

WIND CAVE NATIONAL PARK

2008 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 2008 at the PMC.

Table 1

Species	Common Name	Target lbs (PLS)	PMC Harvest 2006-2008 (Bulk Clean)	PLS	Unit
<i>Andropogon gerardii</i>	Big bluestem	5	1.30	0.6	lb
<i>Aristida purpurea</i>	Purple three awn	2	(dirty)8.50	8.5	lb
<i>Bouteloua curtipendula</i> *	Sideoats grama	5	No planting	*	
<i>Bouteloua gracilis</i>	Blue grama	5	1.59	0.8	lb
<i>Elymus elymoides</i>	Bottlebrush squirreltail	2	16.4	12.2	lb
<i>Koeleria macrantha</i>	Prairie junegrass	2	13.2	7.6	lb
<i>Nassella viridula</i>	Green needlegrass	subst.	12.3	11.0	lb
<i>Pascopyrum smithii</i>	Western wheatgrass	5	31.0	25.6	lb
<i>Schizachyrium scoparium</i>	Little bluestem	5	4.45	2.6	lb
<i>Astragalus missouriensis</i> *	Missouri milkvetch	.5	No planting	*	
<i>Cirsium undulatum</i>	Wavyleaf thistle	.5	1.10	0.8	lb
<i>Dalea purpurea</i>	Purple prairieclover	.5	39	39**	g
<i>Oxytropis campestris</i>	Slender crazyweed	subst.	4.9	4.4	lb
<i>Oxytropis lambertii</i>	Lambert's crazyweed	subst.	2	2	g
<i>Sphaeralcea coccinea</i> *	Scarlet globemallow	.5	No planting	*	

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

** No seed tests

Seed has been bulked and tested for purity and germination (North Dakota Seed Department). One lot of each species will be distributed to WICA in 2009. It will be tagged with germination and purity information.

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.

2007-2008 - Seed was harvested from PMC plots of most species and cleaned. Seed production accomplishments and shortfalls are found in Table 1.

TECHNOLOGY DEVELOPMENTS

Seed production, seed cleaning and seed harvest methods were devised for many of the species. Information related to plant performance was noted.

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 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 planted in the PMC greenhouse 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 improve pollination. Rows were spaced approximately 4-5 feet apart. Four rows contained all of the species. Field row length was approximately 800 feet. Plant spacing within the row was approximately 1 foot. Field planting for most species was early June 2006. Slow growing seedlings were field planted in early August when their roots were larger.

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 hand cut in April 2007. Weeds were hand tilled when small. The plants were not irrigated in 2007, as timely rains fell in the spring and early summer. No fertilizer, herbicide or insecticide was applied. Purslane, pigweed, lambsquarter, and kochia were the predominant weeds.

2008 - Residue from 2007 was removed at 2007 harvest or early in the spring of 2008 by hand clipping and mowing. Field plots were shallow tilled between the rows throughout the growing season when weeds were generally less than 4 inches in height. There was no application of fertilizer, herbicides, or insecticide.

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, straight combining, or clipping heads and then thrashing through a plot combine. Seed harvest was fair for most species. It was poor for *Oxytropis lambertii*, *Dalea purpurea*, and *Andropogon gerardii*.

2008 - Many of the species were harvested using a plot combine. Some species were hand harvested due to limited seed production. Method of harvest for each species is found in the Species Performance section.

Species Performance

Andropogon gerardii (big bluestem)

2006 - Approximately ¼ pound of dirty seed was received from WICA. Seed was cleaned using a debearder and fanning mill. Approximately 34.6 grams of clean bulk seed remained. Seed germinated readily in the greenhouse, but plants had 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 averaged 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 heads were green and seed was poorly filled. Seed was cleaned using a debearder and fanning mill. Approximately 0.3 clean bulk pounds of seed were produced.

2008 - Plant diversity was evident. Seed was hand harvested due to the wide variability in flowering dates among the plants. Harvest began in early September and was completed September 25, 2008. Approximately 1 pound of clean bulk seed was produced. Seed was cleaned using a hammermill, 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 small percentage of awns, but broke seed. Awns were removed for seed planted in the greenhouse by clipping with a scissor. 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 were shallow. Several plants produced heads. Seed was harvested by hand stripping. Removal of awns was a challenge. Seed was scarified and trash was removed by hand picking. Some seeds shattered when scarified and many were not filled. Five grams of poor quality seed remained after cleaning.

2007 - Plants were vigorous and produced abundant seed heads. Seed ripening was uneven. Plant leaves were narrow and remained slightly 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.

2008 - Seed was hand stripped from August 18-September 19. The seeds appear somewhat larger than in 2007. Seed harvested from 2006-2008 was bulked. No seed cleaning method to remove the awns was found. Seeds are difficult to handle and containerize as they have very sharp tips that burrow and stick into various types of materials. Seed will be distributed to WICA with awns.

