrass cultivars being evaluated are 'Alkar', from Pullman PMC, and 'Largo' and 'Jose' from the former SCS nursery in Albquerque, NM. 'Alkar' is adapted to Plant Hardiness Zone (PHZ) 5 the others to PHZ 4. 'Alkar' was reported to be very tolerant to wet conditions and is later maturing than the other wheatgrass. A variety not in study 'Orbit' tolerates flooding for three to four weeks in spring. (Alderson and Sharp, 1994). Although it performs best in areas having >450 mm/yr precipitation, tall wheatgrass responds well to irrigation both in areas with high precipitation and in areas with low precipitation. (Lauriault et al., 2002).
Tall wheatgrass has been investigated as a vegetative wind barrier for control of wind erosion in the Northern Great Plains where it was reported "that the barriers reached height of about 1.2 m and the stems remain erect throughout the winter"(Aase and Pikul, 1995). In a study at Big Flats, New York 'Jose' tall wheatgrass and several other tall wheatgrass accessions performed very well as a vegetative barrier, remaining upright over winter. The tall wheatgrass matures later than other cool season grasses (Lauriault et al., 2002) and may be able to be harvested later allowing harvest of the yearly biomass from one cutting.

Yields of tall wheatgrass have been reported typically under grazing style clipping studies, in different climates and precipitation with various fertilizer and irrigation treatments resulting in large variability in reported yields. In Bushland, TX 'Jose' yielded 11.3 Mg/ha. A second study in that location with the three varieties we are investigating only yielded 3.8 Mg/ha, however this study used much less fertilizer. In Los Lunas, NM 13.2 Mg/ha were reported for 2 to 3 harvests annually using 146 kg /ha total N., while at the same station only 4.8 Mg/ha was reported from 2 to 3 harvests with a split application of 230 kg/ha of total N. A study in Tucumcari, NM reported maximum yearly yields with irrigation and split application of 168 kg/ha of N of 4.5 Mg/ha (Lauriault et al., 2002). Yields of 13.2 Mg/ha are consistent with high management yields of other cool season

grasses in the Northeast. The ability to stand up over winter and late seed maturity, (the potential improvements made with 'Szarvasi-1' Energy Grass) may make tall wheatgrass a potential bio-feedstock. Vogel and Moore (1998) determined that the genetic base of tall wheatgrass cultivars is narrow. The lineages of four of the six cultivars released in the US trace to a common accession, PI 98526 ('Alkar' not 'Jose' or 'Largo'). They evaluated 50 accessions and determined many of the accessions had equivalent yields and IVDMD equivalent or higher than the check cultivars. There has been no work in the Northeast reported with these grasses for yield, fertilizer response, insect or disease resistance or persistence.

Presently several universities and USDA-ARS are considering reed canarygrass (*Phalaris arundinaceae* L.) for a cool season grass bio-feedstock. Potential expansion of acres dedicated to reed canarygrass is likely to be controversial due to the species generally being considered invasive as well as prohibited from use in Massachusetts and its listing as a noxious weed in Washington and Connecticut. This study may provide information on the potential of tall wheatgrass to be used in place of reed canarygrass on certain soils.

Materials and methods

Due to the high degree of variability between PMCs, any type of statistical comparison between locations is not possible. More detailed and specific analysis on a site by site basis can be found in individual PMC annual progress reports. Depending on location and local interest the following plant species and cultivars were established in trials: tall wheatgrass cultivars 'Jose', 'Szarvasi-1', 'Alkar', and 'Largo', intermediate wheatgrass, and 'Bellevue' reed canarygrass.

Trials were established at 9 plant material centers in 2007/2008. Participating PMCs were located in Arizona, Idaho, Oregon, Washington, Colorado, Montana, Michigan, Maryland, and New York. The experimental design used was a randomized complete block (RCB) with 4 replicates at AZ, CO, ID, MT, MI, OR and WA PMC's, and 6 replicates at the NY and MD PMCs.

Tall wheatgrass studies have been direct seeded at 15 (Butler and Muir, 2006) and 20 lbs/ac (Lauriault et al., 2002). Their 40 lb/ac seeding rate is considered higher than necessary so an additional seeding rate of 20 lb/ac will be used for studies in Maryland, Michigan, and New York. The recommended NRCS FOTG seeding rate of 8lbs PLS/ac is being used in western region studies.

Treatments at the western PMCs consisted of the 4 tall wheatgrass cultivars with a single seeding rate of 8 PLS lbs per acre. Eastern PMC treatments consisted of the 4 tall wheatgrass cultivars, an intermediate wheatgrass, reed canarygrass, with seeding rates of 20 and 40 PLS per acre. PMCs were asked to obtain row spacing between 6-12 inches depending on available equipment.

PMCs were asked to fertilize, maintain and evaluate plots as follows:

- Optimum level of P and K will be applied based on soil test (Record soil test levels and amount time of fertilizer application).
- Broadcast N at a rate of 100 lb/acre (112 kg/ha) as ammonium nitrate or sulfate at the 3rd leave stage in the spring (record rate, method, timing and form of N fertilization).

- Weeds will be controlled during the duration of study. Control method will be at the discretion of the cooperator (e.g. hand rouging, herbicides, cultivation) (record weeds, rate, date and herbicides applied, and/or other weed control methods).
- Irrigation water will be applied during the establishment year only. The plots will not be irrigated in subsequent years (record amount and time of application).
- Following harvesting of the center rows of plot for yield and biofuel quality analyses, remaining standing biomass will need to be clipped at the same harvest height (leaving a stubble of 2-4 inches) as the plant in the center row and removed from the study area. Border row will also need to be harvested and removed from the study area.
- Harvest treatments will consist of 1 treatment occurring at full maturity and will depend on location.
- Harvest treatments are assigned to the middle of each plot.
  Dry matter yield will be determined by harvesting 80 inches of middle each plot.
- Plot weight (wet weight) for the harvested section of the row will be weighed (record weigh and date of harvest).
- A subsample (~300g representation of the total harvest) will be taken for dry matter determination and biofuel analyses (record wet weight of the sample). FUNDING DEPENDENT
- Subsample will be dried at 55° C for 16-24 hrs. Drying time may vary depending on species and harvest treatment (record dry weight). FUNDING DEPENDENT
- Sample will be ground with a mill to pass through a 1mm screen for dry matter and elemental analysis. FUNDING DEPENDENT
  Analysis for these samples will be performed to assess gross biofuel quality and mineral removal from the field. These analyses include: those for dry matter (crude protein, acid detergent fiber, neutral detergent fiber, TDN, lignin, gross energy, total ash) and a series of mineral analysis by flame ionization (P, K, Ca, Mg, S, Fe, Mn, Zn, Cu, B) (AOAC 200) FUNDING DEPENDENT

PMC were asked to make the following evaluations:

Year 1 Evaluations:
% Stand
Digital photos from established photo points monthly (1 per entry)
Biomass production
Comments (disease, insects, nutrient problems)

Year 2-3 Evaluations:
% Stand
Biomass production
Digital photos from established photo points at harvest (1 per entry)
Comments (disease, insects, nutrient problems)

Results

See appendices 1-10

Discussion:

First year results indicate that 'Largo' and 'Alkar' were the best performers among tall wheatgrass entries in both stand establishment and vigor. Yield (Table 1) among tall wheatgrass entries was less clear with no tall wheatgrass entries having significantly better yields at all locations, however 'Largo' yields overall appear best. Intermediate wheatgrass produced the greatest yields in trials where included (MD,NY, MI). The Hungarian 'Szarvasi-1' "energy grass" performance was generally ranked poorer than the other tall wheatgrass entries although this may be due to seed quality.. New York germination analysis indicated actual germination was well below the level stated on the seed bag tags which suggests that the received seed of 'Szarvasi-1' was of poor quality. Among PMCs with different seeding rates no statistical differences in yield were evident between 20 lbs/acre and 40/lbs/acre seeding rates. In New York trials the yield trended higher at the lower planting rate of 20 lb/acre. Washington trials were installed with 6 and 12 inch row spacing. No significant differences in yield were evident.
As expected the species is not adapted to the hot desert regions and is not a practical source of bio-fuel feedstock as plots in Tucson had substantial stand deterioration during the summer period, although regularly irrigated.

Wet chemistry work (Appendix 9, Tables 2-6) performed by Washington State University indicated that the cultivars 'Largo', 'Alkar', and 'Szarvasi-1' were statistically the same in lignin content, ADF, and NDF. The values were at the lower end of expected values for grasses (Linn and Martin 1999) indicating excellent forage potential, but questionable value as a biofuel-feedstock as compared to switchgrass and other conventional bio-fuel feedstocks such as poplar, oak, etc. Alkai has significantly lower % ash content than Largo and Svarsavi-1, but was not significantly lower than Jose.

