La Semilla

2005 Technical Report

Tucson Plant Materials Center

United States Department of Agriculture
Natural Resources Conservation Service

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Introduction

The Tucson Plant Materials Center (TPMC) is operated by the USDA-Natural Resources Conservation Service. In 1935 the USDA-Natural Resources Conservation Service recognized the need for adapted plant material for use in their conservation programs. This need was addressed by the establishment of plant materials nurseries in critical areas throughout the United States. The Plant Materials program has grown into a network of 27 centers throughout the United States. The Tucson Plant Materials Center (Tucson PMC) was one of the initial centers established to provide adapted plant material for conservation programs in the southwest United States. Over the past 70 years the Tucson PMC has developed and evaluated plant materials and technologies for their establishment that have enhanced conservation efforts throughout its service area.

The Tucson PMC service area supports the Sonoran, Mohave and Chihuahuan desert regions. Plant Material products and support is provided to areas within the states of Arizona, California, Nevada, Utah, and New Mexico. The Tucson PMC works closely with its customers to provide effective, cost-efficient vegetative solutions for conservation problems. Rangelands, mined lands, critical areas, urban and urban interface areas, riparian areas, croplands, water and air quality, invasive species, and wildlife habitat all present resource issues within the PMC service area.

The PMC evaluates the conservation potential of native grasses, shrubs, forbs and trees at the federally owned 45-acre farm in Tucson, Arizona. Selected plant materials become part of advanced trials designed to develop cultural and management practices that enhance seed production and ease of establishment in their native plant communities or environments. These practices, along with efficiency and adaptability, are assessed using field plantings at selected test sites throughout the PMC service area.

The Tucson PMC works in partnership with NRCS field offices, resource conservation and development (RC&D) groups, conservation districts, federal and state agencies, non-profit groups and private landowners to develop improved resource technology. Cooperation with agencies and groups other than NRCS provides opportunities for the joint development of plant materials and management practices as well as for exchange of information, seed, and planting stock.

This publication provides information on studies and activities carried out at the PMC during 2005.

Summary of 2005 Weather Conditions at the Tucson Plant Materials Center Tucson, Arizona

Month	Temperature (^oF)		Precipitation (inches)
	Maximum	Minimum	
January	70	44	1.84
February	69	48	1.83
March	76	48	0.25
April	86	54	0.28
May	97	64	0.56
June	105	73	0.12
July	109	80	0.88
August	100	81	4.42
September	99	73	0.06
October	91	61	0.53
November	83	48	0.00
December	74	40	0.04
	Avg. 88	Avg. 59	Total 10.81

Frost Free Days = 358

Days Above 100 ^oF = 104

Coldest Temperature = November 28th 27 ^oF

Hottest Temperature = July 17th 116 ^oF

1st day 100 ^oF = May 16th

1st day 32 ^oF = January 6th

STUDY NUMBER: AZPMC-P-8901-CR

Spike Dropseed Population Development Produces the Selected Release Cochise Germplasm

Description

In 1989 an initial evaluation planting (IEP) of spike dropseed (*Sporobolus contractus* A.S. Hitchc.) was established at the Tucson PMC, consisting of 44 accessions collected from Arizona, Utah, New Mexico and Nevada. Convergent-Divergent selection was used to development a population of spike dropseed with a broad genetic base, adapted to a wide area within its natural range.

spike dropseed plant

Objectives of this study are:

- Develop a widely adapted population for use as an alternative to the introduced lovegrass species.
- Evaluate seed production, germination and seedling establishment as well as harvesting and seed processing techniques.

Introduction

Spike dropseed is a native, perennial, warm-season bunchgrass. The culms are 16 to 47 inches (40-120 cm) tall and 0.75 to 1.50 inches (2-4 mm) in diameter at the base occurring in small clusters or clumps. Sheaths are rounded and glabrous on the back with tufts of long hairs on either side of the collar and often covered with fine hairs on the margins. Ligules may have a dense fringe of short or long hairs. Blades are 4 to 12 inches (10-30 cm) long, flat or rolled at the margins, tapering to a slender tip lacking hair. The blades and sheaths persist on the plant, twisting up like a corkscrew. The panicle is a dense, contracted, spikelike 0.3 inch (1 cm) or less thick and 6 to 8 inches (15-20) cm long, the bottom portion and sometimes the entire panicle remains enclosed in the sheath. Spikelets are light brownish or gray colored, 0.07 to 0.11 inch (2-2.8 mm) long. Glumes are thin, membranous and unequal, the first usually about half as long as the second, the second equaling the lemma or slightly shorter. Caryopsis are about 0.4 inch (1 mm) in length, broad and flattened.

spike dropseed panicle

This species occurs naturally on dry, open, sandy or rocky slopes and washes. It frequently occurs along roadsides, mostly at elevations from 2500 to 6500 feet (760-1981 m). It flowers normally flowers from August to October, occasionally as early as June. Spike dropseed is found growing from Colorado to southeastern California to Texas, and Sonora, Mexico.

Reports indicate that spike dropseed germinates at temperatures from 60^0 to 90^0 F, with germination occurring faster at higher temperatures. Germination typically occurs in 3 to 7 days dependent of temperature. Most seed had germinates within 5 days. Moisture stress levels below 0 bars decreases germination of spike dropseed. Studies have reported various light requirements for germination, however it appears that with most ecotypes light is not necessary. When green and actively growing the forage quality of spike dropseed is good for cattle, horses and wildlife. It is less palatable when dormant. The dropseeds may increase under moderate grazing pressure, but will decrease and disappear under heavy grazing. The least damage is done by grazing in the fall and winter. Spike dropseed may be very useful in seeding disturbed areas.

Materials and Methods:

This project uses the convergent-divergent plant improvement strategy (**CDI)**. This strategy brings a large assemblage of plant accessions to one common point (Tucson PMC). An equal number of plants from each accession are planted into a crossing block or production field (CONVERGENCE). Equal quantities of seed are collected from each plant in the convergence block. Plants are propagated from each collection from the convergence block and taken to diverse environments to allow natural selection (DIVERGENCE).

Convergence Planting

The convergence planting in 1989 consisted of 44 accessions (Table 1). These accessions were planted in a randomized complete block design with 4 replications. They were evaluated in 1991 and 1992 for vigor (Table 2), forage height, uniformity of seed production and in 1991 for forage fresh weight.

A total of 220 plots were established to form the convergence planting block. Equal quantities of seed from each plot were bulked to form a new population. The seed from the new population was used to establish a seed production block at the Tucson PMC. Seed from this production block was used to propagate individual plants, for divergence plantings at 3 locations in southern Arizona.

Cochise germplasm spike dropseed fields at the Tucson Plant Materials Center

Table 1. Accession number and collection location of 44 accessions in initial evaluation of spike dropseed.

