United States Department of Agriculture
Natural Resources Conservation Service

Tucson Plant Materials Center
Annual Technical Report

2011

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Heather Dial	Assistant Manager
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Introduction

In 1935, the United States Department of Agriculture (USDA)-Natural Resources Conservation Service (NRCS) recognized the need for adapted plant material for use in conservation programs. This need was addressed by the establishment of plant materials nurseries in critical areas throughout the United States. The Tucson Plant Materials Center (AZPMC) was one of the initial centers established in the southwest. Since 1935, the Plant Materials program has grown into a network of 27 centers located throughout the United States, each with their own area of responsibility.

The AZPMC service area encompasses the Sonoran, Mohave, and Chihuahuan desert regions. The center 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 resource technology to meet the service area's conservation needs. Rangelands, mined lands, urban and urban interface areas, riparian areas, croplands, water and air quality, invasive species, and wildlife habitat all present resource challenges within the AZPMC service area.

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

This publication provides a summary of studies and activities carried out by the AZPMC during fiscal year 2011. For further information please contact us at:

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Summary of 2011 Weather Conditions at the Tucson Plant Materials Center Tucson, Arizona

Month	Temperature (°F)		Precipitation (inches)
	Maximum	Minimum	
January	78	21	0.00
February	82	18	0.25
March	90	40	0.02
April	95	37	0.28
May	100	47	0.00
June	112	59	0.03
July	111	67	1.64
August	108	72	1.35
September	106	63	5.60
October	99	45	0.06
November	87	35	0.97
December	79	28	2.03

Frost Free Days	=	344
Days Above 100 ^{o}F	=	70
Coldest Temperature	=	18° (February 3 and 4)
Hottest Temperature	=	112° (June 27)
1st day 100 ^{o}F	=	May 27
1st day 32 (or Below) ^{o}F	=	January 1

Tucson Plant Materials Center Service Area

Tucson Plant Materials Center Studies

Development of a Sideoats Grama (*Bouteloua curtipendula*) Population for a Major Land Resource Area 41

Study ID Code	AZPMC-T-0601-CR
Title	Development of Technology for Production of Sideoats grama (*Bouteloua curtipendula*) for Southeast Arizona
National Project No.	Natural Areas 1.1 Rangeland Pastureland/hayland 2.1 Wildlife 1.1
Study Type	Population Development
Study Status	Active
Location	AZPMC
Study Leaders	Manuel Rosales, Heather Dial AZPMC
Duration	2006 through 2012
Description	Sideoats grama is common throughout Arizona and well recognized by the general public. A regional ecotype for the Southeastern Arizona Basin and Range MLRA would be a welcome addition to seed mixes for conservation plantings.
Status of Knowledge	Sideoats grama is a native grass common throughout Arizona, particularly in the Southeastern Arizona Basin and Range MLRA. 'Niner' and 'Vaughn' sideoats from NM have been shown to be short-lived in field trials in Arizona, particularly following drought, and likely not adapted to Arizona's environmental conditions.
Experimental Design	Randomized Complete block Design with 8-replications of 28 accessions. Fewer numbers of plugs from accessions 29-36 did not allow for their inclusion in the primary plots. However, they were used to establish a secondary plot to increase the genetic diversity of the planting. This design is used to arrange accessions to maximize intercrossing by placing the accessions adjacent to each other as frequently as possible. (See plot plan)
Materials & Methods	Samples of seed were assembled by AZPMC and AZ field office and technical staff from southeastern Arizona. Seed will be planted at the Tucson Plant Materials Center. Plants will be grown in plugs in the greenhouse and transplanted to the field. Each experimental unit will consist of an equal number of transplants. The plants will be planted into an irrigated field. Rows will be approximately 38 inches apart and spacing between plants will be approximately 12 inches. Cultural practices may include mechanical and chemical weed control, fertilization and chemical control of pests. Growth characteristics such as height, mass, flowering times and seed production will be evaluated for the different accessions throughout the growing season.
Final Evaluations	Field Plantings will be installed in various locations in southeastern Arizona to test adaptation of the material. Seed from original collections and from the new population will be analyzed for genetic diversity within and between populations.
Technology Transfer Products	Plant fact sheet, planting guide, internal reports, research article, presentations
Literature Cited	Flora of North America, Vol. 25; A Field Guide to the Grasses of New Mexico; Principles of Crop Improvement; Principles of Cultivar Development; Experimental Design, ANOVA and Regression.