Table 1. 2008 Avg yield (tons/ac) of cultivars by PMC

PMC	Alkar Tons/ac	Jose Tons/ac	Largo Tons/ac	Svarasi Tons/ac	Chiefton Tons/ac	Bellevue Tons/ac	Intermediate wheatgrass Tons/ac
Arizona	.64	.61	.79	.58	NA	NA	NA
California	3.6	3.6	3.8	3.8	NA	NA	NA
Colorado	.24	.18	.52	.29	NA	NA	NA
Maryland	1.4	1.6	1.6	1.7	NA	NA	1.9
Michigan	.3	.3	.3	.3	NA	.3	1.0
Montana	No results	No results	No results	No results	NA	NA	NA
New York	4.1	3.7	5.3	4.0	4.1	4.2	5.6
Nevada	No results	No results	No results	No results	NA	NA	NA
Oregon	No results	No results	No results	No results	NA	NA	NA
Washington	No results	No results	No results	No results	NA	NA	NA

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APPENDIX 1

Arizona PMC 2008 data and analysis

Plots were established using a Latin Square statistical design in November of 2007 using a Truax rangeland drill. See figure one for plot plan. Stand evaluation was conducted in March of 2008 (figure 2). Results of the evaluation show the 'Largo' cultivar performing the best. Plots were clipped in June of 2008 to a height of approximately two inches. Clippings were weighed both pre and post drying. See figure 3 for post drying weights.

Stands deteriorated severely during the hot summer months of 2008 despite repeated irrigation. Stands were removed in August 2008. There were no statistical differences (LSD 5%) between yields of cultivars (table 1). No further evaluations will be taken.

Figure 1:

1 = 'JOSE'
2 = 'ALKAR'
3 = 'LARGO'
4 = 'SZARVASI'

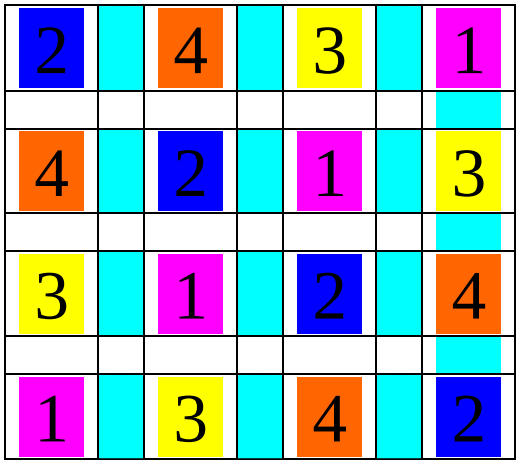

Figure 2:

1-5: 1= worst

3	3	4	2
3	3	2	3
4	1	2	3
2	3	2	3

Table 1: Tall wheatgrass yield at Tucson, Arizona 2008.

Cultivar	Dry Yield (g)	Yield (T/acre)	Avg. cultivar Yield T/acre
'Alkar'	167.41	0.75	.64
'Alkar'	174.72	0.78	
'Alkar'	101.7	0.45	
'Alkar'	130.57	0.58	
'Jose'	154.11	0.69	.61
'Jose'	170.97	0.76	
'Jose'	121.07	0.54	
'Jose'	97.47	0.43	
'Largo'	163.62	0.73	.79
'Largo'	172.95	1.11	
'Largo'	249.27	0.55	
'Largo'	123.23	0.77	
'Szarvasi-1'	176.00	0.78	.58*
'Szarvasi-1'	633.29*	2.82	
'Szarvasi-1'	113.13	0.50	
'Szarvasi-1'	103.24	0.46	

*** Outlier removed in ANOVA.**

Table 2. Tall wheatgrass yield ANOVA 2008.

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Latin Square AOV Table for Yield

Source	DF	SS	MS	F	P
Rep	3	5518.40	1839.47		
Blocks	3	4971.34	1657.11		
Cultivar	3	5038.35	1679.45	1.19	0.4021
Error	5	7051.27	1410.25		
Total	14				

1 missing value, SS are marginal (type III) sums of squares

Grand Mean 146.22 CV 25.68

Tukey's 1 Degree of Freedom Test for Nonadditivity

Source	DF	SS	MS	F	P
Nonadditivity	1	482.72	482.72	0.29	0.6165
Remainder	4	6568.55	1642.14		

	Relative Efficiency
Completely Randomized Design	1.10
Randomized Complete Block, Rep	0.97
Randomized Complete Block, Blocks	1.00

Means of Yield for Cultivar

Cultivar	N	Mean	SE
Alkar	4	143.60	18.777
Jose	4	135.91	18.777
Largo	4	177.27	18.777
Szarv	3	128.10	21.681

APPENDIX 2

California PMC 2008 data and analysis

Plots were planted March 7, 2008 (Figure 1), seedling emergence was noted on March 18. Plots were irrigated on March 19, 2008. Only 2 reps were evaluated in 2008. The cultivar 'Largo' had statistically larger plants as measured in July evaluations (Table 1), but no statistical differences were evident in dry weights resulting from the November 2008 harvest Table 2-3). Szarvasi-1 and 'Largo' had the largest yield among the tall wheatgrass cultivars and 'Jose' the smallest. Subjective evaluations taken throughout 2008 and summarized in Table 4 shows that 'Largo' and 'Alkar' were overall the best performers in the initial establishment year of 2008.

Figure 1. Tall wheatgrass plot layout, Lockeford, CA 2008

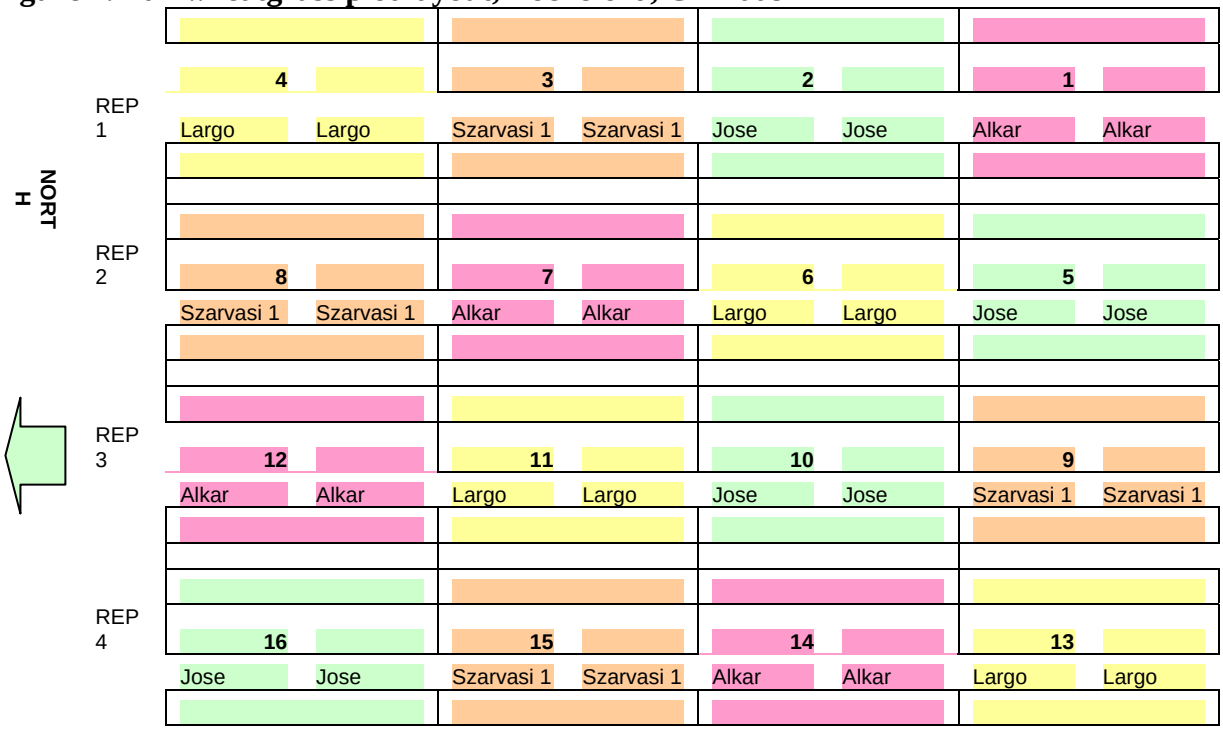

Table 1. Plant size (Height X Diameter (cm)) July 3, 2008 ANOVA

Randomized Complete Block AOV Table for Size

Source	DF	SS	MS	F	P
Rep	1	186508	186508		
Cultivar	3	512917	170972	31.71	0.0090
Error	3	16177	5392		
Total	7				

Note: SS are marginal (type III) sums of squares

Grand Mean 1101.7 CV 6.67

Tukey's 1 Degree of Freedom Test for Nonadditivity

Source	DF	SS	MS	F	P
Nonadditivity	1	967.4	967.41	0.13	0.7555
Remainder	2	15209.7	7604.84		

Relative Efficiency, RCB 5.41

Means of Size for Cultivar

Cultivar	Mean
'Alkar'	1015.8
'Jose'	909.5
'Largo'	1535.3
'Szarvasi-1'	946.3

Observations per Mean 2
Standard Error of a Mean 51.925
Std Error (Diff of 2 Means) 73.433

LSD All-Pairwise Comparisons Test of Size for Cultivar

Cultivar	Mean	Homogeneous Groups
'Largo'	1535.3	A
'Alkar'	1015.8	B
'Szarvasi-1'	946.3	B
'Jose'	909.5	B

Alpha 0.05 Standard Error for Comparison 73.433
Critical T Value 3.182 Critical Value for Comparison 233.70
Error term used: Rep*Cultivar, 3 DF
There are 2 groups (A and B) in which the means
are not significantly different from one another.

