

WIND CAVE NATIONAL PARK

2007 Annual Technical Report
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NATURAL RESOURCES CONSERVATION SERVICE PLANT MATERIALS CENTER BISMARCK, NORTH DAKOTA

INTRODUCTION

U.S. Geological Survey (USGS) Northern Prairie Wildlife Research Center and the Natural Resources Conservation Service (NRCS) in North Dakota signed a cooperative agreement in September 2005. The USGS and National Park Service (NPS) are working to preserve the native plant resources and revegetate parklands. The USGS/NPS require that restoration of native plants be accomplished using germplasm from populations as closely related genetically and ecologically as possible to park populations. The Bismarck Plant Materials Center (PMC) has agreed to propagate seed of selected species and provide the seed to Wind Cave National Park (WICA) in the Black Hills of South Dakota for revegetation and further research. Table 1 lists the selected species, the amount of seed requested, and the amount of seed harvested through 2007 at the PMC.

Table 1

Species	Common Name	Target lbs (PLS)	PMC Harvest 2006 & 2007 (Clean amount)	Units
<i>Andropogon gerardii</i>	Big bluestem	5	157	g
<i>Aristida purpurea</i>	Purple three awn	2	(dirty) 4	lb
<i>Bouteloua curtipendula</i> *	Sideoats grama	5	No PMC planting	
<i>Bouteloua gracilis</i>	Blue grama	5	1	lb
<i>Elymus elymoides</i>	Bottlebrush squirreltail	2	12	lb
<i>Koeleria macrantha</i>	Prairie junegrass	2	5	lb
<i>Nassella viridula</i>	Green needlegrass	substitute	2.15	lb
<i>Pascopyrum smithii</i>	Western wheatgrass	5	13	lb
<i>Schizachyrium scoparium</i>	Little bluestem	5	4	lb
<i>Astragalus missouriensis</i> *	Missouri milkvetch	.5	No PMC planting	
<i>Cirsium undulatum</i>	Wavyleaf thistle	.5	473	g
<i>Dalea purpurea</i>	Purple prairieclover	.5	39	g
<i>Oxytropis campestris</i>	Slender crazyweed	substitute	326	g
<i>Oxytropis lambertii</i>	Lambert's crazyweed	substitute	2	g
<i>Sphaeralcea coccinea</i> *	Scarlet globemallow	.5	No PMC planting	

* Little or no seed was collected for these species. Those listed as substitutes have been grown and planted at the PMC along with the other targeted species.

ACCOMPLISHMENTS

2005 - Wildland collections of seed were made by WICA personnel and shipped to the Bismarck PMC.

2006 - Wildland collected seed was cleaned, propagated in the greenhouse and planted to field beds at the Bismarck PMC. Very small amounts of seed of a few species were harvested from PMC fields in the fall.

2007 - Seed was harvested from PMC field plots of most species and cleaned. Production of some species met targeted goals.

TECHNOLOGY DEVELOPMENTS

Seed cleaning and seed harvest methods were devised for many of the species. Additional data will be collected in 2008 regarding plant growth.

MATERIALS AND METHODS

Details of the Accomplishments and Technology Development are found in the remainder of this report.

Seed Collection and Processing

Seed was collected by WICA personnel in the fall of 2005. Seed set was poor for some species due to drought conditions at WICA. Seed was collected from other species to substitute for those producing no viable seed and sent to the PMC. Seed was collected at WICA by clipping seed heads or hand stripping seed from the heads. Seed was cleaned at the PMC using a rub board, a column seed blower (South Dakota type), an office sized fanning mill, a laboratory debarker, and pan screens. Seed fill was poor for many of the species. Exact amounts of material received from WICA were not recorded as much of the weight was from sticks or other vegetative parts. The collections were not given an accession number (PMC ID number), as all material will be allocated back to WICA.

Greenhouse Propagation

Seed was propagated in the greenhouse at the PMC, with seed planting starting January 11, 2006. The seed of most species was planted into Cone-tainers™, which are plastic cones with bottom drainage holes. Each cone has a 1 ½-inch diameter and an 8 ¼-inch depth. Flats were also planted. Plants from the flats were used to transplant into cones where seed did not germinate. Premier Promix BX with biofungicide, a no-soil potting mix was used. The goal was to produce 200-400 seedlings of each species to be planted into a field plot. Seedlings were hardened off in the lath house prior to field planting.