Number	Accession Number	Collection Location	Number	Accession Number	Collection Location
1.	9029241	Cochise Co., AZ	23.	9053639	
2.	9015265	Cochise Co., AZ	24.	9053640	
3.	9022775	Utah	25.	9053641	
4.	9003960	Cochise Co., AZ	26.	9053642	
5.	9003959	Snowflake, AZ	27.	9055802	ShuckToak, AZ
6.	9003958	Duncan, AZ	28.	9055820	Sells, AZ
7.	9003953	Yavapai Co., AZ	29.	9055821	
8.	9015266	Sun Valley, AZ	30.	9055822	
9.	9047372	Searchlight, NV	31.	9055823	
10.	9047373	Tonopah, NV	32.	9055824	
11.	9047374	Pinal Co., AZ	33.	9055826	
12.	9047424	Pima Co., AZ	34.	9055827	Cochise Co., AZ
13.	9047423	Pima Co., AZ	35.	9055831	Pima Co., AZ
14.	9047452	Pima Co., AZ	36.	9055834	Lincoln Co., NV
15.	9053631	Tonopah, NV	37.	9055835	Lincoln Co., NV
16.	9053632	Tonopah, NV	38.	9055838	Gila Co., AZ
17.	9063633	Coconino Co., AZ	39.	9055847	Greenlee Co., AZ
18.	9053634	Cochise Co., AZ	40.	9055848	Graham Co., AZ
19.	9053635		41.	9055849	Greenlee Co., AZ
20.	9053636	Greenlee Co., AZ	42.	9055851	Pima Co., AZ
21.	9053637		43.	9055855	Catron Co., NM
22.	9053638		44.	9055856	Cochise Co., AZ

Table 2. Vigor rankings (visual 1 to 9) of 44 accessions in initial evaluation of spike dropseed in 1991 and 1992.

Accession	Vigor Ranking (1-9)		Accession	Vigor Ranking (1-9)	
	1991	1992		1991	1992
9029241	3.25	2.50	9055802	3.25	2.75
9015265	6.33	3.00	9055820	3.25	2.00
9022775	7.00	4.00	9055821	5.50	3.50
9003960	4.33	4.00	9055822	3.75	3.50
9003959	-	-	9055823	4.50	3.25
9003958	4.50	3.00	9055824	3.75	3.50
9003953	-	-	9055826	3.75	3.50
9015266	5.50	2.50	9055827	4.50	3.25
9047372	6.00	3.25	9055831	4.00	2.50
9047373	5.75	2.75	9055834	4.50	3.50
9047374	4.25	3.25	9055835	6.25	3.00
9047424	5.00	3.33	9055838	5.25	3.25
9047423	4.50	3.50	9055847	5.00	4.00
9047452	4.25	2.25	9055848	5.50	3.25
9053631	5.25	3.00	9055849	3.75	2.50
9053632	4.25	1.25	9055851	4.00	3.25
9063633	4.25	2.25	9055855	6.00	4.75
9053634	3.75	2.50	9055856	3.75	2.25
9053635	3.50	3.00	9055802	3.25	2.75
9053636	5.00	3.00	9055820	3.25	2.00
9053637	4.75	2.75	9055821	5.50	3.50
9053638	3.75	3.00	9055822	3.75	3.50

Divergence Plantings

Three divergence plantings (CDI) were established in southern Arizona. The sites were established in areas of differing ranges of precipitation: 1) Dusty A7 Ranch site near Pomerene, Arizona, the area of least precipitation (MLRA 41-3), 2) the BLM enclosure site near Bowie, Arizona the site of intermediate precipitation (MLRA 41-2) and 3) Y4 Ranch in Texas Canyon, Arizona the site of highest precipitation (MLRA 41-3).

Pomerene, AZ, Dusty A7 Ranch site

On August 14, 17, and 18, 1998, 196 spike dropseed plants were transplanted into 14 x 14 planting grids on each site (Dusty A7 ranch - August 14, 4Y ranch - August 17, and Bowie - August 18, 1998). Holes were dug with a gasoline-powered auger. Each hole was filled with approximately 2 quarts of water prior to transplanting. This was done to allow the plants to overcome transplant shock and become established on the sites. No additional water was provided.

Texas Canyon, AZ, Y4 Ranch site

Bowie, AZ, BLM exclosure site

The sites at Pomerene, Texas Canyon, and Bowie were evaluated on September 23, 1999. Seed were harvested randomly from 41 plants and brought back to the Tucson PMC. The Bowie site had high plant mortality, therefore seed was harvested from the 41 best plants. The seed was collected from individual plants, cleaned and stored. Equal amounts of cleaned seed from each lot were blended to form a population of breeder seed. (Accession# 9064129, Lot# SBR-00-7011).

In the spring of 2000 spike dropseed plugs were propagated from the breeder's seed developed from the September 1999 harvest from the divergence plots. These plants were planted into a breeder's block located at Tucson PMC on June 27, 2000. Small mammal grazing caused this planting to fail. The breeder's block was be reestablished in 2001. In 2003 the block was increased to 1 acre. This 1 acre planting became the generation 1 of the selected release of Cochise germplasm.

Cochise Germplasm Spike Dropseed

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UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
TUCSON PLANT MATERIALS CENTER
TUCSON, ARIZONA

AND

THE UNIVERSITY OF ARIZONA
TUCSON, ARIZONA

NOTICE OF RELEASE OF A SELECTION OF SPIKE DROPSEED SELECTED CLASS OF GERMPLASM

The U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS), and the University of Arizona announce the release of a selected class of spike dropseed (*Sporobolus contractus* A.S. Hitchc.) for the southwestern United States.

As a selected release, this germplasm will be referred to as Cochise Germplasm spike dropseed to document general collection location. It has been assigned the NRCS accession number 9064068. Cochise Germplasm is released as a selected class of certified seed.

This alternative release procedure is justified by the lack of existing commercial sources of spike dropseed. The biological qualities of spike dropseed make it a good choice for preliminary vegetation in areas dominated by exotic grasses. Propagation material of this species is needed for ecosystem restoration and enhancement. The potential for immediate use is high. At present, there are no commercial releases of spike dropseed.

Species:	*Sporobolus contractus*
Common Name:	spike dropseed
Plant Symbol:	SPCO4
Accession Numbers:	9064068

Collection Site Information

Cochise Germplasm is a composite of 44 accessions collected from native spike dropseed stands in Arizona, southern Utah, and Nevada (Table 1). Plant materials were collected from areas within the Tucson Plant Materials Center (TPMC) service area to develop a population of spike dropseed with a broad genetic base and adapted to a wide area within its natural range.

Description

Spike dropseed is a native, cespitose, perennial warm-season bunchgrass. Culms range from 40-120 cm tall and 2-4 mm in diameter at the base. Culms may occur in small

Table 1. Accession number and origin of collections for Cochise Germplasm spike dropseed.

Accession Number	Collection Location
1. 9029241	T20S, R25E, Sec 13 Cochise County, AZ
2. 9015265	T14S, R24E, Sec 15 Cochise County, AZ
3. 9022775	Utah
4. 9003960	T18S, R15E Santa Rita Ex. Range
5. 9003959	T13N, R22E Navajo County, AZ
6. 9003958	T8S, R30E Greenlee County, AZ
7. 9003953	T15, R6E Yavapai County, AZ
8. 9015266	T18N, R21E Gila County, AZ
9. 9047372	T28N, R62E, Sec 14 Clark County, NV
10. 9047373	T2N, R45E, Sec 15 Nye County, NV
11. 9047374	Pima County, AZ
12. 9047424	T21S, R7E Sec 10 Pima County, AZ
13. 9047423	T19S, R8E Pima County, AZ
14. 9047452	T17S, R8E, Sec 10 Pima County, AZ
15. 9053631	T5N, R60E, Sec 12 Nye County, NV
16. 9053632	T12N, R60E, Sec 18 Nye County, NV
17. 9063633	T20N, R11E, Sec 17 Coconino County, AZ
18. 9053634	T14S, R25E, Sec 10 Cochise County, AZ
19. 9053635	Cochise County, AZ
20. 9053636	T8S, R30E, Sec 18 Greenlee County, AZ
21. 9053637	T7S, R23E, Sec 18 Graham County, AZ
22. 9053638	Cochise County, AZ
23. 9053639	Cochise County, AZ
24. 9053640	T9, R17E, Sec 36 Cochise County, AZ
25. 9053641	T19S, R15E, Sec 9 Eddy County, NM
26. 9053642	Cochise County, AZ
27. 9055802	T14S, R6E, Sec 27 Pima County, AZ
28. 9055820	T16S, R8E, Sec 32 Pima County, AZ
29. 9055821	Cochise County, AZ
30. 9055822	Cochise County, AZ
31. 9055823	Pima County, AZ
32. 9055824	Cochise County, AZ
33. 9055826	T11S, R20E, Sec 5 Cochise County, AZ
34. 9055827	T14S, R25E, Sec 10 Cochise County, AZ
35. 9055831	Pima County, AZ
36. 9055834	T4S, R64E, Sec 10 Lincoln County, NV
37. 9055835	T4S, R64E, Sec 10 Lincoln County, NV
38. 9055838	T1S, R16E, Sec 11 Gila County, AZ
39. 9055847	T8S, R31E, Sec. 13 Greenlee County, AZ
40. 9055848	T7S, R23E, Sec 18 Graham County, AZ
41. 9055849	T8S, R32E, Sec 5 Greenlee County, AZ
42. 9055851	T18S, R1W, Sec 31 Pima County, AZ
43. 9055855	T3S, R11W, Sec 6 Cochise County, AZ
44. 9055856	T14S, R25E, Sec 9 Cochise County, AZ