Table2. Dry Wt. Yield November 2008

Rep	Cultivar	Estimated Biomass per ACRE in Tons (2000#)
1	Alkar	**2.57**
1	Jose	**2.33**
1	Szarvasi	**2.38**
1	Largo	**2.70**
2	Jose	**1.59**
2	Largo	**3.58**
2	Alkar	**2.08**
2	Szarvasi	**3.50**

Table3. Dry Wt. November 2008 ANOVA*

```
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Randomized Complete Block AOV Table for Yield

Source     DF          SS          MS      F        P
Rep         1   4.930E-32   4.930E-32
Cultivar    3     0.05385     0.01795   1.33   0.4102
Error       3     0.04050     0.01350
Total       7

Note: SS are marginal (type III) sums of squares

Grand Mean 3.6975    CV 3.14

Tukey's 1 Degree of Freedom Test for Nonadditivity
Source         DF        SS        MS       F        P
Nonadditivity   1   0.00000   0.00000    0.00   1.0000
Remainder       2   0.04050   0.02025

Relative Efficiency, RCB 0.80

Means of Yield for Cultivar

Cultivar    Mean
Alkar     3.6550
Jose      3.5850
Largo     3.7900
Szarv     3.7600
Observations per Mean           2
Standard Error of a Mean    0.0822
Std Error (Diff of 2 Means) 0.1162
```

*** data transformed(log ^{x})due to non-additivity.**

Table 4. Average performance in 2008 by plot.

PLOT	Cultivar	Stand Count 12"	Uniformity YTD	Vigor YTD	Insect YTD	Disease YTD	Cold YTD	Heat YTD
1	'Alkar'	8.80	4.60	4.40	**6.80**	7.80	9.00	6.40
2	'Jose'	3.40	3.20	3.40	6.40	8.20	9.00	6.20
3	'Szarvasi-1'	7.00	3.50	3.90	**6.70**	**8.50**	9.00	6.20
4	'Largo'	**13.00**	**5.50**	**5.90**	5.70	**8.40**	9.00	6.00
5	'Jose'	3.20	3.20	3.40	6.00	7.60	9.00	6.40
6	'Largo'	5.40	4.60	5.20	6.40	**8.60**	9.00	6.60
7	'Alkar'	9.80	**5.40**	5.00	6.50	8.10	9.00	6.60
8	'Szarvasi-1'	5.20	4.00	4.40	6.10	**8.30**	9.00	6.40
9	'Szarvasi-1'	2.40	2.55	3.15	6.30	**8.10**	9.00	6.60
10	'Jose'	1.40	3.15	3.55	6.50	**8.20**	9.00	6.60
11	'Largo'	7.20	4.60	**5.60**	6.50	8.00	9.00	6.60
12	'Alkar'	6.40	4.80	5.00	**6.90**	7.60	9.00	6.60
13	'Largo'	**15.20**	**6.40**	**6.10**	**7.50**	**8.10**	9.00	6.40
14	'Alkar'	**12.00**	**5.90**	5.40	**6.90**	7.70	9.00	6.60
15	'Szarvasi-1'	5.60	4.60	4.30	**7.10**	**8.10**	9.00	6.60
16	'Jose'	7.40	3.80	4.40	6.40	7.80	9.00	6.60
East guard		5.00	**5.44**	5.44	**7.44**	**8.11**	9.00	**6.80**
West Guard		6.75	5.00	4.89	6.44	7.78	9.00	**6.80**

SCALE 1= poor, severe, dead 9= BEST, NONE, No visible damage,

Stand count = plants in 12" averaged for 5 dates

‘Largo’

November 18 2008, Lockeford CA

July 11, 2008, Lockeford, CA

APPENDIX 3

Upper Colorado Environmental Plant Center (UCEPC) 2008 data and analysis

Plots were established November 2007 and harvested September 17, 2008. There were no statistical differences between cultivars yield or height. 'Largo' was the top producer for dry biomass/acre in this initial establishment year and. 'Alkar' had the best stand.

Table 1. Summary of tall wheatgrass performance at UCEPC 2008.

Entry	Dry-Biomass tons/acre[1]	Percent Dry Weight at Harvest[2]	Plant Height[3] (cm)	Percent Plant Stand[4]
'Largo'	0.52	49.4	90.7	73.7
'Szarvasi-1'	0.29	50	86.4	51.2
'Alkar'	0.24	39.5	79.1	80
'Jose'	0.18	48.3	80.8	53.7
Mean	0.31	46.8	84.2	64.7
LSD(0.05)	NS[5]	NS	NS	10.7

1. Air-dry above ground biomass (cut 4 inches above soil surface)
2. Percent dry weight calculated by the following formula: Dry weight/ wet weight X 100
3. Plant height measure to top of spike
4. Visual estimate per plot basis: 4 complete rows per plot = 100 percent
5. Least Significant Difference at P<0.05. NS = Not Significant

'Largo' tall wheatgrass at Meeker, Colorado PMC 2008

APPENDIX 4

Idaho PMC 2008 data and analysis

Plots were established June 2, 2008 in a randomized complete block design with 4 replications. The trial was irrigated to approximate the equivalent of 8 inches of precipitation from the planting date to the evaluation on July 23, 2008. Percent stand data was collected (Tables 1, 2 and 3). Percent stand for 'Alkar' was 78.5 percent and was significantly better than the other accessions evaluated.

The trial will be evaluated for biomass production in 2009. For more information contact Loren St.John, PMC Team Leader at Loren.St.John@ID.usda.gov

Table 1. Tall wheatgrass stand , June 23 2008

Accession	Rep	Plt stand/plot*	Percent stand
'Szarvasi-1'	1	7	35
'Alkar'	1	14.5	72.5
'Largo'	1	16	80
'Jose'	1	10	50
'Jose'	2	11.5	57.5
'Szarvasi-1'	2	9.5	47.5
'Alkar'	2	14	70
'Largo'	2	16	80
'Jose'	3	13	65
'Alkar'	3	17	85
'Largo'	3	9.5	47.5
'Szarvasi-1'	3	10	50
'Alkar'	4	17.5	87.5
'Jose'	4	13	65
'Szarvasi-1'	4	12.5	62.5
'Largo'	4	18	90

* mean of middle 2 rows

Table 2. Percent stand July, 2008.

Randomized Complete Block AOV Table for Percent_S

Source	DF	SS	MS	F	P
Rep	3	676.56	225.521		
Cultivar	3	2289.06	763.021	6.13	0.0148
Error	9	1120.31	124.479		
Total	15				

Note: SS are marginal (type III) sums of squares

Grand Mean 65.313 CV 17.08

Tukey's 1 Degree of Freedom Test for Nonadditivity

Source	DF	SS	MS	F	P
Nonadditivity	1	5.34	5.344	0.04	0.8496
Remainder	8	1114.97	139.371		

Relative Efficiency, RCB 1.12

Means of Percent_S for Cultivar

Cultivar	**Mean**
‘Alkar’	78.750
‘Jose’	59.375
‘Largo’	74.375
‘Szarvasi-1’	48.750

Observations per Mean 4
Standard Error of a Mean 5.5785
Std Error (Diff of 2 Means) 7.8892

LSD All-Pairwise Comparisons Test of Percent_S for Cultivar

Cultivar	**Mean**	**Homogeneous Groups**
‘Alkar’	78.750	A
‘Largo’	74.375	AB
‘Jose’	59.375	BC
‘Szarvasi-1’	48.750	C

Alpha 0.05 Standard Error for Comparison 7.8892
Critical T Value 2.262 Critical Value for Comparison 17.847
Error term used: Rep*Cultivar, 9 DF
There are 3 groups (A, B, etc.) in which the means
are not significantly different from one another.

Plot overview at Aberdeen, Idaho PMC 2008

‘Alkar’ tall wheatgrass , Aberdeen, Idaho 2008

‘Jose’ tall wheatgrass, Aberdeen, Idaho 2008

‘Largo’ tall wheatgrass, Aberdeen, Idaho 2008

‘Szarvasi-1’ tall wheatgrass, Aberdeen, Idaho

APPENDIX 5

Maryland PMC 2008 data and analysis

Tall wheatgrass and intermediate wheatgrass are well adapted to the Northeast, and other moist and cool environments, and produce large quantities of biomass with potential for use as a biofuel. In cooler growing areas, wheatgrass may require fewer inputs of herbicides to control weeds than switchgrass, another potential biofuel, which is less adapted and less competitive with cool-season weeds. In addition, wheatgrass establishes quickly in 1 year, whereas switchgrass may take 2 or 3 years to reach full production.