Field Planting

2006 - A field plot was prepared by tilling. A subsoiler was used to make a 10-12 inch deep trench in which the cone-tainerized seedlings were planted by hand. Moisture conditions were good at the time of planting and the field was irrigated after transplanting. Seedlings were planted in paired rows to help improve pollination. The rows were spaced approximately 4-5 feet apart. Four rows contained all of the species. Field row length was approximately 800 feet. Plants were spaced approximately 1 foot apart within the row. Seedlings for most species were planted to the field in early June 2006. Some of the forb and grass seedlings were very slow to grow in the greenhouse, so were planted to the field plot in early August when they had larger root systems.

Field Maintenance

2006 - Weeds were controlled by shallow tilling with a garden tiller and hand weeding. No chemicals were applied. Weeds were removed throughout the growing season and were not a limiting factor for plant growth. Plant residue was left standing at the end of 2006. The

seedlings were irrigated immediately after field planting and a few additional times from June through September to keep the plants alive in the severe drought and hot conditions of 2006. **2007** - Residue from 2006 was cut with hand shears in April 2007. Weeds were controlled by hand tilling and weeding when weeds were small. The plants were not irrigated in 2007, as timely rains fell in the spring and early summer. There was no application of fertilizer, herbicide or insecticide on any of the plots. Purslane, pigweed, lambsquarter, and kochia were the predominant weeds.

Field Harvest

2006 - Few seeds were harvested in 2006. Any seed harvested was gathered by hand. **2007** - Seed was harvested by clipping heads, hand stripping seed from heads, straight combining, and clipping heads and then thrashing through a plot combine. Seed harvest was fair for most species. Only small amounts of seed were produced for *Oxytropis lambertii*, *Dalea purpurea*, and *Andropogon gerardii*. Seed harvested in 2006, 2007, and 2008 will be bulked together for each species and a purity and germination test run for each lot. See Table 1 for list of seed amounts harvested through 2007.

Species Performance

Andropogon gerardii - (big bluestem)

2006 - Approximately ¼ pound of dirty seed was received from WICA. Seed were cleaned using a debearder and fanning mill. Approximately 34.6 grams of clean bulk seed remained. Seed germinated readily in the greenhouse, but plants were of poor vigor. Cool greenhouse conditions and lack of proper nutrients in the soil were contributing factors. Approximately 108 seedlings were planted to the field in August. Seedlings grew to about 4-5 inches tall in the field. **2007** - Plants were vigorous and grew to 5 feet in height. Plants were very diverse in size, shape, and seed maturity. Seed culms were not abundant, but were produced on most plants. Seed heads were clipped on October 17. Many of the heads were green and many did not appear to be filled. Seed was cleaned using a debearder and fanning mill.

Aristida purpurea - (purple three awn)

2006 - Approximately 200 grams of seed with awns were received from WICA. This seed was very difficult to process. Awns could not be removed using a rub board. A scarifier removed a few awns, but not a high percentage. The seed tended to break using the scarifier. The majority of the seed for greenhouse planting had the awns removed by clipping with a scissors. Germination was rapid in the greenhouse (approximately 1 week). Seedlings (326) were planted to the field on June 8, 2006. Plants were healthy and vigorous. Roots appeared to be quite shallow. Several plants produced heads. Seed was harvested by hand stripping. Removal of awns was again a challenge. Seed was run in a scarifier and trash was removed by hand picking. Many of the seeds were not filled. Five grams of seed remained after cleaning. Quality of the cleaned seed was poor.

2007 - Plants were vigorous and produced abundant seed heads. Seed ripening was uneven. Plant leaves were narrow and remained somewhat green until frost. Seed shattered with strong winds, but otherwise remained on the plant. Awns protruding from the seed are very fine and caryopses are fragile. These characteristics make cleaning very difficult. Attempts to debeard and hammermill broke the seed or rolled it into a dense wad. The Bismarck PMC has found no acceptable method of cleaning the seed at this time.