Sideoats grama (AZPMC-T-0504-CR) Plot Plan:

Accession	ID Within the Plot Plan	Accession	ID Within the Plot Plan
9092528	1	9092704	19
9092550	2	9092705	20
9092551	3	9092718	21
9092580	4	9092737	22
9092581	5	9092519	23
9092582	6	9092538	24
9092599	7	9092588	25
9092623	8	9092613	26
9092651	9	9092616	27
9092654	10	9092641	28
9092660	11	9092517	29
9092667	12	9092518	30
9092672	13	9092521	31
9092674	14	9092629	32
9092579	15	9092555	33
9092604	16	9092520	34
9092682	17	9092553	35
9092694	18	9092578	36

Accomplishments/Results:

Background:

This field (field 6, border 10) was planted in late July of 2006. In 2007, seed samples were collected from four of the planted rows to evaluate how seed quality and germination varied between the accessions. Approximately 500 seed per accession were harvested from the middle 6 plants of each 10 plant unit. Out of the 500 seeds, four packets of 100 seed were counted exactly using a Count-A-Pak seed counter. These packeted seeds will be used for a greenhouse germination experiment planned for next year.

Growing season 2008:

In 2008, the majority of seed set in the field was lost to a summer thunderstorm.

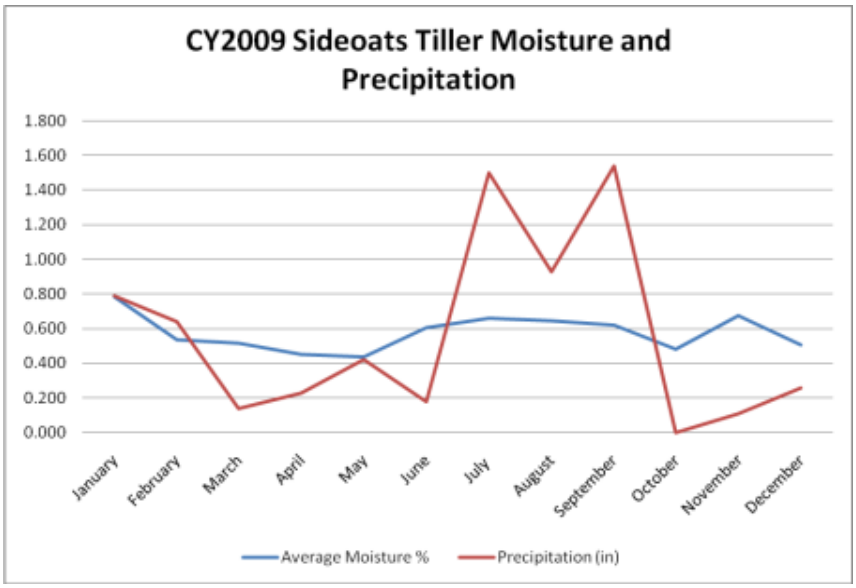
Growing season 2009:

Technology:

Germination trials were conducted in December of 2008 on seed collected from the field in 2007. The trials consisted of four replications of 100 seed from 28 accessions collected from four rows. Each 100 seed replication was cleaned on a rubbing board and placed in germination trays in the greenhouse at alternating temperatures of approximately 60°F/85 °F for four weeks. None of the replications exhibited a germination response. University of Arizona professor, Dr. Steve Smith, was consulted in mid January 2009 about the germination trial results.

Dr. Smith indicated that in order to encourage viable seed production from plants adapted to this region, it might be necessary to decrease the irrigation frequency of the planting. A monitoring schedule for the tiller moisture of individual plants within the planting was initiated to estimate the field's drought stress. To determine the tiller moisture of the plants, a four inch section of green tiller was cut, weighed, dried, and weighed again. The following equation was then used to determine the moisture fraction of the tillers: % dry weight = (fresh weight – dry weight) / (fresh weight). The planting was to be irrigated when average tiller moisture reached ~30% due to precipitation inputs (see graph below). Tiller moisture measurements never fell below 40%, although significant drought stress was apparent in some accessions. A single irrigation of 0.17 acre feet was conducted in early August to prevent mortality of these accessions. The field was treated with 3 quarts/acre of a pre-emergent herbicide (oryzalin) in March 2009 to control broadleaf weeds.