This trial is being conducted by NRCS at the National Plant Materials Center (NPMC) in Beltsville, Maryland. Similar wheatgrass biofuel variety trials are being conducted at other plant materials centers (MI, NY, CA, OR, AZ, MT, WA, CO, ID, and NV) as part of an inter-center strain trial.

The objective of the study at the NPMC is to determine the yield differences of tall wheatgrass cultivars and an intermediate wheatgrass when grown in Maryland in a simulated biofuel production system. Yield information will help farmers evaluate varieties of wheatgrass for the production of biofuels and optimize production in a sustainable manner that will conserve natural resources and benefit the farmer's bottom line.

EXPERIMENTAL DESIGN AND CONDUCT

The trial includes 4 varieties of tall wheatgrass and 1 variety of intermediate wheatgrass. The trial was conducted on Galestown-Evesboro loamy sands, 0-8% slope, somewhat excessively drained (available water holding capacity in a 60-inch soil profile is about 3.7 inches). Varieties were seeded in six-row plots with a 5-inch row spacing using a cone-seeder. All varieties were seeded September 25, 2007. Two seeding rates for 'Szarvasi-1' tall wheatgrass at 20 and 40 pounds pure live seed (PLS) were used. The remainder of the entries were seeded at 20 lbs PLS per acre. Varieties and seeding rates are listed in Table 1. The trial was planted in a randomized complete block design with four replications. Plot size was 3 ft. × 20 ft. with yield measurements taken from the entire plot area. Soil test (10/4/07) values were pH 5.6, P = 142 ppm (very high), and K = 65 ppm (low). Pelletized dolomitic lime was applied at 1 ton/acre in early May 2008. Nitrogen was applied at a rate of 100 pounds per acre at the beginning each growing season. Irrigation was only applied during establishment (2007) and was not applied in 2008.

The plots were not harvested until 2008 to allow grasses to fully establish. Cuttings were made using a Carter flail-type harvester and cut to a height of 8 inches. Plots were harvested once on July 2, 2008. Dry matter yields for this harvest are reported in Table 2. Harvested material was weighed green in the field and samples were collected for dry matter (DM) determinations from 2 of the 4 replications.

Table 1. Cultivars Used and Seeding Rates.

Scientific Name	Common Name	Cultivar Name	Seeding Rate (PLS#/acre)
Thinopyrum ponticum	Tall Wheatgrass	'Alkar'	20
Thinopyrum ponticum	Tall Wheatgrass	'Largo'	20
Thinopyrum ponticum	Tall Wheatgrass	'Jose'	20
Thinopyrum ponticum	Tall Wheatgrass	'Szarvasi 1'	20
Thinopyrum ponticum	Tall Wheatgrass	'Szarvasi 1'	40
Thinopyrum intermedium	Intermediate Wheatgrass	9051920	20

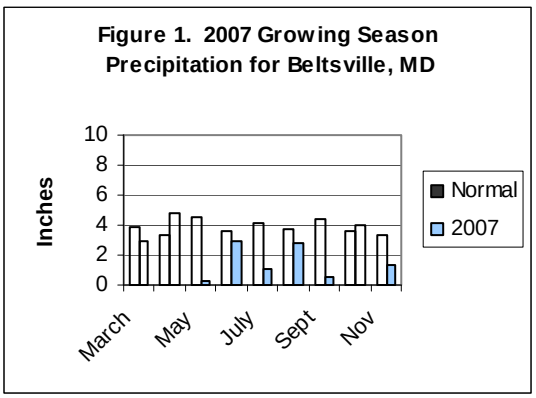
INTERPRETING DATA

Analysis of variance was conducted using the Randomized Complete Block Model from Statistix 8 (v 8.2, 2007, Analytical Software, Tallahassee, FL). Fisher's Least Significant Difference Test (LSD) was used to determine the differences between variety means for each year. Significance was determined for all analyses at the 0.05 probability level.

The LSD value represents the threshold of forage yield above which varieties must differ in order for the yields to be significantly different, or in other words, not happening by chance alone. The value for coefficient of variation (CV) is a measure of the relative variation. In forage trials, the CV for yield is typically between 5 and 15 percent. Uncontrollable or immeasurable variations in soil type, soil fertility, soil moisture and environmental factors contribute to increased CV values.

PRECIPITATION

The precipitation amounts by monthly total for the trial period growing seasons are reported in Figures 1 and 2. In the 2007 growing season, there was overall below average precipitation and extremely low precipitation in September and early October around the time of seeding. Precipitation in 2008 was above average for April, May and June, but below average in March, July, August, and September.



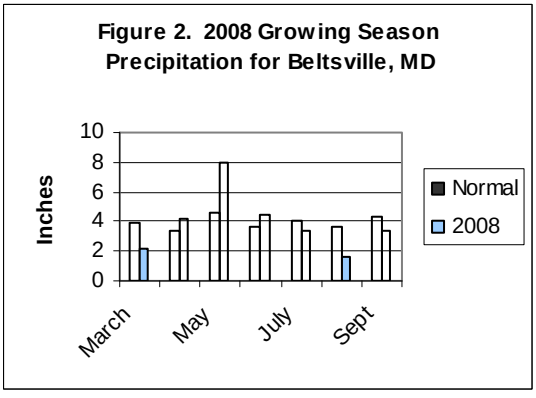



Figure 3. Szarvasi (20 lbs/acre) Rep 1

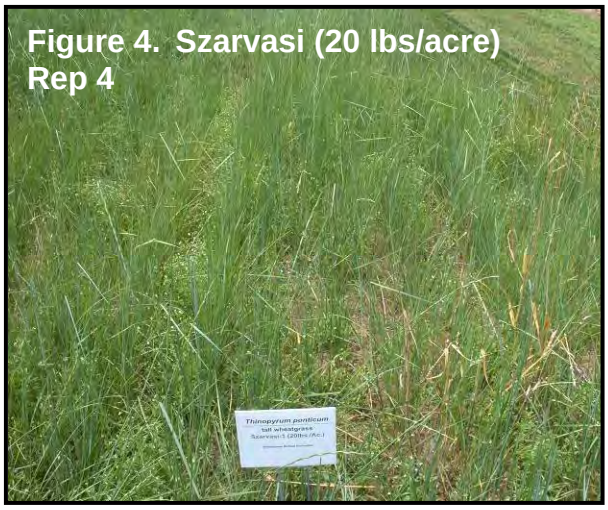


Figure 4. Szarvasi (20 lbs/acre) Rep 4

YIELD

Germination and establishment for all treatments were excellent. All plots achieved and maintained 100% stands with very few weeds. Despite uniform establishment, there was a large amount of variation in growth in 2008. This variation was clearly due to some variation in the field as shown in Figures 3 and 4. The source of this variation was not obvious, but could have been caused by some variation in the pH of the soil. The pH may have varied slightly above and below a pH threshold where the growth of the wheatgrass is greatly limited below this level. Wheatgrass is known to prefer alkaline soil. Prior to planting, the field had a pH of 5.6. Lime was not applied until early May, 2008. The low pH likely limited growth during establishment in fall 2007 and spring 2008. Growth improved after lime application, but adjustment of pH occurs slowly and may not have adjusted uniformly at the same rate over the entire field.

Summary of yields and stand scores are reported in Table 2. Varieties are ranked according to yield performance for 2008.

Table 2. Yield data for 2008, ranked by total.

Cultivar Name	Dry Matter Yield (lbs/acre) July 2, 2008
'Szarvasi 1' (40 lbs/acre)	3772
9051920	3757
'Largo'	3288
'Jose'	3281
'Szarvasi 1' (20 lbs/acre)	3071
'Alkar'	2891
Mean	3343
LSD[1/] (0.05)	2235
% CV[2/]	42

1/ = least significant difference test at 5% level of probability;
2/ = coefficient of variation

RESULTS AND DISCUSSION

Results for 2008 are not significant due to the very large variation in growth that occurred in the field. The large growth differences were apparently related to the location of plots within the field and not the cultivar or replication. This variation occurred within each of the replications and therefore could not be eliminated from the analysis of the data and has resulted in a very high coefficient of variation. With the addition of another 1 Ton of lime per acre in January 2009, and more time for the original application to have adjusted pH, growth and uniformity of growth is expected to improve in 2009.

CONCLUSIONS

No conclusions can be made at this time. The yield results that this study was designed to test are not significant due to very large variations within the study area. The cause of the variation is unknown, but was likely due to differences in soil pH throughout the field, but this was not verified in this study.