clusters to large clumps. The sheath is rounded and glabrous on the back, usually with tufts of long hairs on either side of the collar and often ciliate pilose on the margins. The ligule has a dense fringe of short or relatively long hairs. The blades are flat or involute, tapering to a slender tip, glabrous and 10-30 cm long. The panicle is dense, contracted, spikelike or moderately lobed, typically 1 cm or less thick and 15-20 cm long. The basal portion and sometimes the entire panicle remain enclosed in the sheath. Spikelets are light brownish or lead colored and 2-2.8 mm long. The glumes are thin, membranous and unequal. The first glume is usually half as long as the second; the second equals the length of the lemma or is slightly shorter. The caryopsis is approximately 1 mm in length, broad and flattened.

This species occurs naturally on dry, open, sandy or rocky slopes and washes. It is frequently found along roadsides at elevations from 760-1,981 meters. Flowering in native environments occurs from August to October, occasionally as early as June. In cultivation flowering may be controlled by availability of water. Spike dropseed is found from Colorado to southeastern California, Texas, and Sonora, Mexico.

Spike dropseed germination occurs within two ranges of alternating temperatures: 15.5 to 19 ºC (8 hr) and 26.5 to 29.5 ºC (16 hr), and at 26 to 32.5 ºC (8 hr) and 15.5 to 19 ºC (16 hr) (Sabo et al., 1979). Germination results at the first set of temperatures range from 3 to 5 days, with most germination occurring after 4 days. Germination in the second set of temperatures is slightly longer, ranging from 4 days to 7 days. Germination may be decreased when moisture stress levels are below 0 bars, but is not effected by the presence or absence of light (Sabo et al., 1979).

Spike dropseed has the potential to aid in the reclamation of rangelands dominated by exotic perennial grasses. This species was selected for germplasm development based upon biological characteristics that may allow it to compete with introduced exotic species such as Lehmann lovegrass that dominate some rangelands in southern Arizona.

Method of Selection

Cochise Germplasm was developed using the convergent-divergent plant improvement strategy. This strategy was developed to improve regional adaptation of germplasm (Lonnquist et al., 1979). It involves the collection of germplasm from the area of proposed use, followed by intercrossing and then dispersal to a set of target locations in the area. Finally, seed selected from the target locations was planted at the Tucson PMC to produce the Cochise germplasm of spike dropseed. The convergent-divergent process aims to develop germplasm that performs well in most sites within the proposed area of use.

Convergence Planting

The convergence planting in 1989 consisted of 44 accessions (Table 1). These accessions were planted at the Tucson PMC in a completely randomized block design with 4 replications. The accessions were allowed to intercross and seed was collected from individual plants in 1992. In 1993 equal amounts of seed from individual plants were combined and used to plant a seed production block at the Tucson PMC (nontarget environment). Seed from this production block was used to propagate individual plants for divergence plantings at 3 locations in southern Arizona.

Divergent Plantings

Three divergent sites (target environments) were established in southern Arizona. The sites were established in areas of differing ranges of annual precipitation: 1) the Dusty A7 Ranch site near Pomerene, Arizona, with the least precipitation (MLRA 41-3), 2) the BLM enclosure site near Bowie, Arizona, an area of intermediate precipitation (MLRA 41-2), and 3) the Y4 Ranch in Texas Canyon, Arizona, the site of highest precipitation (MLRA 41-3). These sites were also infested with stands of the exotic species, including Lehmann lovegrass (*Eragrostis lehmanniana*).

In August 1998, 196 spike dropseed plants were transplanted into 14 x 14 planting grids on each site (Dusty A7 ranch - August 14, 4Y ranch - August 17, and Bowie - August 18, 1998). Holes were dug with a gasoline-powered auger. Each hole was filled with approximately 2 quarts of water prior to transplanting. This was done to allow the plants to overcome transplant shock and become established on the sites. No additional supplemental water was provided.

The sites at Pomerene, Texas Canyon, and Bowie were evaluated on September 23, 1999. Seed were harvested randomly from surviving plants and brought back to the Tucson PMC. The seed were collected from individual plants, cleaned and stored. Equal amounts of cleaned seed from each plant were blended to form the Cochise Germplasm spike dropseed.

Ecological Considerations

Cochise Germplasm spike dropseed is a composite of naturally occurring germplasm and has undergone minimal purposeful selection. Cochise Germplasm does not differ significantly in rate of spread, seed production, or vigor from naturally occurring spike dropseed. Cochise Germplasm spike dropseed was “OK to release” when evaluated through the “Worksheet for Conducting and Environmental Evaluation of NRCS Plant Releases”.

Anticipated Conservation Use

The potential uses of Cochise Germlasm spike dropseed include erosion control, wildlife food/cover, restoration of disturbed areas, rehabilitation of rangeland and for increasing plant diversity in arid rangeland communities.

Anticipated Area of Adaptation

Cochise Germplasm spike dropseed was developed for use in Southern Arizona. Spike dropseed is found naturally growing in dry open areas. It appears to prefer open sandy or rocky slopes and washes and is frequently along roadsides.

Availability of Plant Materials

Seed production will be maintained by the USDA-NRCS Tucson Plant Materials Center. Limited quantities of seed are available to seed producers for increase and to other interested parties as available.

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STUDY NUMBER: AZPMC-P-9901-CR

Pima Pappusgrass Population Development

Description:

Pima pappusgrass (*Pappophorum vaginatum* Buckley) is also known as whiplash pappusgrass. The goal of the population development project is to provide a genetically broad-based population with a wide area of adaptation. Plant materials resulting from this project will be valuable in the revegetation of the diverse environments of southern Arizona. Pima pappusgrass is not available through any commercial sources, so all genetic resources are from field collections. There are currently 16 accessions of Pima pappusgrass being evaluated at the Tucson PMC.

Materials and Methods:

Seed were collected from at least 50 individuals from 18 sites in southern Arizona (Table 1). Sixteen accessions were planted into a randomized complete design at the Tucson PMC in 1999. Rows were spaced 42 inches apart. An experimental unit consisted of 10 plants.

Table 1: Collection locations of Pima pappusgrass (*Pappophorum vaginatum*) accessions.