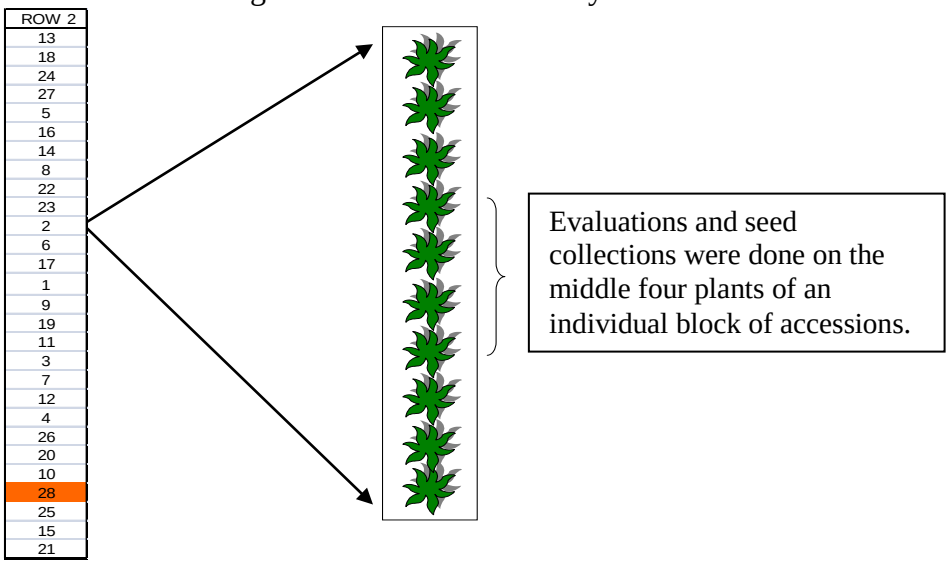
Graph of Average Tiller Moisture Percentages and Precipitation Totals for 2009



Genetic Diversity:

It is believed that the majority of the accessions in this field are of the variety *caespitosa*, a predominately apomictic reproducer. However, MLRA 41 may harbor populations of varieties *curtipendula* or *tenuis*, which in general produce sexually or vegetatively. To determine which varieties are present in the planting, evaluations of individual accessions were conducted on 5 and 13 August 2009. The following characteristics were evaluated on the middle four plants of an accession: # of branches/panicle, # of spikelets/branch, anther color, vegetative color, and the presence or absence of stolons.

In mid-September 2009, hand harvests were conducted from three rows (2, 4, and 6) within the field. Seed was collected from the middle four plants of an individual block of accessions. Seed produced per accession was estimated by counting intact seed found in 0.5 grams of harvested seed. The seed will be used in germination tests in fiscal year 2010.



Growing season 2010:

On 21 May 2010, the sideoats plot was damaged by archaeologists working for the Arizona Department of Transportation (ADOT). The western accessions in replication one were completely removed from the ground. The western accessions in replications 2-8 were buried by soil dug up from replication one. The majority of the damage done to the plants was done to those of the secondary plot. The archaeological crew completed the backfill of the trenches dug in the plot on the 27th of May.

Trenches dug in sideoats field

Sideoats field after backfilling

For the remainder of 2010, the field was allowed to recover from the damage and no data was collected. A significant amount of re-leveling/furrowing between the planted replications was necessary to allow for irrigation waters to reach the end of the field. The buried plants recovered slowly from the damage.

Growing Season 2011:

In late 2010, yellow sticky cards were placed in the border of sideoats to gauge the insect population of the field. An unusually high number of thrips (*Chirothrips spp.)* were found within the field. An insect control program was planned and implemented in May of 2011. Pyreth-it®, a highly concentrated pyrethrum insecticide, was sprayed approximately every two weeks from May until July 2011.

On July 28th and 29th, evaluations of individual accessions in replications 3, 4, 5 and 6 were conducted. Evaluations included seed harvest by accession, counting branches per panicle and noting anther color and any distinguishing characteristics of the individual accessions. 2011 seed yields were dramatically reduced when compared to the 2009 yields. It is believed that the Pyreth-it® applications were ineffective. Another insecticide spraying regimen is being developed for growing season 2012.