APPENDIX 6

Michigan PMC 2008 data and analysis

The intermediate wheatgrass had the highest yield and produced 3 times the biomass of the highest yielding tall wheatgrass. There were few significant differences between yields of the tall wheatgrass entries. 'Alkar' had significantly better stand than 'Jose' or 'Szarvasi-1' among tall wheatgrass entries. The reed canarygrass had the largest stand as measured by tillers/acre. See Table 1.

Table 1. Stand count, plant height, and yield of wheatgrasses for potential use as biofeedstock for biofuel. Rose Lake PMC. 2008.

	Stand count (tillers/acre)[1,2]	Plant height (in)[1,2]	Aboveground harvested biomass (dry matter lbs/a)[2,3]
'Alkar' Tall Wheatgrass @ 20 lbs/a	5.7E+06 B	10.3 BC	662 BC
'Alkar' Tall Wheatgrass @ 40 lbs/a	6.2E+06 B	10.5 BC	604 BCD
'Largo' Tall Wheatgrass @ 20 lbs/a	4.9E+06 BCD	10.5 BC	603 BCD
'Largo' Tall Wheatgrass @ 40 lbs/a	5.5E+06 BC	9.5 C	759 B
'Jose' Tall Wheatgrass @ 20 lbs/a	3.3E+06 E	10.3 BC	528 CD
'Jose' Tall Wheatgrass @ 40 lbs/a	4.0E+06 CDE	10.0 BC	647 BCD
'Szarvasi-1' Tall Wheatgrass @ 20 lbs/a	3.4E+06 E	10.8ABC	456 D
'Szarvasi-1' Tall Wheatgrass @ 40 lbs/a	3.6E+06 DE	11.3AB	576 BCD
'Bellevue' Reed Canarygrass @ 20 lbs/a	8.0E+06A	6.3 D	556 CD
Intermediate Wheatgrass @ 20 lbs/a	3.5E+06 DE	12.0A	1911A

[1]19 May 2008 stand count and height measurement. 1.0E+06 = 1 million. [2]Means followed by same letter do not differ significantly at $LSD_{(0.05)}$ within same column. [3]29 July 2008 biomass harvest.
This multi-year, multi-location study was designed to assess the potential of wheatgrass for use as biofeedstock for biofuel. No conclusions about potential use may appropriately be drawn from these single-harvest, single-year, single-location data.

Biofeedstock Study establishment with plot drill. Rose Lake PMC. 12 Sept 2007.

'Szarvasi-1' Tall Wheatgrass (20 lb/a seeding). Rose Lake PMC. 4 Oct 2007.

APPENDIX 7

Montana PMC 2008 data and analysis

The tall wheatgrass bio-mass study was planted at the Bridger Plant Materials Center, Bridger, MT, on March 13, 2008. A Kincaid cone planter, set up for four rows spaced 12" apart, was used for establishment. The seed was placed ¼" deep into a firm, clod-free seedbed. Each plot is four feet by twenty feet in area and the four species of tall wheatgrass are each replicated four times. They are 'Alkar', 'Jose', 'Largo' and ''Szarvasi-1'' (from Hungary). 'Trailhead' basin wildrye was planted around the study borders as an additional species for observational bio-mass consideration. The plot area was irrigated twice during the initial growing season at Bridger and good emergence and stands were noted for all the plots in the study. Weeds were controlled by hand-hoeing in May and July during the first growing season. Fall fertilization took place at 50 lbs/acre actual N in the middle of October. An additional 50 lbs actual N and 50 lbs actual P will be applied in early April of 2009.

Figure 1. Tall wheatgrass plot layout at Bridger, Montana PMC 2008

↑ N

Rep 1	Rep 2	Rep 3	Rep 4
Trailhead BWR 30	Trailhead BWR 35	Trailhead BWR 40	Trailhead BWR 25
'Alkar' 85	'Largo' 90	'Jose' 85	'Alkar' 65
'Jose' 90	'Jose' 80	'Szarvasi1' 85	'Szarvasi1' 80
'Largo' 85	'Szarvas1' 85	'Alkar' 85	'Largo' 70
'Szarvasi1' 95	'Alkar' 90	'Largo' 85	'Jose' 75
Trailhead BWR	Trailhead BWR	Trailhead BWR	Trailhead BWR

Table 1. Estimated percent stand May 5, 2008

Variety	Rep	% Stand	Variety	Rep	% Stand
'Alkar'	1	85	'Jose'	1	90
	2	90		2	80
	3	85		3	85
	4	65		4	75
	average	81.25		average	82.5
'Largo'	1	85	'Szarvasi1'	1	95
	2	90		2	85
	3	85		3	85
	4	70		4	80
	average	82.5		average	86.25
Trailhead	1	30			
	2	35			
	3	40			
	4	25			
	average	32.5			

Plot overview at Bridger, Montana PMC 2008

APPENDIX 8

New York PMC 2008 data and analysis

Introduction: Tall wheat grass is known to be later maturing than most other cool season forage grass species (lauriault et.al. 2002). In a low input system for biomass where forage quality is less important then gross yield (personal communication Kevin Stone Mascoma corp.) a species that accumulates most of its biomass in a single cutting will require less time and energy to harvest biomass.

Material and Methods: A cutting study was conducted at Big Flats Plant Material Center on a Unadilla silt loam soil (soil test needs to be processed). The field was conventionally tilled and cultipacked before and after seeding on 9/4/07 using a Truax Drill. The Tall wheatgrass cultivars 'Alkar' from Pullman WA PMC a selection out of PI-98526 from the former USSR and 'Szarvasi-1' from a commercial source in Hungary was used. The cultivars were seeded at the 20 and 40 lb/ac rate with no fertilizer applied at planting. The field was fertilized with 75 lb/ac of N in the form of calcium ammonium nitrate on 4/29/08. The cutting dates for the 1st cut was 7/3/08, 7/10/08, 7/17/08 and 10/10/08. the first three cutting dates were cut a second time on 10/10/08. There were 4 replications per treatment and the cutting area was 2 x 2 ft^2 and the data analyzed by completely randomized design.

Results and Discussion: After only one cutting season it appears that the tall wheatgrass species can effectively be harvested with one cutting. The 'Alkar' averaged 5.0 t/ac for the first three 1st cutting dates for the 20 lb/ac rate. The second cutting was poor regardless of the first cutting date averaging 0.56 t/ac for the above treatments. Although the first cut was reduced to 4 t/ac by 10/10/08 it can be inferred that the first cut could be delayed past the season for ground nesting birds of Aug. 1st. For the 'Alkar' there was a consistent trend for the 20 lb/ac rate to out perform the 40 lb/ac rate for both the one cut as well as when the aftermath was included. The emergence of the 'Szarvas-1' was poor compared to the 'Alkar' a greenhouse germination test revealed a germination rate of 50% compared to 94% for the 'Alkar', the seed tag for the 'Szarvas-1' indicated an 81% germination rate. It is warranted to observe these plantings over time and to include an August 1st cutting date. It may be useful to include the "'Szarvasi-1'' in future trials with a better seed lot.