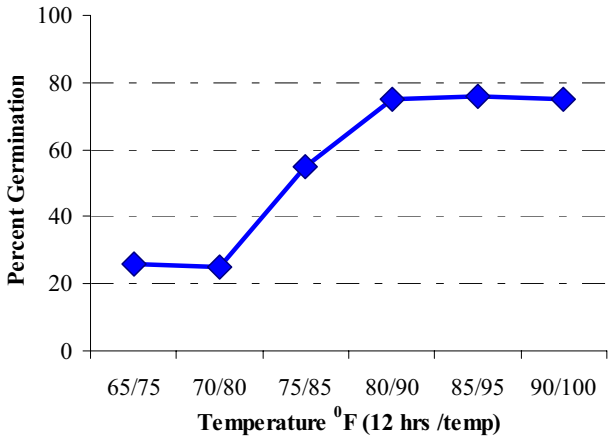
Accession Number	Collection Date	Collection Location	Comments
9064074	8/11/96	T24S, R28E, Sec. 12	Douglas, AZ
9064075	11/19/96	T19S, R19E, SE1/4 of SE1/4 of Sec. 24	Hwy 90 on Sands Ranch
9064076	9/25/96	T21S, R24E, SW1/2 of SE1/4 of Sec. 27	47 Ranch
9064077	9/26/96	T23S, R24E, SE1/2 of NW1/4 of Sec. 10	Lee Station Ranch
9064078	9/19/96	T17S, R20E, NE1/4 of NE1/4 of Sec. 7	
9064079	10/19/96	T13S, R20E, NE1/4 of NW1/4 of Sec. 26	Harris' VF Ranch
9064080	9/10/96	T8S, R2E, SE1/4 of Sec. 20	
9064081	9/5/96	Tohono O'odham Res.	near roadside
9064082	9/5/96	Tohono O'odham Res.	
9064083	12/3/96	16S, R10E, NW1/4 of Sec. 7	Three Points, AZ
9064106	10/3/97	T21S, R9E, NW1/4 of SW1/4 of Sec. 34	Chilton's Arivaca Ranch
9064124	8/6/99	T17S, R14E, NW1/4 of SE1/4 of Sec. 20	pasture 5N in SRER
9064125	8/13/99	T17S, R20E, NW 1/4 of Sec. 4	Benson, AZ
9064126	8/16/99	T24S, R28E, SE1/4 of NE1/4 of Sec. 17	Douglas, AZ
9064127	10/4/99	T20S, R20E, NW 1/4 of Sec. 6	2 mi. N of Mustang Corners
9064128	8/12/99	1920 W. Copper St., Tucson, AZ	undeveloped lot
9067450	unknown	unknown	unknown

Introduction

Pima pappusgrass is a native perennial warm season bunchgrass. It is found along roadsides, in valleys and in low places on plains. Pima pappusgrass occurs in the southwestern United States, Mexico, Argentina and Uruguay. In Arizona, Pima pappusgrass is found primarily in Pima and Cochise counties at elevations ranging from 2,500 to 4,000 feet. Pima pappusgrass has erect culms, 25 to 40 inches (60-100 cm) tall. The leaf blades are 0.08 to 0.20 inches (2-5 mm) wide and flat with edges that may roll inward. The panicle is a spikelike 4 to 8 inches (10-20 cm) long, tawny to whitish colored with a tapered end. Spikelets are short-pediceled with 1 or 2 fertile florets and 2 or 3 sterile reduced ones.

Results and Discussion

Eleven accessions of Pima pappusgrass were evaluated for germination across a range of temperatures. The optimum temperature range for germination in this study was 85 to 100 degrees. This temperature correlates with summer temperatures in southern Arizona during the monsoon rains. This would be the optimum time for germination.



Optimum temperature range for germination of Pima pappusgrass.

The 18 accessions in the evaluation planting did not express any discernable phenotypic differences. Seed harvested from the planting was harvested in bulk and used to establish a G0 increase block in 2005. This block will provide seed for a selected release of Pima pappusgrass.

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STUDY NUMBER: AZPMC-T-0502-CR

Bush Muhly Development

Introduction

Bush muhly (*Muhlenbergia porteri* Scribn. Ex Beal.) is a warm season native perennial bush grass. Plants may reach up to 3 feet (1 m) in height and are highly branched. It occurs in desert grasslands, desert shrub, within interior chaparral and it is an undersory component of evergreen woodlands. Distribution occurs from the southern Great Basin and Intermountain region south to California, Texas and Mexico. Bush muhly originally existed in extensive stands. It can be very susceptible to winter grazing and likely has retreated to areas where it is protected from grazing by shrubs. When bush muhly has sufficient moisture it does not die back to the root crown in winter, and new growth starts from near the base of the previous year's stems.

Materials and Methods

Transplants of bush muhly were grown in 5.7 cu. in. containers in the lathhouse at the PMC. Six rows were established in a small border in September of 2005. The border was fertilized with 200 lbs/acre of ammonium sulfate (21-0-0) prior to planting. After plants had established the pre-emergent herbicide Oryzalin was applied.

When mature this planting will be used to evaluate cultural practices related to seed yield, harvesting and seed processing.

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STUDY NUMBER: AZPMC-T-0405-CR

Development of Technology for Seed Production of 'Stevan' Plains Bristlegrass

Introduction

Plains bristlegrass [*Setaria leucopila* (Scribn. & Merr.) K. Schum.] is a very desirable grass for restoration, providing good grazing for livestock and wildlife. 'Stevan' plains bristlegrass was released by the Tucson Plant Materials Center in 1994. 'Stevan' was selected for vigor and forage production. New plantings of 'Stevan' produced quality seed; however as the plantings aged seed fill reduced significantly. 'Stevan' was removed from production at the PMC because seed fill was extremely poor. The fact that young plantings of 'Stevan' produced viable seed indicates that the poor seed fill is not an intrinsic problem, but a cultural one. The objective of this study is to develop cultural practices for good seed production in plains bristlegrass.

Description

Plains bristlegrass is widespread and abundant in southern Arizona. It occurs at elevations from 2,000 to 7,000 feet (610 to 2,134 m). It is found growing in dry plains and washes, on rocky slopes, and often in partial shade of shrubs and trees.

Plains bristlegrass is a native, perennial, C_4, warm season bunchgrass. Culms are 16 to 47 inches (40 to 120 cm) tall, firm, wiry and bent sharply. The lower nodes are usually pubescent to hairy. The sheath is ciliate on the margins and with a tuft of hair on either side of the ligule. The ligule has a fringe of straight, stiff hairs. The panicle is dense and spikelike, 2 to 6 inches (5 to 15cm) long.

Materials and Methods

Thirteen accessions (Table 1) were planted in an initial evaluation planting (IEP) and observed from 1975-1979 and no significant differences were observed. Seed from the 13 accession were blended to form the composite 'Stevan' (accession 9003939).

To reestablish 'Stevan' transplants of were grown in 5.7 cu. in. containers in the lathhouse at the PMC. Four rows were established in a small border in September of 2004. The border was fertilized with 200 lbs/acre of ammonium sulfate (21-0-0) prior to planting. After plants had established the pre-emergent herbicide Oryzalin was applied.

When mature, this planting will be used to evaluate cultural practices with the potential to increase the seed viability and yield of plains bristlegrass.

Table 1. Accession number and collection location of accessions used in the composite cultivar 'Steven'.