Development of Technology for seed production of 'Sonora' Black grama (*Bouteloua eriopoda*)

Study ID Code	AZPMC-S-0503-CR
Title	Development of technology for seed production of 'Sonora' Black grama (*Bouteloua eriopoda*)
National Project No.	Natural Areas 1.1 Rangeland 1.1 Pastureland/hayland 2.1 Wildlife 1.1
Study Type	Technology development
Study Status	Active
Location	AZPMC
Study Leaders	Manuel Rosales, Heather Dial
Duration	2006 through 2011
Description	Develop agronomic protocols for seed production of the 1965 release 'Sonora' Black grama
Status of Knowledge	In demo garden, 'Sonora' has been shown to be better adapted to southern Arizona than 'Nogal' and appears to be much more rhizomatous. 'Sonora' black grama [*Bouteloua eriopoda* (Torr.) Torr.] was released by the AZPMC 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 the time of 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 buildup of parasitic insects.
Experimental Design	Randomized complete block or split plot with 3-4 replications will be utilized depending on need.
Materials & Methods	Seed will be planted at the Tucson Plant Materials Center. Plants will be grown in plugs in the greenhouse and transplanted to the field. The plugs will be planted into an irrigated field. Rows will be approximately 38 inches apart and spacing between plants will be approximately 12 inches. Cultural practices may include mechanical and chemical weed control, fertilization, and chemical control of pests.
Final Evaluations	Field Plantings will be installed in various locations in southeastern Arizona to test adaptation of the material. Seed from original collections and from the new population will be analyzed for genetic diversity within and between populations.
Technology Transfer Products	Plant fact sheet, planting guide, internal reports, research article
Literature Cited	Flora of North America, Vol. 25; A Field Guide to the Grasses of New Mexico; Principles of Crop Improvement; Principles of Cultivar Development; Experimental Design, ANOVA and Regression.

Accomplishments/Results:

Background:

In 2005, a 0.25 acre production field was established at the AZPMC to determine if agronomic and pesticide protocols could be developed that would make 'Sonora' a viable cultivar for southern Arizona and New Mexico. No seed crop was harvested from this plot until 2008 due to minimal seed set.

Growing season 2008:

During the 2008 harvest, personnel were caught in a typical summer/late fall monsoon. The small amount of seed collected was soaked. As such, no data was collected. Thrips have been observed in the florets of the plants and could be a contributing factor for the low amount of seed that is being set every year. Our next step is to set up an insecticide spraying program to control the thrips.

Growing season 2009:

In early March, the field was treated with 5 quarts/acre of a pre-emergent herbicide (pendimethalin). The field received 4 irrigations (March, June, June, and July) totaling 0.93 acre feet of application. On June 4th, a 20 lb/acre application of nitrogen was completed and during the month of July 1.5 pints/acre of 2,4-D was applied for weed control. In August, 6.25 bulk pounds of seed was collected using the Woodward FlailVac. Field investigations conducted throughout the season indicate that thrips are active in the field. A trial using two to three insecticides for thrips control is being planned for growing season 2010.

Growing season 2010:

In June, BASF Sensor® 3x5 in. yellow pest monitoring cards were placed in the field to aid in identification of insect populations. As expected, an unusually high population of thrips (Order *Thysanoptera*) was found. A randomized complete block design with 3 replications was established in the field to conduct an insecticide trial. The field dimensions are 388 feet long by 32 feet wide with a total area of approximately 0.3 acres.

FIELD LAYOUT

IRRIGATION DITCH

REP-III		**REP-II**		**REP-I**	
R-6	**R-5**	**R-4**	**R-3**	**R-2**	**Row-1**
Control	**Spray**	**Spray**	**Control**	**Control**	**Spray**

Three insecticides were evaluated for use in the trial. The insecticide chosen for use in the trial was Pyreth-it® based on its low risk for humans and the environment.

The field was sprayed twice (July and August) at a rate of 16oz. / acre. On November 1st, three square meter samples were clipped from each row to determine what effect, if any, the insecticide applications had on seed production. The samples have not been processed and statistically analyzed at the time of this report. The frequency of spray treatments will be adjusted during growing season 2011 based on the sample results.