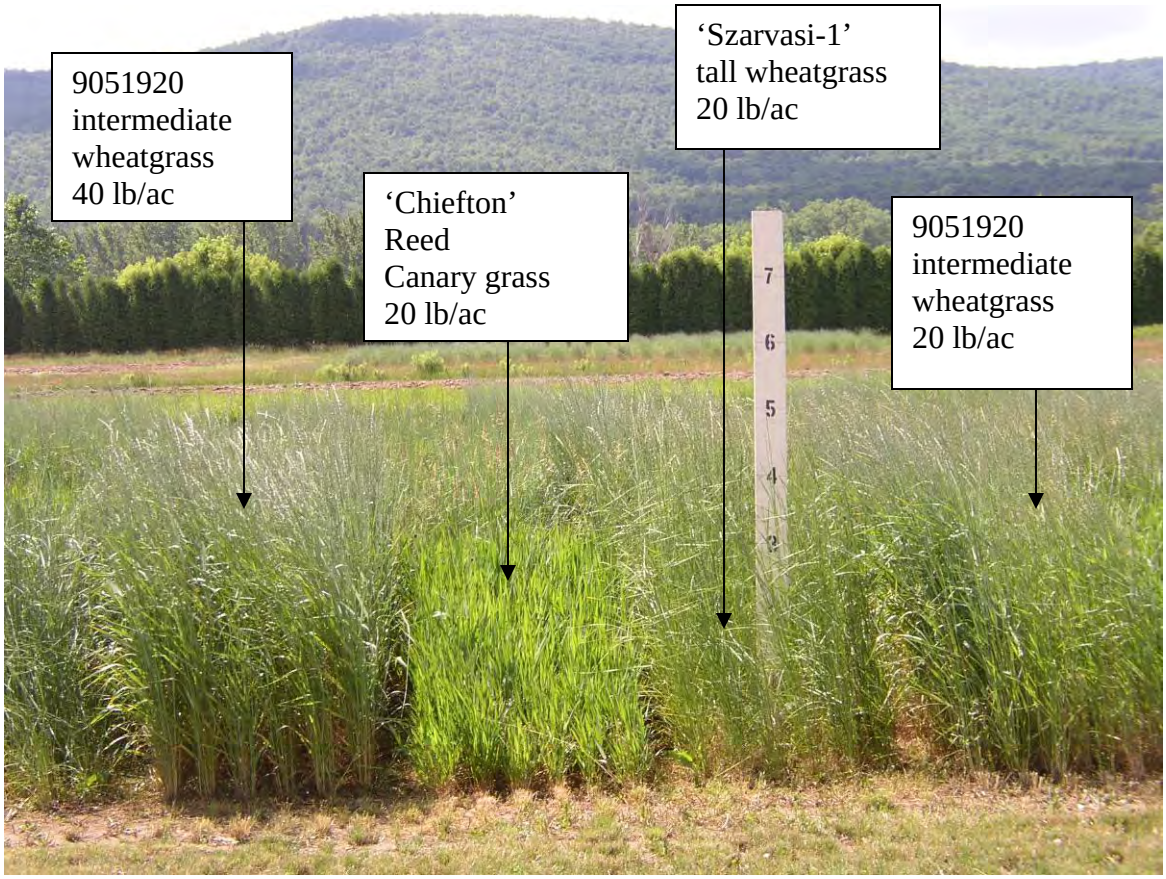
Cultivar	seeds/gram	Seeding Rate lb/A	Plot Size A 3.5 x 15	Seed per plot g	Quick Germ-Seed Tag	g seed per package	No seeds per plot
'Alkar' tall wheatgrass	165	40	0.001205	21.9	0.95	23	3801
'Jose' tall wheatgrass	165	40	0.001205	21.9	0.95	23	3801
'Largo' tall	165	40	0.001205	21.9	0.95	23	3801

wheatgrass							
'Szarvasi-1' tall wheatgrass	165	40	0.001205	21.9	0.81	27	4458
Common intermediate							
Intermed. Wheatgrass	165	40	0.001205	21.9	0.95	23	3801
Common intermediate.							
Wheatgrass	165	20	0.001205	10.9	0.95	12	1900
'Alkar' tall wheatgrass	165	20	0.001205	10.9	0.95	12	1900
'Jose' tall wheatgrass	165	20	0.001205	10.9	0.95	12	1900
'Largo' tall wheatgrass	165	20	0.001205	10.9	0.95	12	1900
'Szarvasi-1' tall wheatgrass	165	20	0.001205	10.9	0.81	14	2230
Bellevue reed canarygrass	1185	20	0.001205	10.9	0.84	13	15438
'Chiefton' reed canarygrass	1185	20	0.001205	10.9	0.4	26	30876

Tall wheatgrass cultivar comparison of seeding rates and cutting dates[1]

			Avg. tons/ac				Avg. Mg/ ha		
Species	**Date**	**Seeding rate**	**1st cut**		**2nd cut[2]**	**Total**	**1st cut**	**2nd cut[2]**	**Total**
'Alkar'	**7/3/2008**	**20 lbs/ac**	4.70	abc	0.54	5.24	10.52	1.22	11.74
Tall Wheatgrass		**40 lbs/ ac**	3.72	bcd	0.75	4.47	8.34	1.67	10.01
	7/10/2008	**20 lbs/ac**	4.95	ab	0.52	5.46	11.08	1.16	12.24
		40 lbs/ ac	4.18	abcd	0.59	4.77	9.36	1.33	10.69
	7/17/2008	**20 lbs/ac**	5.24	a	0.62	5.86	11.74	1.38	13.12
		40 lbs/ ac	4.07	abcd	0.80	4.88	9.13	1.79	10.92
	10/10/2008	**20 lbs/ac**	4.00	abcd			8.96		
		40 lbs/ ac	4.22	abcd			9.46		
'Szarvasi-1'	**7/3/2008**	**20 lbs/ac**	3.81	abcd	0.52	4.33	8.59	1.16	9.75
Tall Wheatgrass		**40 lbs/ ac**	4.58	abcd	0.75	5.33	10.26	1.67	11.93
	7/10/2008	**20 lbs/ac**	3.26	d	0.49	3.74	7.30	1.09	8.39
		40 lbs/ ac	4.37	abcd	0.58	4.95	9.79	1.30	11.09
	7/17/2008	**20 lbs/ac**	4.66	abcd	0.47	5.13	10.44	1.05	11.49
		40 lbs/ ac	4.11	abcd	0.73	4.84	9.21	1.63	10.84
	10/10/2008	**20 lbs/ac**	3.50	d			7.84		
		40 lbs/ ac	3.73	bcd			8.35		

[1]Tall wheatgrass was planted on 9/4/07 75 lb/ac applied as calcium ammonium nitrate on 4/24/08
[2]All 2nd cuttings were done on October 10, 2008



Tall Wheatgrass 2008 Total Dry Matter Yield
Statistix 8.1 1/6/2009, 10:54:16 AM

Randomized Complete Block AOV Table for t

Source	DF	SS	MS	F	P
Rep	2	0.2221	0.11106		
Entry	11	18.5044	1.68222	3.86	0.0034
Error	22	9.5945	0.43612		
Total	35	28.3211			

Grand Mean 4.5757 CV 14.43

Tukey's 1 Degree of Freedom Test for Nonadditivity

Source	DF	SS	MS	F	P
Nonadditivity	1	0.63146	0.63146	1.48	0.2374
Remainder	21	8.96308	0.42681		

Relative Efficiency, RCB 0.96

Means of t for Entry

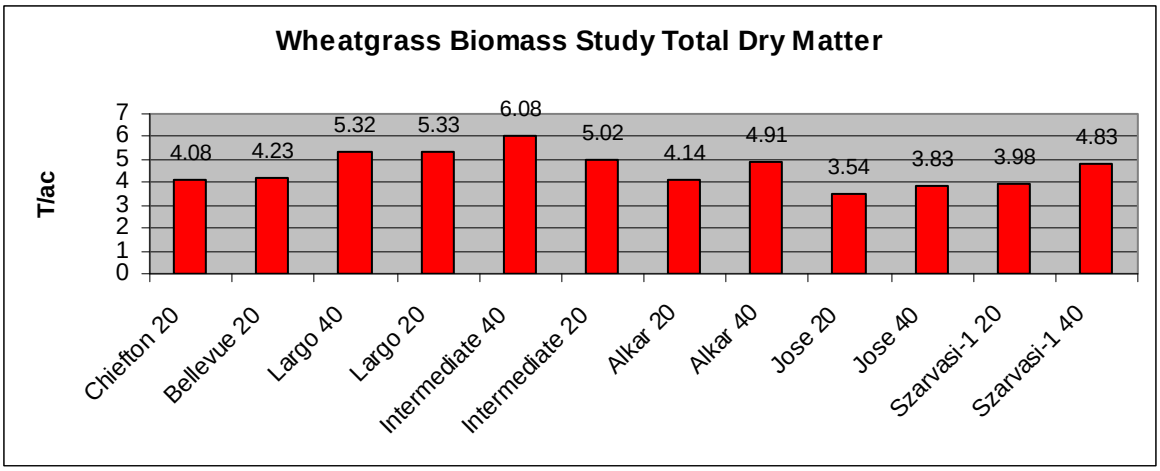
Entry	Mean	Entry	Mean
1	4.5397	'Alkar' 40	7 3.5442 'Jose' 20
2	3.8308	'Jose' 40	8 5.3266 'Largo' 20
3	5.3172	'Largo' 40	9 3.9792 Hung 20
4	4.8299	Hung 40	10 5.0154 Interm 20
5	6.0793	Interm 40	11 4.2345 Bellevue RCanar 20
6	4.1329	'Alkar' 20	12 4.0786 'Chiefton' RCanar 20

Observations per Mean 3
Standard Error of a Mean 0.3813
Std Error (Diff of 2 Means) 0.5392

LSD All-Pairwise Comparisons Test of t for Entry

Entry	Mean	Homogeneous Groups
5	6.0793	A
8	5.3266	AB
3	5.3172	AB
10	5.0154	ABC
4	4.8299	BCD
1	4.5397	BCDE
11	4.2345	BCDE
6	4.1329	CDE
12	4.0786	CDE
9	3.9792	CDE
2	3.8308	DE
7	3.5442	E

Alpha 0.05 Standard Error for Comparison 0.5392
Critical T Value 2.074 **Critical Value for Comparison 1.1182**
Error term used: Rep*Entry, 22 DF
There are 5 groups (A, B, etc.) in which the means are not significantly different from one another.