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. Greenhouse germination was fair to poor. Seedlings (242) were field planted on June 12, 2006. Approximately 90 percent of the plants produced seed heads. Seed heads were hand clipped 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. 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.

2008 - Seed heads were generally fewer and shorter in 2008 compared to 2007. Plant vigor was fair. Approximately 129 grams of seed was produced in 2008. Plants were hand clipped and fed through a combine due to their short stature.

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. No 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.

2008 - Plant vigor was slightly poorer initially in 2008 compared to 2007. Plants produced fewer heads. The dry conditions after harvest in 2007 may have been a factor. Plant stalks were cut on July 28, 2008. It was then run through a plot combine after floor drying. Approximately 4.5 clean bulk pounds of seed were produced.

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 height, 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.

2008 - Seed production was over 8 clean bulk pounds. Plants were vigorous and seed fill was good. Individual plants generally appeared larger in 2008 compared to 2007. Seed culm production was abundant. Seed was harvested with a plot combine on July 18, 2008. Plants were not swathed prior to harvest.

Nassella viridula (green needlegrass)

2006 - The PMC received 13 grams of hand stripped seed. Awns were removed using a rub board. Seed was 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.

2008 - Plants were vigorous and produced abundant seed heads. Seed ripening was very sporadic. Seed at harvest was ½ to ¾ hard and dark. Seed was harvested by straight combining on July 9, 2008. The windrow remaining was left to dry and run through the combine again on July 14, 2008. Approximately 11 clean bulk pounds of seed was harvested..

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 prior to field planting. Seedlings (360) were field planted on June 8, 2006. Rhizome and forage production were excellent. No seed heads were produced.

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

2008 - Plants were vigorous. In late fall of 2007 and early spring of 2008, space between rows was rototilled. Seed production is assumed to be greater in stands that are not sodbound. Plants spread quickly between the rows and formed a solid stand. Seed heads were abundant in spite of the solid stand. Experience with other western wheatgrass varieties at the at the PMC has shown seed production decline after the second or third year. The plants of this collection have shown no decline thus far. Seed was combined on August 6, 2008. Seed amount after cleaning was approximately 18 clean bulk pounds.

Schizachyrium scoparium (little bluestem)

2006 - Seed received from WICA was hand stripped from the plants. Awns were removed using a debearder and inert material was 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 clean bulk pounds remained from 7 pounds of harvested material.

2008 - Plants were vigorous, and abundant seed heads were produced. Seed ripening was uneven. Seed was fluffed out and shattering when harvested with a plot combine on September 17, 2008. Seed fill was poor. Thirteen pounds of dirty material cleaned to less than 1 pound of seed. More seed may be lost and more inert material may be harvested in the combining process compared to hand harvesting.

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 plucked from the block shaped seed before greenhouse planting. Many of the seeds had insect holes. Damaged 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. Fifty-two seedlings were field planted. The plants thrived and grew into 1-2 foot diameter rosettes. Plant spacing greater than 1 foot may 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 heads when seed were ripe. Heads were hand clipped when birds appeared, the base started to brown, and the tops fuzzed out white. Plant stems became hollow and died back by late August. Dead plant material was removed. New plant rosettes were 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.

2008 - Few seed heads were produced. They were produced on plants that were rosettes in 2007. The rosettes were a result of plants reseeding themselves in 2006. This is typical of biennials. Seed heads were greatly infested with larvae. Single exit holes in some empty seeds indicated larvae developed inside the kernel. Seed production was poor. A systemic insecticide very early in the growing season may have reduced infestation.

Dalea purpurea (purple prairieclover)

2006 - Material from WICA was received at the PMC as fluffy seed stripped from the heads. Seed fill was poor. Many seeds were 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. Biofungicide in the potting soil may have limited growth. Seedlings (247) were field planted in early August. Seedling mortality was low. 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.

2008 - Plants were severely browsed by rabbit and deer. No seed heads were produced.

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 field planted in August 2006. Seedlings remained small, growing to 2-4 inches in height.

2007 - Plants were vigorous. Bees appeared to pollinate the pale purple flowers. Yellow is the most common flower color, so species identity is questionable. Seed pods were hand stripped July 16 and 30, 2007 and cleaned using a debearder, hammermill, and fanning mill. A few seeds clung to the creased pods and were difficult to separate.

2008 - Plant growth, flowering, and seed production were prolific. Plants grew very prostrate. Seed was hand harvested from mid July to mid August due to its indeterminate flowering and ripening. Over 4 pounds of clean bulk seed was produced.

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 field planted in August. Plants grew but remained small. Plants were prostrate in growth. No seed was produced in 2006.

2007 - Plant growth was initially good and more upright than in 2006. Flower color was a bluish purple. Plants died soon after flowering in early July for unknown reasons. A few seed pods were produced, hand harvested and cleaned.

2008 - No plants remained by the spring of 2008.



Elymus elymoides



Koeleria macrantha



Pascopyrum smithii



Aristida purpurea