Thrips monitoring

Collecting samples

Growing season 2011:

The samples collected during 2010 were processed with a Westrup Brush Machine and Office Clipper and evaluated for seed production in the winter of 2010. There was no appreciable seed found in any of the samples collected in 2010. During growing season 2011, the field was again sprayed with Pyreth-it® 5 times (5/17, 5/23, 6/1, 7/1, and 7/25), with no positive results in seed yield. A different insecticide will be applied during growing season 2012 to determine if seed yields can be increased.

Development of Technology for Seed Production of Various Releases for First-Time Native Seed Farmers in Southern Arizona

Study ID Code	AZPMC-S-0602-CR
Title	Development of Technology for Seed Production of Various AZPMC Releases for First-Time Native Seed Farmers in Southern Arizona
National Project No.	Natural Areas 1.1 Rangeland 1.1
Study Type	Development of Establishment Technology
Study Status	Active
Location	AZPMC
Study Leaders	Manuel Rosales, Heather Dial, Mary E. Hershdorfer, AZPMC
Duration	2006 through 2012
Vegetative Practices	342 Critical Area Planting 550 Range Seeding 645 Wildlife Upland Habitat Management
Description	Develop protocol for establishment of commercial seed production fields for first-time native seed growers in southern Arizona.
Status of Knowledge	The native seed business for the Desert Southwest is currently in peril. Few native seed growers exist in southern Arizona, or for that matter, within the AZPMC service area. Potential seed purchasers in this region are often discouraged from native seed plantings because of the high cost of seed and frequently low germination rate or persistence. Many plantings have been conducted using "common" seed without consideration of genetic origin, possibly the cause of the previous plantings' failures. Most seed available to the market with adaptation to this region is hand-harvested by contracted seed collectors at a steep price. The AZPMC would like to encourage the use of regionally adapted ecotypes in rangeland plantings to increase their success. Having seed grown under agronomic conditions would decrease the per pound price of the seed. A recent study conducted by the AZPMC comparing multiple alkali sacaton accessions from southern Nevada suggests that harsh dry climates likely require the use of adapted germplasm in order for the plants to germinate and persist. AZPMC releases are now developed from multiple collections across their intended region of use. Few AZPMC releases are commercially available, although the AZPMC has made an effort in recent years to work on species currently in demand. The AZPMC would like to encourage interested farmers in southern Arizona to enter into native seed production agreements, however, locating farmers willing to take the initial risk of transitioning to a new crop with different requirements is a challenge. Several ideas to decrease risk to the farmer and increase chances of their success have been suggested to encourage this transition. Experiences and lessons learned will be included in this study.
Experimental Design	None. The study is designed to increase seed production of AZPMC releases in Southern Arizona.

Materials & Methods

Multiple AZPMC Releases are currently in demand and simple to grow, including 'Loetta' Arizona cottontop, Pima Germplasm Pima pappusgrass, Vegas Germplasm Alkali sacaton and Moapa Germplasm Alkali muhly. Several species not yet released but in development at the AZPMC have origins in southeast Arizona, and the establishment of growers in this region would be ideal due to the adaptive nature of the species.

Experienced farmers willing to try new crops will be considered for this project. Only simple to grow species with a guaranteed market will be recommended for these first-time growers. Assistance with specialized equipment will be provided or possibly available through the local RC&D for loan.

Final Evaluations

Farmers will need to keep their fields weed free, sufficiently irrigated/maintained, and harvested at appropriate times for commercial success. Evaluations of field success will be conducted using adapted versions of the On Farm Assessment & Evaluation sheets. With producer's approval, other information documented will include:

- How long it takes producer to come up with a saleable product
- Yield data for the 1st several years to determine when the crop reaches optimal yield
- Length of time for stand establishment
- Difficulties such as weed control, irrigation, harvest

Technology Transfer Products

Tech Note on establishment protocol, Planting guides, internal reports.