	Accession Number	**Collection Location**		**Accession Number**	**Collection Location**
1.	A-14266	Willcox, AZ	8.	A-18173	Klondyke, AZ
2.	A-14539	Montezumas Well, AZ	9.	A-18174	Sasabe, AZ
3.	A-16535	Odessa, TX	10.	A-18176	Douglas, AZ
4.	A-17004	NM	11.	A-18294	Odessa, TX
5.	A-18170	Bowie, AZ	12.	A-18309	Douglas, AZ
6.	A-18171	Willow Springs Ranch, AZ	13.	A-18312	Klondyke, AZ
7.	A-18172	Tucson, AZ			

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STUDY NUMBER: AZPMC-T-0503-CR

Development of Technology for Seed Production of 'Sonora' Black Grama

Description

Black grama is a long lived native perennial grass. It is an important native range grass of the semiarid and arid desert rangelands of the southwest. Distribution stretches from Texas to southern California and from Mexico northward to Colorado, Wyoming and Utah. It has wiry, spreading stems reaching 8 to 24 inches (20 to 60 cm). The growth habit of black grama varies among regions, being primarily caespitose in some areas and to stoloniferous in others. Leaves are smooth, narrow, flexuous and mostly basal. Leaf blades are 1 to 3 inches (2 to 7 cm) long and 0.08 to 0.02 inches (0.5 to 2 mm) wide. The inflorescence is a panicle consisting of 3 to 8 spicate unilateral branches.

The primary mode of regeneration for black grama is through tilling and stoloniferous expansion. Black grama regeneration through seed is often sparse. In most years less than 20 percent of black grama florets produce viable seed. This poor seed set has been attributed to insect infestation. Insects collected from black grama stands from 1957 through 1960 included representatives from nine orders, 55 families, 109 genera and 120 species of insects. Control of insects may result in an up to 700% increase in florets that produce mature caryopsis.

Black grama once occurred in almost pure stands over extensive areas of southeastern Arizona, southern New Mexico, western Texas and into northern Mexico. Due to human and natural factors these stands are now less extensive. The fact that black grama's primary reproduction is asexual means that existing stands of black grama spread slowly into adjacent areas. Black grama has not generally been used for reseeding because of characteristic poor seed production and scarcity of quality seed.

'Sonora' black grama [*Bouteloua eriopoda*(Torr.) Torr.] was released by the Tucson PMC in 1965. It was the first improved black grama cultivar to be released for commercial seed production. The cultivar was developed from 11 vegetative and 47 seed accessions collected from Arizona and New Mexico in 1957. At release 'Sonora' was characterized as outstanding for leafiness, vigor, forage production, vegetative spread, seed set and seed production. However, seed production in subsequent years declined and 'Sonora' was abandoned due to poor seed yield. Subsequent research has provided information indicating that the reduction in seed yield was due to a build up of parasitic insects.

A 0.25 acre production field was reestablished at the PMC to determine if agronomic and pesticide protocols could be developed that would make 'Sonora' a viable cultivar. Transplants were grown in 5.2 cu. in. forestry pellets and transplanted in September with a mechanical transplanter. The border was fertilized with 200 lbs/acre of ammonium sulfate (21-0-0) prior to planting. At maturity this planting will be used to evaluate cultural practices and insecticide treatments to determine if production of 'Sonora' is economically viable.

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STUDY NUMBER: AZPMC-T-0301-CR

Demonstration of Native Grasses

Introduction

A grass demonstration nursery was established at the Tucson Plant Materials center in 2003. This nursery consists of warm and cool season native plant material (Table 1). The nursery consists of Plant Material Program Releases adapted or presently used for plantings. This nursery is used for training and for informal evaluation.

Table 1. Plant Materials Releases in the Native Grass Demonstration Nursery at the Tucson Plant Materials Center.

Common Name	Scientific Name	Release Name	Origin
Eastern Gamagrass	*Tripsacum dactyloides*	'Pete'	KSPMC
Indian Ricegrass	*Achnatherum hymenoides*	'Rimrock' 'Nezpar' 'Paloma'	MTPMC IDPMC NMPMC
Green Sprangletop	*Leptochloa dubia*	'Marfa'	TXPMC
Bottlebrush Squirreltail	*Elymus elymoides*	'Tusas' 'Sandhollow'	NMPMC ARSUT
Galleta Grass	*Pleuraphis jamesii*	'Viva'	NMPMC
Sand Bluestem	*Andropogon halli*	'Elida' 'Garden'	NMPMC KSPMC
Sideoats Grama	*Bouteloua curtipendula*	'Haskel' 'Vaughn' 'Niner'	TXPMC NMPMC NMPMC
Spike Dropseed	*Sporobolus contractus*	Potter County Germplasm	TXPMC
Arizona Cottontop	*Digitaria californica*	'Loetta'	AZPMC
Arizona Fescue	*Festuca arizonica*	'Redondo'	NMPMC
Switchgrass	*Panicum virgatum*	'Alamo' 'Kanlow' 'Blackwell'	TXPMC KSPMC KSPMC
Little Bluestem	*Schizachyrium scoparium*	'Cimmaron'	KSPMC
Blue Grama	*Bouteloua gracilis*	'Alma' 'Hachita'	NMPMC NMPMC
Big Bluestem	*Andropogon gerardii*	'Earl'	TXPMC
Alkali Sacaton	*Sporobolus airoides*	'Saltalk'	TXPMC
Cane Bluestem	*Bothriochloa barbinodis*	Saltillo Germplasm Grant Germplasm	AZPMC NMPMC
Sand Dropseed	*Sporobolus cryptandrus*	Borden County Germplasm	TXPMC
Black Grama	*Bouteloua eriopoda*	'Nogal' 'Sonora'	NMPMC AZPMC
Sand Lovegrass	*Eragrostis trichodes*	'Mason'	TXPMC
		'Bend'	KSPMC

Seed from each species were sown into cone-tainers (SC-10 super cells) in the greenhouse in March 2003. Each species was watered and fertilized as needed. In June the plants were transplanted to the field. Plants were planted in single rows 50 feet long with 40 inches between the rows. Material of the same species were planted adjacent to each other. The planting was fertilized with 100 lbs/acre of urea (46-0-0). Water was applied immediately after fertilization to prevent volitization of the urea as ammonia. After plants were established the pre-emergent herbicide Oryzalin was applied to prevent weeds and seedlings from the plants. Oryzalin is re-applied at 6 month intervals. The planting is watered and cultivated as needed. They are mowed 2 times per year.

Cool Season Grasses

None of the cool season grasses planted thrived and most did not survive the southern Arizona summer. Cool season grasses are not typically included in seeding mixes for southern Arizona. However, many land managers have expressed interest in including them in mixes at elevations above 2500 feet.

Bottlebrush squirreltail:

Tusas germplasm is superior to Sandhollow germplasm in this planting. The Sandhollow germplasm plants all died before September 2003. They did not survive the summer. Approximately 20% of the Tusas germplasm plants survived and produced seed in spring 2004. The surviving plants remained in 2005

Indian ricegrass:

The cultivar 'Paloma' appears to be the better choice for southern Arizona. Even though it is very stressed by the summer heat, it continues to survive and produce seed. Neither 'Nezpar' nor 'Rimrock' survived the first summer.

Warm Season Grasses

All warm season grasses have survived. The Eastern gamagrass seems to be perpetually chlorotic, probably due to the high soil pH. Big bluestem, sand bluestem and sand lovegrass are all struggling, but are surviving.

Sideoats grama:

'Vaughn' sideoats appears to be superior to 'Haskell' and 'Niner', as it is much more vigorous, and produces more vegetation.

Switchgrass:

All switchgrass cultivars are thriving. 'Alamo' produces the bigger plants.

Sand bluestem:

'Elida' is the more vigorous cultivar under the conditions of this trial.

Switchgrass cultivars

Cane bluestem:

The cane bluestem germplasm Saltillo and Grant appear very similar. The Saltillo germplasm greens up approximately 2 weeks before Grant, however Grant produces more vegetation.