Bouteloua gracilis - (blue grama)

2006 - Blue grama was received from WICA as clipped heads. Approximately 35 grams of bulk seed remained after cleaning with pan screens and rub board. Seed germination was fair to poor in the greenhouse. Seedlings (242) were planted to the field on June 12, 2006. Approximately 90 percent of the plants produced seed heads. Seed was harvested by hand clipping the heads on September 26, 2006. Seed was cleaned using a fanning mill and debearder. Sticks were removed by blowing good seed over and dropping sticks through the screens. Harvesting only the seed head would have reduced the amount of sticks to remove. Seed fill was poor. Clean bulk seed yield was 100 grams.

2007 - Plants in the field were vigorous and quite variable in size, flowering time, and seed head production. Seed was harvested at various dates starting August 10, 2008. Heads were hand stripped or clipped. Seed was cleaned using a small debearder and fanning mill. Seed fill was fair to poor. Hot temperatures during pollination may have been a factor.

Elymus elymoides - (bottlebrush squirreltail)

2006 - Seed heads were received from WICA. The curved awns were removed by hammer-milling. Approximately 37 grams of bulk seed remained after cleaning with a SD seed blower. Seedlings (286) were planted to the field on June 8, 2006. Plants had a bunch type growth and were vigorous in the field. Various plants showed slight signs of leaf rust. Five seed heads were produced in 2006. None of the seed was viable.

2007 - Plant growth was tremendous. Plants produced abundant forage and seed heads. Heads were large and lodged severely. Due to lodging, seed culms were hand clipped on July 16, 2007, and fed through a plot combine. Seed was cleaned using a debearder to remove the long awns and a fanning mill. Twenty-one pounds of combined material cleaned to 12 pounds of bulk seed. The plants showed little regrowth after harvest.

Koeleria macrantha - (prairie junegrass)

2006 - Seed of wildland collections was hand stripped and chaff was separated using pan screens. Approximately 30 grams of seed and chaff remained after stripping. The SD seed blower did not separate seeds due to static. Several seeds per Cone-tainer™ were planted in the greenhouse in mid January. Seed germination was good, and 3-5 seedlings grew in each cone. An attempt to thin the seedlings was not successful. Growth was not inhibited by multiple seedlings in each cone. Seedlings (479) were planted to the PMC field plot on June 12, 2006. No seed heads were formed. Deer browsed the species. Plants were vigorous and grew to 4 inches in height.

2007 - Plant vigor was excellent. Each plant produced multiple seed heads. The average height of a plant, on June 6, 2007, averaged 20 inches. Anthers were just beginning to appear. Seed was harvested by hand clipping heads on July 9, 2007, and thrashing them through a plot combine. The small plot size, lodging of heavy heads, and short stature of some plants would have made direct combining difficult. Seed was cleaned using a hammermill and fanning mill. The embryo is not easily distinguished, making separation of chaff from viable seeds difficult. Plant growth and appearance varied among plants, but not significantly.

Nassella viridula - (green needlegrass)

2006 - The 13 grams of bulk seed received at the PMC had been hand stripped. Awns were removed using a rub board. Seed was also scarified a few seconds to scratch the seedcoat and

reduce dormancy. Seed germination was fair. Seedlings were planted to the field on June 8, 2006. Plants were very vigorous in the field. Leaves grew to a length of 1 foot. No seed heads were produced in 2006.

2007 - Plant growth was good. Seed was hand stripped as it became ripe from June 28 through July 24, 2007. Seed was cleaned using a debearder and fanning mill.

Pascopyrum smithii - (western wheatgrass)

2006 - Approximately 81 grams of clipped heads were received from WICA, producing 50 grams of clean bulk seed. Seed readily germinated and seedlings were healthy and vigorous at the time of field planting. Seedlings (360) were planted to the field on June 8, 2006. Rhizome spread and leaf growth were excellent in the field. No seed heads were produced in 2006.

2007 - Plants had vigorous growth and rhizome spread and produced abundant seed heads. Seed was harvested on July 23, 2007, using a small plot combine. Thirteen pounds of bulk clean seed was cleaned from 28 pounds of combined material using a fanning mill.

Schizachyrium scoparium - (little bluestem)

2006 - Seed received from WICA was hand stripped from the plants. Awns were removed using a debearder. Empty seeds and debris were removed using a fanning mill. Approximately 50 grams of bulk seed remained after cleaning. Germination was fair and growth was good in the greenhouse. Seedlings (255) were planted to the field on June 12, 2006. Growth in the field was excellent. Plants were vigorous and produced seed heads. Seed was hand harvested in October 2006, which is later than normal for little bluestem but typical for first year plantings. Seed fill was poor. A total of 36 grams of clean bulk seed was produced.