Literature Cited

- Native Grass Seed Production for Southern Nevada, Tucson PMC, USDA- NRCS, March 2006
- Native Seed Production, AZPMC in cooperation with Coronado RC&D, USDA-NRCS, September 2004
- Steve Smith and Debra Hendenheim, Seed of wildland plants in Arizona: Evaluating current supplies and projecting demands, University of Arizona, 2004.
- BLM annual project reports (also in AZPMC Annual Technical Report) – yr 2005, 2006, 2007

Accomplishments/Results:

Growing season 2008:

AZPMC personnel met with Tohono O'odham Farming Authority representatives during the growing season of 2008. Afterward, the AZPMC provided seed of Pima germplasm Pima pappusgrass and 'Loetta' Arizona cottontop to the authority for the establishment of a pilot project. Authority representatives have since been in contact with AZPMC personnel to discuss planting times and requirements. Additionally, AZPMC personnel met with Bob Roth, the director of the University of Arizona Maricopa Agricultural Center, about production of native grasses. Seed of Vegas alkali sacaton and Moapa alkali muhly was provided to Mr. Roth for a growing trial. AZPMC personnel have maintained contact with Mr. Roth and are working to provide technical assistance in the planting of the seed.

Growing season 2009:

In April of 2009, Bruce Munda, Arizona Plant Materials Specialist, visited the Tohono O'odham Schuk Toak Farm to provide technical assistance to the farm supervisor, Max Banda. In September of 2009, 'Loetta' Arizona cottontop and Pima germplasm Pima pappusgrass were direct seeded into a five acre planting on the farm. AZPMC staff was on hand during the planting to provide technical assistance and have since visited the farm twice to check the status of the plantings. Plantings of Vegas alkali sacaton and Moapa alkali muhly were not initiated at the University of Arizona Maricopa Agricultural Center but are still being discussed.

Growing season 2010:

The plantings of Pima germplasm Pima pappusgrass (*Pappophorum vaginatum*) and 'Loetta' Arizona Cottontop (*Digitaria californica*) conducted during September of 2009 at the Tohono O'odham Schuk Toak Farm were a success. Both species germinated well. Pima germplasm had an approximately 90 percent germination rate and Arizona Cottontop exhibited approximately 70 percent germination. In May of 2010, AZPMC staff provided an on-site demonstration of the Woodward flail-vac seed stripper to harvest the Pima pappusgrass. Approximately 350-400 bulk pounds of seed were harvested from the 5 acre field. The harvested seed was sold by Tohono O'odham Schuk Toak Farm to a local seed vendor. The AZPMC provided information on harvesting equipment and seed cleaning equipment to the Schuk Toak Farm and continues to provide technical assistance. It is our hope that the Schuk Toak farm will continue growing native grasses to supply the local market.

Pima Pappusgrass, Tohono O'odham Schuk Toak Farm

Growing season 2011:

On April 5, 2011, the AZPMC Manager, Manuel Rosales, visited the Schuk Toak Farm to evaluate the planting and to determine if the Schuck Toak Farm was still interested in proceeding with commercialization of the AZPMC releases. Rosales spoke with the farm supervisor, Brett Salvador. Brett indicated that Benito Alvarez Jr., Tohono O'odham Farming Authority, General Manager, was still interested. Rosales provided the contact information for a local native seed re-vegetation company, as a possible customer for seed produced at the Shuck Toak Farm. The fields planted in 2010 were visited and the planting is still in good condition.

Development of Technology for Seed Production of Various AZPMC Releases for First-Time Native Seed Farmers in California