Wheatgrass Biomass Study Total Dry Matter
T/ac
0
1
2
3
4
5
6
7
4.08
4.23
5.32
5.33
6.08
5.02
4.14
4.91
3.54
3.83
3.98
4.83
Chiefton 20
Bellevue 20
Largo 40
Largo 20
Intermediate 40
Intermediate 20
Alkar 20
Alkar 40
Jose 20
Jose 40
Szarvasi-1 20
Szarvasi-1 40

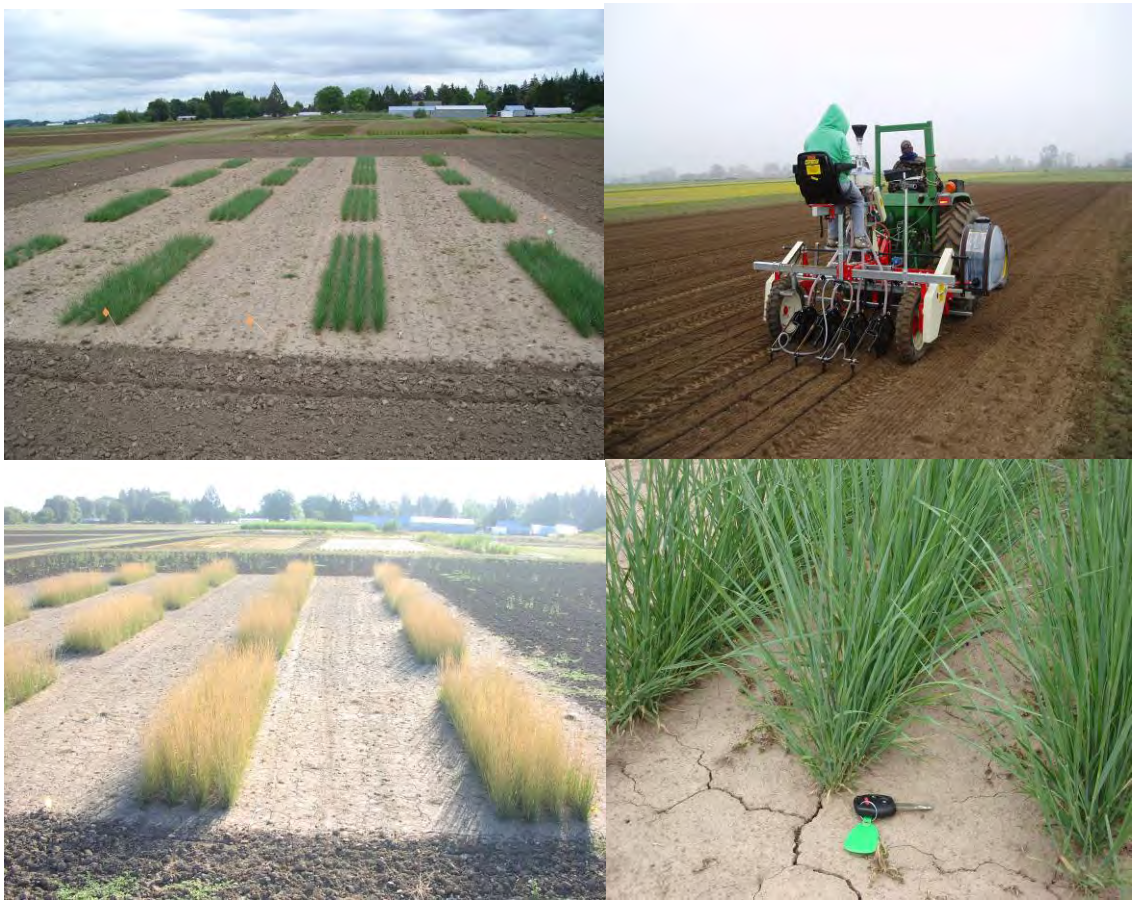
$LSD_{.05} = 1.12$

APPENDIX 9

Oregon PMC 2008 data and analysis

Plots were established November 6, 2007. All plots were slow to emerge due to weather conditions during the winter. Once plots emerged, plant growth was rapid. No supplemental irrigation was applied during the growing season.
Plots were visually evaluated August 14, 2008. No harvest measurements were taken in 2008.

'Jose'- Vigorous stand (95%); uniform maturity; good seed set; no insect or disease damage observed.
'Szarvasi-1'- Vigorous stand (90-95%); uniform maturity; good seed set; no insect or disease damage observed.
'Alkar'- Vigorous stand (90-95%); uniform maturity; good seed set; no insect or disease damage observed.
'Largo'- Vigorous stand (95%); uniform maturity; good seed set; no insect or disease damage observed.



Plot Overview at Corvallis, Oregon PMC 2008

APPENDIX 10

Washington PMC 2008 data and analysis

Plots were established September 6, 2007 at Prosser, Washington. Initially, 'Alkar' and 'Largo' had best stands regardless of row spacing. Plots were sampled (9 sq. ft.) September 7, 2008 and wet weights determined. No statistical differences were found in (LSD .05) yield (wet weight) among cultivars or row spacing. Chemical analysis indicated a significant difference between cultivars with 'Alkar' and 'Jose' having the lowest lignin content (Table 3) and acid insoluble ash (AIA) (Table 4), NDF (Table 5), and ADF (Table 6). The stated values indicate and excellent forage, but mediocre bio-fuel feedstock.

Figure 1. Installed field layout

301 'Largo' – 6"	302 'Jose' – 6"	303 SZAR-12"	304 'Alkar'- 6"	305 SZAR- 6"	306 'Jose' – 12"	307 'Largo'- 12"	308 'Alkar'- 12"
201 SZAR-12"	202 'Largo' – 6"	203 'Alkar'- 6"	204 'Jose' – 12"	205 'Largo'- 12"	206 'Alkar'- 12"	207 SZAR- 6"	208 'Jose'-6"
101 'Jose' – 12"	102 'Alkar'- 6"	103 'Largo'- 12"	104 SZAR- 6"	105 'Jose'-6"	106 'Largo' – 6"	107 'Alkar'- 12"	108 SZAR-12"

Table 1. Stand rating September 6, 2007 and February 22, 2008

Cultivar	Row spacing (inches)	Stand 9/6/2007*	Stand 2/22/2008*
103 'Largo'	12	10	10
202 'Largo'	6	10	10
307 'Largo'	12	10	10
106 'Largo'	6	10	9
203 'Alkar'	6	9	9
205 'Largo'	12	8	9
304 'Alkar'	6	9	9
102 'Alkar'	6	10	8
301 'Largo'	6	4	8
107 'Alkar'	12	8	6
206 'Alkar'	12	5	6
308 'Alkar'	12	6	6
303 'Szarvasi-1'	12	3	5
104 'Szarvasi-1'	6	5	4
105 'Jose'	6	4	4
207 'Szarvasi-1'	6	3	4
305 'Szarvasi-1'	6	5	4
101 'Jose'	12	5	3
108 'Szarvasi-1'	12	5	3

201 'Szarvasi-1'	12	5	3
204 'Jose'	12	3	2
208 'Jose'	6	3	2
302 'Jose'	6	3	2
306 'Jose'	12	4	2

*** 10=best**

Table 2. Sequential analysis of NDF, ADF, ADL with no sodium in the NDF Step, May 5, 2008 samples.

Sample #	Name	Rep	%NDF	%ADF	%ADL	%AIA	% LIGNIN/CUTIN
107	'Alkar'	A	57.65	30.94	2.53	0.508011	2.02
107	'Alkar'	B	56.70	29.96	2.54	0.58579	1.95
107	'Alkar'	C	57.19	30.88	2.65	0.609193	2.04
206	'Alkar'	A	56.98	31.06	3.40	0.786937	2.61
206	'Alkar'	B	56.20	30.67		1.065066	
206	'Alkar'	C	56.21	30.91	2.68	0.78769	1.89
308	'Alkar'	A	61.34	32.54	2.81	0.787845	2.02
308	'Alkar'	,B	61.37	33.33	6.18	1.445087	4.74
308	'Alkar'	C	61.02	32.55	7.03	1.000944	6.03
Means	'Alkar'		58.29	31.43	3.73	0.84	2.91
101	'Jose'	A	55.79	29.29	8.95	0.563841	8.39
101	'Jose'	B	54.48	28.83	2.54	0.654083	1.88
101	'Jose'	C	54.67	28.97	2.74	0.641026	2.10
204	'Jose'	A	56.71	31.24	3.05	1.039198	2.01
204	'Jose'	B	56.83	31.28	8.47	0.97212	7.50
204	'Jose'	C	56.28	31.17	3.25	1.226878	2.03
306	'Jose'	A	58.80	32.56	3.61	1.587598	2.02
306	'Jose'	B	59.00	33.72	10.49	2.279485	8.21
306	'Jose'	C	58.52	32.55	12.06	1.590203	10.47
Means	'Jose'		56.79	31.07	6.13	1.17	4.96
103	'Largo'	A	60.19	32.24	2.63	0.481481	2.15
103	'Largo'	B	59.81	31.99	3.25	0.40976	2.84
103	'Largo'	C	59.94	32.27	2.92	0.388601	2.53
205	'Largo'	A	56.35	31.85	3.51	1.417787	2.09
205	'Largo'	B	56.97	32.20	3.81	1.87037	1.94
205	'Largo'	C	56.28	31.79	4.53	1.51913	3.02
307	'Largo'	A	61.82	34.42	4.85	2.057535	- 2.80
307	'Largo'	B	61.64	35.46	5.24	2.642352	2.60
307	'Largo'	C	61.19	35.03	5.75	1.431981	4.32
Means	'Largo'		59.36	33.03	4.06	1.36	2.70
108	Szarvasi I	A	57.28	31.49	2.78	0.856364	1.93
108	Szarvasi I	B	56.68	30.94	5.88	1.013704	4.86
108	Szarvasi I	C	56.01	31.05	4.05	1.149866	2.90
. 201	Szarvasi I	A	58.56	32.94	3.81	1.647323	2.16
201	Szarvasi I	B	58.80	33.39	4.11	1.391536	2.71
201	Szarvasi I	C	57.74	33.06	3.70	1.526858	2.17
303	Szarvasi I	A	61.80	35.70	3.30	1.11711	2.19
303	Szarvasi I	B	58.36	35.58	4.78	1.326211	3.45
303	Szarvasi I	C	60.95	35.45	4.70	1.470588	3.23
Means	Szarvasi I		58.46	33.29	4.12	1.28	2.85
X1.3	Horse Hea	A	76.59	47.03	7.07	1.392241	5.68
X13	Horse Hea	B	76.75	47.75	7.54	1.369863	6.17