Black grama:

'Sonora' is much more rhizomatous than 'Nogal' in this planting. 'Sonora' also seems to continue to grow throughout the summer season, where 'Nogal' appears to shut down during the hottest months. Seed from 'Sonora' mature earlier, perhaps before the monsoon rains.

Black grama cultivars

Sand lovegrass:

'Mason' is much more adapted to conditions in this trial than 'Bend'.

Although this trial was planted as a demonstration it is providing valuable information on the adaptability of various plant materials releases being planted in southern Arizona. It has also proven to be invaluable when discussing species variability with students, field office personnel and other PMC visitors.

Tucson Plant Materials Center Native Grass Demonstration Nursery

STUDY NUMBER: AZPMC-P-06-07-CR

Audubon Ranch Seed Collection

Linda Kennedy and Bill Branan at the Audubon Society's Appleton-Whittle Research Ranch outside Elgin, AZ, are committed to combating lehmann and boer lovegrasses (*Eragrostis lehmanniana and E. curvula*). Both exotic species have increased following a catastrophic fire in 2002. In the future, the Ranch may hold some of the last vestiges of native grasslands in southern Arizona.

The Ranch wanted to look at simplified land management uses following the good monsoon rains in 2004 that produced an above average native seed crop. We decided to do a mixed-species harvest, skip the seed processing step, and spread the seed the way it's done in nature. The Woodward flail-vac was used for harvesting to do as little damage as possible to the harvest site. The seed harvest included blue grama, black grama, hairy grama, sideoats grama, sprucetop grama, plains lovegrass, cane beardgrass, various forbs and sub-shrubs.

The 150+ lbs of seed will be available for reseeding multiple test plots at the Ranch, as well as a mixed species border here at the PMC.

Sporobolus airoides and *Muhlenbergia asperifolia:* population developments for southern Nevada

Midterm Report of 2005 Activities

By
Mary Hershdorfer and Ramona Garner

Tucson Plant Materials Center
USDA-Natural Resources Conservation Service

March 2006

Introduction

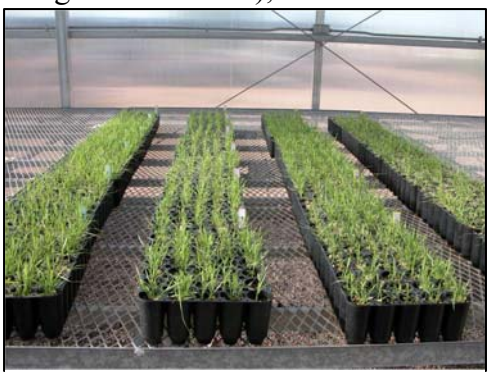
As part of a collaborative project with the Southern Nevada Restoration Team (SNRT), represented by the four major federal agencies (and land holders) of southern Nevada, the NRCS Tucson Plant Materials Center (PMC) has completed the first phase in the development of genetically diverse, regionally adapted ecotypes of two native grasses, alkali sacaton (*Sporobolus airoides*) and alkali muhly (*Muhlenbergia asperifolia*). This seed will be used in 2006 to establish local seed growers in southen Nevada. The release of ecotypes of these species provides material commercially, making them available for use in large-scale restoration of Mojave desert riparian areas.

Materials & Methods

Due to differences in the amount of seed available, different methods were used for the two species, particularly in timing of activities, field plot design, and the opportunity to evaluate accession differences in the year of establishment. The step-by-step process taken to develop these two populations is explained below.

1. Alkali sacaton population

Alkali sacaton seed were supplied to us from collections made at nine distinct sites within Clark, Lincoln and Nye Counties in southern Nevada (Appendix A): 3 from Moapa National Wildlife Refuge (40 mi northeast of Las Vegas near the town of Moapa), 3 from Pahranagat National Wildlife Refuge (100 mi north of Las Vegas near Alamo), 2 from Ash Meadows National Wildlife Refuge (60 mi west of Las Vegas near the town of Pahrump), and one from Sacaton Canyon, Lake Mead National Recreation Area (70 mi southeast of Las Vegas near the Arizona border).



Alkali sacaton plugs in the PMC greenhouse (April 2005)

Upon arrival, visible differences in seed color and size were apparent. Certain accessions were twice the size of others, some collected within the same vicinity. Most of the seed arrived already processed, and percent purity and percent fill were determined with x-ray. These values were used to calculate and combine equal amounts of pure live seed to create the four accessions of the four sites named. (Appendix B).

With adequate seed to work with, seed from the four accessions were directly sewn into plugs in March 2005. Three accessions germinated in the greenhouse within 5 days at 70 deg F (day)/60 deg F (night), but the accession from Sacaton Canyon did not germinate until the temperature was raised to 80 deg F (day)/70 deg F (night). Plugs were fertilized and clipped weekly, and moved to the shade house in May. In June the plugs were planted in a 0.5 ac field at the PMC. Plugs were planted by hand 1 foot apart in four rows in a latin square design to maximize hybridization between accessions. An

Alkali sacaton field, early (right) and mid-growing season (July and September 2005)

experimental unit consisted of 10 plants. (Appendix C). The field was watered as necessary for vigorous establishment (more often in the year of establishment than in successive years). Observations were made for size and initiation of inflorescence 2 weeks after planting and again at 6 weeks after planting.

Seed were harvested 3 times during the growing season with the Woodward Flail vac seed stripper. The flail vac works by brushing, or stripping, only ripened seed without damage to the inflorescence or foliage. For species like alkali sacaton with indeterminate flowering, this process allows for multiple harvests throughout the growing season. This also allows for continued data collection on plant growth. In October, additional observations were made to compare inflorescence maturity and stage of flowering.

In November a more formal and quantitative evaluation was conducted to compare forage and reproductive characeristics. The second plant of each experimental unit of the center two rows was clipped at the base approximately 3 inches off the ground and data collected for six measurements: foliar height, reproductive height, weight, diameter, level of rust and number of inflorescence stalks. Clipped plants were bundled individually for measurement. Plants were weighed, measured for foliar height (length of the bulk of the leaves before tapering off) and reproductive height (length of the tallest inflorescence). Each bundle was opened to count total number of inflorescences and to measure rust along a scale of 1-6. After clipping the diameter of each plant clump was measured. Data were analyzed using Statistix (Version 8.1). Inferential statistics were used to compare these variables using Analysis of Variance and LSD All-Pairwise comparisons tests.

Alkali sacaton field and harvest (October 2005)

One plant from each accession unit was clipped and measured for the evaluation (November 2005)

In February 2006 hay bales were harvested from the alkali sacaton field. Five hay bales were cut weighing a total of 300 lb. Based on these values we expect a minimum of 1200 lb biomass/ac to be produced per cutting.

2. Alkali muhly population

Layering of alkali muhly for cloning

Three collections of alkali muhly (scratchgrass) were made in Clark County and sent to the PMC, 2 from Moapa National Wildlife Refuge and one from Pot-O-Gold Spring in Rainbow Gardens of Lake Mead National Recreation Area. The seed were combined to form three accessions. Because insufficient seed were available, extra steps were needed to have sufficient plugs to fill a PMC field.

To maximize seed, they were sown directly into flats, and the germinated seedlings were individually transplanted into plugs. Approximately 6 weeks later, when the plugs were large enough, they were periodically cloned using a clipping and layering process. The rooted cuttings were then planted into plugs. The extraordinary vegetative reproduction capabilities of this species, through rhizomes and stolons, lends itself well to this layering process as well as, presumably, asexual establishment in its native environment.

Alkali muhly planting at the PMC (Sept. 2005)

The extra steps required to increase the number of alkali muhly plugs postponed the planting of the field by several months. By late September sufficient plugs to fill an approximately 0.2 ac field were cloned and grown to adequate size. Plugs were randomly mixed and planted into a PMC field using a mechanical transplanter.