2007 - Plants were vigorous and produced abundant forage and seed heads. Seed was hand stripped from the plant using hair combs. Larger plots could be successfully harvested by mechanical seed stripping or combining. Plants showed some variability in size and color, but overall were fairly uniform. Fall color was very showy. Seed was cleaned using a debearder and fanning mill. Approximately 4 pounds of bulk seed remained after cleaning the 7 pounds of harvested material.

Cirsium undulatum - (wavyleaf thistle)

2006 - Seed was received from WICA in whole heads. Seeds were carefully removed from the spiny heads using a tweezers and rub board. The hairy appendages were pulled from the block shaped seed before planting in the greenhouse. Many of the seeds had insect holes. These seeds were removed using a SD seed blower. Approximately 8 grams of bulk seed remained after cleaning. Seed in the greenhouse germinated within two weeks. Seedlings did not flourish in the greenhouse environment. Damping off became a problem. Pot size may have hampered growth, as well. Fifty-two seedlings were planted to the field. Once in the field, the plants thrived and grew into large rosettes reaching diameters of 1-2 feet. Plant spacing greater than 1 foot would have allowed for greater growth. As expected, this rosette forming species did not produce seed heads the first year. Plants were very spiny and vigorous.

2007 - Plant growth was good in the field. Most plants produced seed heads. Seed ripened at various times. The first seed was harvested July 13, 2007, and the last seed was harvested in mid August. Insects, including bees and beetles were abundant on the heads throughout the season. Birds tore the side of the seed heads when seed were ripe. Heads were clipped by hand when the birds appeared and when the base started to brown and the tops fuzzed out white. Plant stems

became hollow and died back by late August. The dead plant material was removed. New plant rosettes were found growing beneath some of the old plants. Seed was cleaned by hammermilling the heads and running through a fanning mill. Beetles and their larvae were found in some of the seed. Seed fumigation may be necessary in the future.

Dalea purpurea - (purple prairieclover)

2006 - Material from WICA was received at the PMC as fluffy seed stripped from the heads. Seed fill was poor. Seeds appeared green and unripe. Less than 5 grams of bulk seed remained after cleaning. The fuzzy seed covering was removed using a rub board. The seed was scarified for 10-12 seconds using a Forsberg scarifier prior to greenhouse planting. The purpose of scarification was to scratch the coat and allow quicker water uptake by the seed. Seed germinated readily, but seedlings remained very small in the greenhouse and damping off became a severe problem. The biofungicide in the potting soil may have been a factor limiting growth. Seedlings (247) were planted to the field in early August. Most of the seedlings survived and grew after planting. No seed heads were produced.

2007 - Plants were variable in size, but most remained small. Deer and rabbit browse was severe throughout the growing season. Seed heads were produced but most were browsed. Seed was hand stripped and cleaned using a debearder and SD seed blower. Seed harvest was small.

Oxytropis campestris - (slender crazyweed)

2006 - Seed was received in pods from WICA. Seed was removed from the pods using a rub board and SD seed blower. Approximately 18 grams of pods produced 5 grams of seed. Seed was scarified approximately 12 seconds before seeding in the greenhouse. Seedlings remained small in the greenhouse. Approximately 195 plants were planted to the field plot in August 2006. Seedlings in the field remained small, growing to 2-4 inches in heights.

2007 - Plants were vigorous. Bees appeared to pollinate the pale purple flowers. Yellow is the most common flower color, so species identity is questionable and will be further investigated in 2008. Plants produced seed heads which were hand stripped July 16 and 30, 2007. Seed pods were processed through a debearder and hammermill. Chaff was separated using a fanning mill. A few seeds clung to the creased pods and were difficult to separate.

Oxytropis lambertii - (lamberts crazyweed)

2006 - Very little seed was received from WICA. All seed was planted in the greenhouse. Seed germination was poor. Seedlings (32) were planted to the field in August. Plants remained small, but did grow once in the field. Plants were prostrate in growth. No seed was produced in 2006.

2007 - Plant growth was initially good. Plants were more upright than in 2006. Flower color was a bluish purple. Plants in the field began to die for unknown reasons soon after flowering in early July. The few seed pods that were produced were hand harvested and cleaned.



Western wheatgrass