X13	Horse Hea	C	75.51	45.89	7.09	1.476755	5.61
Means	Horse Heaven-old		76.28	46.89	7.23	1.41	5.82

Sample #	Name	Rep	%NDF	%ADF	%ADL	%AIA	% LIGNIN/CUTIN
Mean	'Alkar'		58.29	31.43	3.73	0.84	2.91
Mean	'Jose'		56.79	31.07	6.13	1.17	4.96
Mean	Larqo		59.36	33.03	4.06	1.36	2.70
Mean	Szarvasi I		58.46	33.29	4.12	1.28	2.85
Mean	Horse Heaven-old		76.28	46.89	7.23	1.41-	5.82

Percent NDF, ADF and ADL are recorded on an as-received basis.

Lignin/cutin=%ADL-%AIA

NDF=neutral detergent fiber; soluble compounds removed, includes hemicelluloses, cellulose, lignin.
ADF=acid detergent fiber;hemicellulose removed, includes cellulose, lignin, ash.
ADL=acid detergent lignin; cellulose removed, includes lignin and ash.
AIA=acid insoluble ash; includes silica also
*** Tossed out ADL and lignin values for 206-'Alkar', Rep B**
Analysis conducted by Tami Stubbs, Associate in Research, Crop and Soil Sciences Dept., Washington State University, Pullman, Washington

Table 3. Percent Lignin ANOVA and LSD from Table 2.

```
Statistix 8.2                                              2/4/2009, 2:26:04 PM
Randomized Complete Block AOV Table for Lignin

Source   DF        SS        MS      F        P
Rep       8   5.96526   0.74566
Cult      3   1.38865   0.46288   3.89   0.0212
Error    24   2.85273   0.11886
Total    35
Note: SS are marginal (type III) sums of squares

Grand Mean 1.1625    CV 29.66
Tukey's 1 Degree of Freedom Test for Nonadditivity
Source          DF        SS        MS       F        P
Nonadditivity    1   0.39775   0.39775    3.73   0.0660
Remainder       23   2.45498   0.10674

Relative Efficiency, RCB 2.21
Means of Lignin for Cult

Cult          Mean
'Alkar'       0.8418
'Jose'        1.1727
'Largo'       1.3577
'Szarvasi-1'  1.2777
Observations per Mean           9
Standard Error of a Mean    0.1149
Std Error (Diff of 2 Means) 0.1625
LSD All-Pairwise Comparisons Test of Lignin for Cult

Cult      Mean  Homogeneous Groups
Largo   1.3577  A
Szarva  1.2777  A
Jose    1.1727  AB
Alkar   0.8418   B

Alpha             0.05     Standard Error for Comparison  0.1625
Critical T Value  2.064    Critical Value for Comparison  0.3354
Error term used: Rep*Cult, 24 DF
There are 2 groups (A and B) in which the means
are not significantly different from one another.
```

Table 4. Percent insoluble ash (AIA) ANOVA and LSD from Table 2.

```
Statistix 8.2                                    WA AIA , 3/5/2009, 2:03:42 PM

Randomized Complete Block AOV Table for AIA

Source     DF        SS        MS      F        P
Rep         8   5.96526   0.74566
Cultivar    3   1.38865   0.46288   3.89   0.0212
Error      24   2.85273   0.11886
Total      35

Note: SS are marginal (type III) sums of squares

Grand Mean 1.1625    CV 29.66

Tukey's 1 Degree of Freedom Test for Nonadditivity
Source          DF        SS        MS       F        P
Nonadditivity    1   0.39775   0.39775    3.73   0.0660
Remainder       23   2.45498   0.10674

Relative Efficiency, RCB 2.21

Means of AIA for Cultivar

Cultivar    Mean
Alkar     0.8418
Jose      1.1727
Largo     1.3577
Szarv     1.2777
Observations per Mean            9
Standard Error of a Mean    0.1149
Std Error (Diff of 2 Means) 0.1625

LSD All-Pairwise Comparisons Test of AIA for Cultivar

Cultivar    Mean  Homogeneous Groups
Largo     1.3577  A
Szarv     1.2777  A
Jose      1.1727  AB
Alkar     0.8418   B

Alpha              0.05     Standard Error for Comparison  0.1625
Critical T Value  2.064     Critical Value for Comparison  0.3354
Error term used: Rep*Cultivar, 24 DF
There are 2 groups (A and B) in which the means
are not significantly different from one another.
```

Table 5. Percent nuetral detergent fiber (NDF) ANOVA and LSD from Table 2.

```
Statistix 8.2                                          2/4/2009, 2:20:45 PM

Randomized Complete Block AOV Table for NDF

Source   DF        SS        MS      F        P
Rep       8   96.0455   12.0057
Cult      3   30.6608   10.2203   6.73   0.0019
Error    24   36.4277    1.5178
Total    35

Note: SS are marginal (type III) sums of squares

Grand Mean 58.225    CV 2.12

Tukey's 1 Degree of Freedom Test for Nonadditivity
Source          DF        SS        MS       F        P
Nonadditivity    1    0.2660   0.26598    0.17   0.6847
Remainder       23   36.1618   1.57225

Relative Efficiency, RCB 2.58
```

Means of NDF for Cult

Cult	Mean
Alkar	58.296
Jose	56.787
Largo	59.354
Szarva	58.464

Observations per Mean 9
Standard Error of a Mean 0.4107
Std Error (Diff of 2 Means) 0.5808

LSD All-Pairwise Comparisons Test of NDF for Cult

Cult	Mean	Homogeneous Groups
Largo	59.354	A
Szarva	58.464	A
Alkar	58.296	A
Jose	56.787	B

Alpha 0.05 Standard Error for Comparison 0.5808
Critical T Value 2.064 Critical Value for Comparison 1.1987
Error term used: Rep*Cult, 24 DF
There are 2 groups (A and B) in which the means
are not significantly different from one another.

Table 6. Percent acid detergent fiber (ADF) ANOVA and LSD from Table 2.

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Randomized Complete Block AOV Table for ADF

Source	DF	SS	MS	F	P
Rep	8	71.6863	8.9608		
Cult	3	33.7575	11.2525	28.04	0.0000
Error	24	9.6329	0.4014		
Total	35				

Note: SS are marginal (type III) sums of squares

Grand Mean 32.203 CV 1.97

Tukey's 1 Degree of Freedom Test for Nonadditivity

Source	DF	SS	MS	F	P
Nonadditivity	1	0.46747	0.46747	1.17	0.2900
Remainder	23	9.16541	0.39850		

Relative Efficiency, RCB 5.87

Means of ADF for Cult

Cult	Mean
Alkar	31.427
Jose	31.068
Largo	33.028
Szarva	33.289

Observations per Mean 9
Standard Error of a Mean 0.2112
Std Error (Diff of 2 Means) 0.2987

LSD All-Pairwise Comparisons Test of ADF for Cult

Cult	Mean	Homogeneous Groups
Szarva	33.289	A
Largo	33.028	A
Alkar	31.427	B

```
Jose    31.068   B

Alpha              0.05     Standard Error for Comparison  0.2987
Critical T Value  2.064     Critical Value for Comparison  0.6164
Error term used: Rep*Cult, 24 DF
There are 2 groups (A and B) in which the means
are not significantly different from one another.
```

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