Rhizomes emerge from alkali muhly 2 ½ months after planting (December 2005)

Due to the late planting, seed from this field were not harvested in the initial year of establishment. However, we were pleased to see that in this short time the plants had already begun to produce seed and rhizomes. Unequal proportions of the three accessions did not lend this population to the evaluation process that was conducted for the Alkali sacaton.

Observations & results from first growing season

Although visual observations were made on both species, data were collected from only the Alkali sacaton throughout the growing season of 2005.

1. Preliminary observations

By June, 2 weeks after planting, distinct differences in size were becoming apparent between the accessions of alkali sacaton. On June 29 and July 29, visual observations were made on plant size and measurements were taken on initiation of inflorescence.

Size differences between accessions (July 2005)

Two weeks after planting, few plants were initiating inflorescence, but Pahranagat accession had the greatest margin (Table 1). A month later, Moapa was the only accession with a majority in flower. Ash Meadows and Sacaton Canyon were not yet in reproductive mode.

Table 1. Mean presence of inflorescence in plants

Accession	June (%) n=80	July (%) n=80
Moapa	4 [a†]	68 [a]
Pahranagat	14 [b]	23 [b]
Ash Meadows	7 [bc]	3 [c]
Sacaton Canyon	2 [c]	0 [c]

[†] Subscripts without common letters are significantly different (α=0.05). Randomized complete block AOV and LSD All-Pairwise Comparisons Tests were conducted.

Inflorescence differences across the four accessions (July 2005)

Two and a half months later, on October 12, only two plants had not grown seed stalks yet (Table 2). Maturity of inflorescence and stage of flowering were measured between the four accessions. Maturity of inflorescence compares initiation of inflorescence, and flowering represents potential for hybridization. Inflorescence initiation is best compared by looking at the presence of immature seed stalks on the plants. While the majority of Sacaton Canyon had only recently initiated inflorescence, Ash Meadows had gone through this stage long before (98% of the inflorescence had desiccated). In contrast, Moapa and Pahranagat had relatively equal proportions of immature and mature seed stalks. Plants from all four accessions were flowering simultaneously, however Moapa and Pahranagat had a majority in flower. Ash meadows flowered earlier in the season, and Sacaton canyon was just entering its flowering stage.

Table 2. October measurements: mean inflorescence maturity and flowering

Accession	Inflorescence maturity (%) n=100			Flowering (%) n=100
	Immature	Mature	Both	
Moapa	23	24	53	80
Pahranagat	31	22	47	60
Ash Meadows	2	45	54	40
Sacaton Canyon*	80	8	10	10

*Two plants had no seed stalks

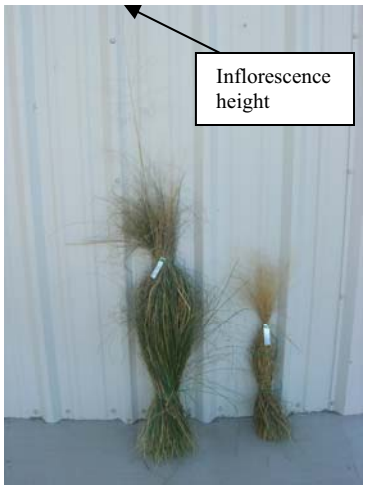
2. Evaluation

Data were collected at the end of the growing season to evaluate the four accessions systematically and quantitatively. Six growth characteristics representing size and reproductive ability were measured: two heights, weight, diameter, number of inflorescences (Table 3). Significant differences were observed for all characteristics except reproductive height. Plants were also evaluated for rust, a pathogen. Although less of an issue in its natural environment, rust may potentially affect production rates in agricultural conditions with higher moisture levels and close proximity of plants. Rust was moderate in all four accessions, although the rates were significantly higher in the smallest accession. We will monitor rust over the next two years to address potential production problems by altering irrigation rates and use of fungicides.

Collecting data for the final evaluation (Nov. 2005)

In all variables describing size, the Sacaton canyon accession was the largest and Ash Meadows was the smallest. Sacaton canyon was the tallest in both foliar height (the length of the bulk of leaves before tapering off) and reproductive height (length of the tallest inflorescence). Differences in reproductive height were visually apparent but not statistically significant, perhaps due to the fact that most inflorescences were dry and brittle by the time of measurement, and many of the tallest had broken off. Foliar estimates of height revealed that Sacaton canyon and Moapa plants were significantly taller than Pahranagat, which was significantly taller than Ash Meadows. Sacaton canyon was approximately 1.5 times heavier than the Moapa and Pahranagat plants, and almost three and a half times heavier than Ash Meadows.

Width and reproductive potential of the plant revealed surprising contrasts with the above measurements of size. Although taller and heavier, Sacaton Canyon did not differ in width from Pahranagat or Moapa, although it was greater than Ash Meadows. Even more interesting was the difference in reproductive potential, represented by total number of inflorescences present at the end of the growing season. Pahranagat, although only of moderate height and mass, had more inflorescences than the three other accessions. This variable was also the only one in which the smaller accession, Ash Meadows, did not rank last. In fact, foliar height was negatively correlated with number of inflorescences. Shorter plants may invest more in reproductive ability.



Size differences were most visible between Sacaton Canyon and Ash Meadows

Table 3. November evaluation of size and reproductive ability

Accession	Foliar height (m) n=38	Reproductive height (m) n=34	Weight (g) n=39	Diameter (m) n=39	Inflorescence (#) n=39
Moapa	0.63 [a†]	1.10 [ab]	471 [b]	0.22 [bc]	55 [b]
Pahranagat	0.54 [b]	1.06 [ab]	451 [b]	0.26 [a]	121 [a]
Ash Meadows	0.40 [c]	0.91 [b]	200 [c]	0.20 [c]	61 [b]
Sacaton Canyon	0.69 [a]	1.23 [a]	694 [a]	0.25 [ab]	74 [b]

[†] Subscripts without common letters are significantly different (α=0.05). Randomized complete block AOV and LSD All-Pairwise Comparisons Tests were conducted.

Conclusions

The establishment year for two southern Nevada species population developments has revealed interesting findings. The large quantity of alkali sacaton seed allowed for planting early in the season and evaluation of the four accessions provided to us from distinct locations in southern Nevada. Unfortunately, due to the extra steps required for alkali muhly, conditions did not allow for the same evaluative process. Although different procedures were undertaken for alkali sacaton and alkali muhly, we expect the same final product in the coming year: a bag of seed. The seed developed from these populations will provide for restoration projects in southern Nevada into the future.

Alkali sacaton growing at Ash Meadows NWR, Nevada

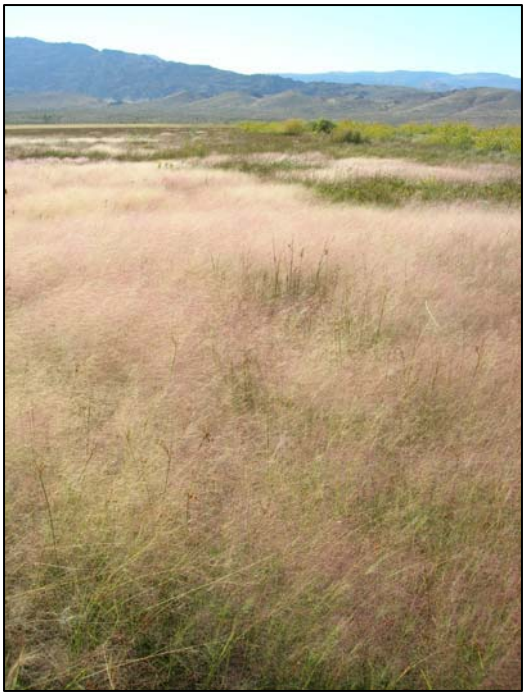
The differences observed between the four accessions of alkali sacaton exemplifies that large variability can exist within species— even within small regions such as southern Nevada. Distance may not be as important as other factors in determining variability in populations. From early observations on seed variation and germination requirements to differences in foliage development and timing of inflorescence, this species reveals remarkable genetic variation within its range in the Mojave Desert of Nevada. While the accession from Sacaton canyon was the tallest and heaviest, its mass was invested in vegetation, whereas the smaller accessions invested more in inflorescence development and reproduction.