Study ID Code	AZPMC-S-0803-CR
Title	Development of Technology for Seed Production of Various AZPMC Releases for First-Time Native Seed Farmers in California
National Project No.	Natural Areas 1.1 Rangeland 1.1
Study Type	Development of Establishment Technology
Study Status	Active
Location	AZPMC
Study Leaders	Manuel Rosales, Heather Dial, Mary E. Hershdorfer AZPMC
Duration	2006 through 2012
Vegetative Practices	343 Critical Area Planting 551 Range Seeding 645 Wildlife Upland Habitat Management
Description	Develop a protocol for establishment of commercial seed production fields for first-time native seed growers in the Mojave region of California.
Status of Knowledge	The native seed business for the Desert Southwest is currently in peril. Few native seed growers exist in southern Arizona, or for that matter, within the AZPMC Service Area. Potential seed purchasers in this region are often discouraged from native seed plantings because of the high cost of seed and frequently low germination rate or persistence. Many plantings have been conducted using "common" seed without consideration of genetic origin, possibly the cause of the previous plantings' failures. Most seed available to the market with adaptation to this region is hand-harvested by contracted seed collectors at a steep price. The AZPMC would like to encourage the use of regionally adapted ecotypes in rangeland plantings to increase their success. Having seed grown under agronomic conditions would decrease the per pound price of the seed. A recent study conducted by the AZPMC comparing multiple Alkali sacaton accessions from southern Nevada suggests that harsh dry climates likely require the use of adapted germplasm in order for the plants to germinate and persist. AZPMC releases are now developed from multiple collections across their intended region of use. Few AZPMC releases are commercially available, although the PMC has made an effort in recent years to work on species currently in demand. The AZPMC would like to encourage interested farmers in California to enter into native seed production agreements, however, locating farmers willing to take the initial risk of transitioning to a new crop with different requirements is a challenge. Several ideas to decrease risk to the farmer and increase chances of their success have been suggested to encourage this transition. Experiences and lessons learned will be included in this study.
Experimental Design	Only individuals with extensive experience in farming, interest in a new challenge need apply. Only simple to grow species with a guaranteed market will be recommended for these first-time growers. The PMC will provide technical assistance as needed.

Materials & Methods	Multiple AZPMC Releases are currently in demand and simple to grow, including 'Loetta' Arizona cottontop, Pima Germplasm Pima pappusgrass, Vegas Germplasm Alkali sacaton and Moapa Germplasm Alkali muhly. Several additional species are currently in development at the Tucson PMC.
Final Evaluations	Farmers will need to keep their fields weed free, sufficiently irrigated/maintained, and harvested at appropriate times for commercial success. Evaluations of field success will be conducted using adapted versions of the On Farm Assessment & Evaluation sheets (Attachment 1). With producer's approval, other information to be documented will include: • How long it takes producer to come up with a saleable product • Yield data for the 1st several years to determine when the crop reaches optimal yield • Length of time for stand establishment • Difficulties such as weed control, irrigation, harvest
Technology Transfer Products	Tech Note on establishment protocol, Planting guides, internal reports.
Literature Cited	• Native Grass Seed Production for Southern Nevada, Tucson PMC, USDA- NRCS, March 2006 • Native Seed Production, AZPMC in cooperation with Coronado RC&D, USDA-NRCS, September 2004 • Steve Smith and Debra Hendenheim, Seed of wildland plants in Arizona: Evaluating current supplies and projecting demands, University of Arizona, 2004. • BLM annual project reports (also in PMC Annual Technical Report)– yr 2005, 2006, 2007

Accomplishments/Results:

Growing season 2009:

PMC personnel attended the Desert Mountain RC&D meeting in Needles, CA on April 30th to discuss the project with the RC&D. Few agriculturalists showed up for the meeting but it was an opportunity to meet key individuals from participating agencies, including NRCS local field offices and the councils for Desert Mountain and the Antelope Valley RC&Ds. On June 3, 2009, a second meeting was scheduled in Lancaster, CA, with the help of the Lancaster NRCS field office and the Desert Mountain RC&D, to present the project to a larger group of agriculturalists. The primary members of the collaborative project gave a presentation to a group of about 20 individuals. A site visit was made to an interested farmer's farm the following day and a decision was made to pursue planting at the farm. PMC personnel began planting alkali sacaton plugs to fill 5 acres on the farmer's farm in June. Unfortunately, the prospective farmer decided to leave his business in July. PMC personnel maintained the alkali sacaton plugs overwinter while the search began anew for an interested farmer.

Growing season 2010:

A new interested farmer located near Needles, California was located in late 2009 with the assistance of the NRCS field office in Kingman, Arizona. A contract was secured with the farmer via the High Desert RC&D based out of Las Vegas, Nevada to produce both Vegas germplasm alkali sacaton (*Sporobolus airoides*) and Moapa alkali muhly (*Muhlenbergia asperifolia*) seed. The plantings are part of a collaborative agreement between the PMC and the Bureau of Land Management (BLM) developed to address the need for locally adapted native plant materials for rehabilitation and restoration projects for the BLM Southern Nevada District.

On April 12th, PMC personnel traveled to Needles, CA to plant the alkali sacaton plugs started the previous growing season. Approximately 5 acres of alkali sacaton plugs were planted using the Holland Mechanical Transplanter. An estimated 30,000 plugs were used for the 5 acres. The planting had an 80% survival rate, and the first harvest was conducted with a Woodward flail-vac seed stripper in November.