These differences observed at the PMC suggest variable tolerances and resource abundance in the accessions' respective origin locations. The exceptionally harsh climate

of the Mojave may allow for particularly distinct divergences in a species within short distances. The observations made on alkali sacaton at the PMC suggest the importance of additional research to determine the value of adapted ecotypes and populations for successful germination and persistence in the landscape. With parent material collected from the peripheries of the area of proposed use (in this case southern Nevada), the progeny germplasm should be well adapted across that area. It may be less desirable to use this material outside that area of origin. We will continue to observe these accessions at the PMC over the next two years for any changes or synchronization in plant growth patterns such as flowering. Following hybridization, it will also be interesting to observe diversity in the progeny, both at the PMC and in field plantings across southern Nevada.

In the coming year, we will continue to observe the alkali sacaton and the alkali muhly fields for time of flowering and other potential differences. We also plan to periodically harvest both fields for maximum production and diversity of seed. We expect the following products from the two population developments:

- Alkali sacaton and alkali muhly seed to plant F1 generation fields at the PMC (spring 2006)
- Alkali sacaton and alkali muhly plugs to establish at least 0.5 ac fields for 2 seed growers in Nevada (fall 2006)
- Hay bales of alkali sacaton from the 2005 growing season (spring 2006)
- Hay bales of both alkali sacaton and alkali muhly from the 2006 growing season (winter 2006)

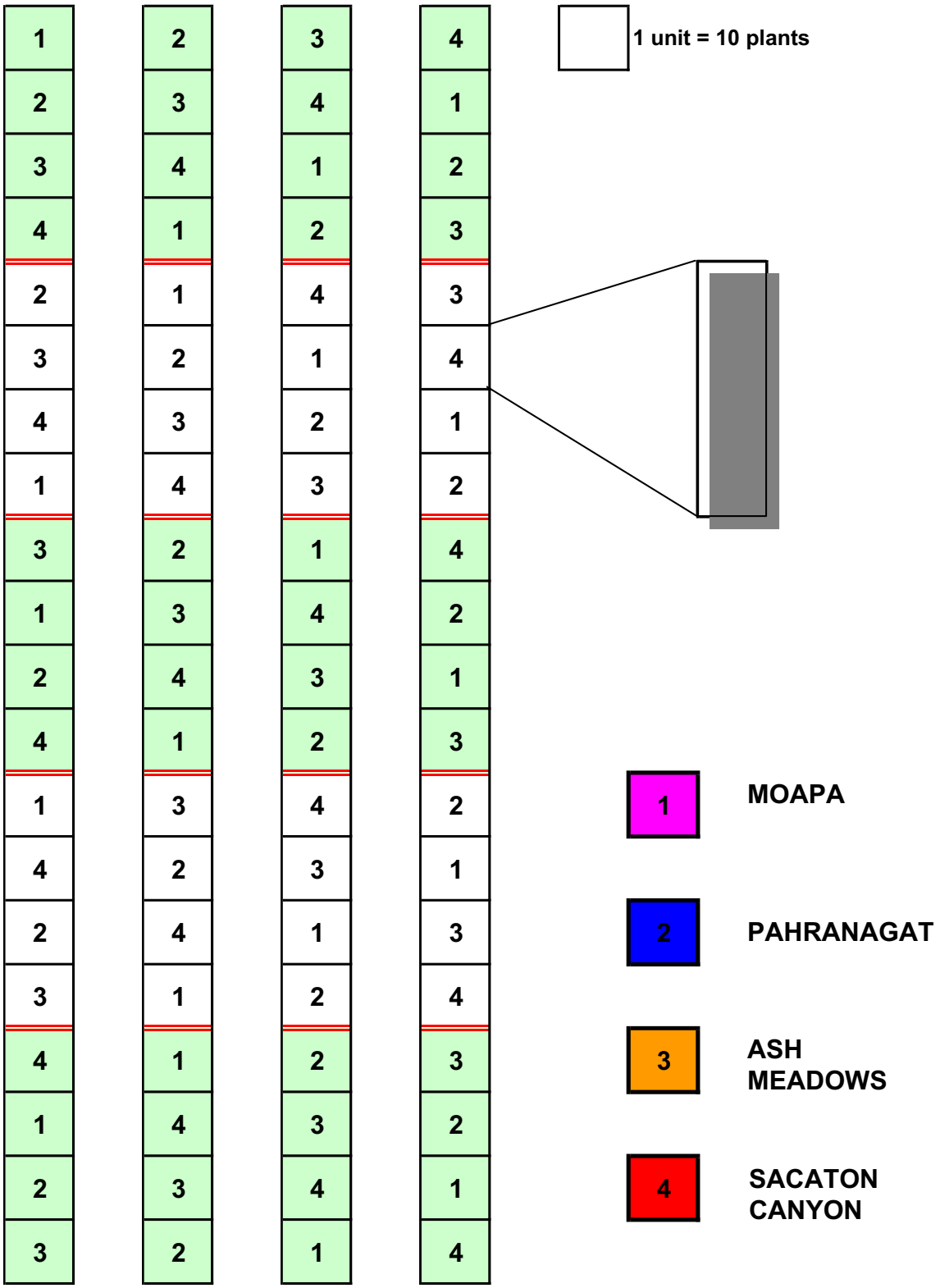


Alkali muhly growing at Pahranagat NWR, Nevada

This fall we plan to assist two seed growers in southern Nevada establish alkali sacaton and alkali muhly fields. We will grow approximately 7,000 plugs of each species/ac and deliver them to the two seed growers. We will help them design and plant the field, and provide information on production, including watering rates, fertilization rates, fungicides and herbicides, and be available to answer or assist with problems they encounter. The continued observations at the PMC on the population development fields, as well as the progeny fields, should help us iron out any potential problems before they occur in production fields in Nevada.

Appendix A. Map of alkali sacaton and alkali muhly collection sites in southern Nevada

Appendix B. Percent purity and percent fill (100 seed X-ray) used to calculate 10 g of pure seed.

Collection Name	Accession Number	Seed/pound	%Purity	% Fill	Quantity Received (g)	Quantity Used (g)
MOAPA	9092497	1,374,545	92	93	12.26	11.44
MOAPA	9092498	1,680,000	92	73	213.30	13.21
MOAPA	9092499	1,463,225	94	93	69.46	11.26
PAHRANAGAT	9092501	1,417,000	94	78	15.89	12.67
PAHRANAGAT	9092502	2,160,000	91	73	34.50	13.36
PAHRANAGAT	9092508	2,268,000	87	83	2117.00	12.78
ASH MEADOW	9092504	N/A	N/A	N/A	76.29*	11.45
ASH MEADOW	9092505	1,744,600	99	94	368.65	10.70
SACATON CANYON	9092507	2,268,000	87	61	59.02	14.69

Appendix C. Alkali sacaton plot plan in Latin Square design with four accessions and four replications.