Alkali Sacaton in Jiffy Plugs-TPMC

Alkali sacaton ready for harvest-Near Needles, CA

Growing Season 2011:

In mid December of 2010, approximately 28,000 plugs of Moapa germplasm alkali muhly (*Muhlenbergia asperifolia*) were seeded. In April 2011, five PMC personnel traveled to Needles, CA to plant the plugs. In addition to personnel from the Las Vegas BLM, Las Vegas High Desert RC&D and NRCS Kingman Field Office personnel were on hand to plant the alkali muhly plants. The plants established well throughout the growing season of 2011 and the first seed harvests are expected in late 2012.

PMC personnel also received and cleaned 911 bulk pounds of alkali sacaton harvested from the Needles, CA planting site during growing season 2011. The seed cleaning process included hammermilling raw material and air screen separation of hammermilled material with the Clipper Eclipse Model 324 Seed and Grain Cleaner. A table summarizing seed received and cleaned is below.

2010-2011 Harter Farms Harvests

Harter Farms SPAI #9094151	Growing Season 2010		Growing Season 2011	
received date	10-Nov-10	9-Mar-11	June	Nov
bulk pounds	230	99	394	188
cleaned pounds	101	2.6	322	87

Transition to Organic: A comparable study between conventional and organically grown alfalfa

Study ID Code	AZPMC-T-1002-PA
Title	Transition to Organic: A comparable study between conventional and organically grown alfalfa
National Project No.	Natural Areas 1.1
Study Type	Technology study
Study Status	Active
Location	AZPMC
Study Leaders	Manuel Rosales, David Forestieri & Heather Dial-AZPMC
Duration	2010 to 2015
Vegetative Practices	327-Conservation Cover 340-Cover Crop 590-Nutrient Management 512-Pasture and hayland Planting
Objective:	To collect information and data to facilitate and support the National Organic Program initiative and to provide technical information regarding the transition to organic production to Arizona NRCS-Field Offices.
Status of Knowledge	Alfalfa (*Medicago sativus*) is a crop that lends itself to transition to organic production due to its soil benefits and biological nitrogen fixing capability. Organic production integrates cultural, biological and mechanical practices that improve cycling of resources, promote ecological balance and conserve and enhance biodiversity. Production of organically grown alfalfa involves following guidelines of the National Organic Program standards as defined by the U. S Department of Agriculture. Growing alfalfa organically as compared to conventionally can be quite challenging. This study was set up to investigate some of the challenges that a producer may encounter while transitioning from a conventional to an organic system, as well as to compare forage production under both systems.
Experimental Design	Non-replicated trial
Materials & Methods	Two fields (0.7 acre each) were seeded to the alfalfa variety CUF -101 at 15 lb per acre. Soil amendments were incorporated into both fields before seeding. One field was prepared conventionally by adding soil amendments (phosphorous (0-45-0) and sulfur (85-3.5-1.5) each at 800lbs. / acre) according to soil test results. The field reserved for the organic treatment received only sulfur to help counteract high soil pH. Both fields were laser leveled prior to planting to improve irrigation efficiency.
Evaluations	Incidence of weeds, insects, and diseases will be observed and recorded. Annual production of forage as well as the number of cuttings/clippings per year will be recorded. Costs of production inputs to establish the plots and maintenance of the plots after the first year of establishment will be recorded. Any other noticeable differences between the plots will be noted.
Technology Transfer Products	Technical note, fact sheet and internal reports.

Literature Cited

1. Summers, G.H., and D.H. Putnam. 2008. Irrigated Alfalfa Management for Mediterranean and Desert Zones. University of California Agriculture and Natural Resources.
2. Tickes, B. and M. Ottman. 2008. Alfalfa Weeds Control in the Low Desert Deserts of Arizona. The University of Arizona Cooperative Extension.
3. Kemper, J. 2006. Transitioning to Organic Production. www.attra.nact.org/organic.html
4. USDA-NRCS-VT. 2007. Transition to Organic Production. Natural Resources Conservation Service Conservation Practice Standard-code 789

Accomplishments/Results:

Growing season 2010:

On April 28, the comparative trial for alfalfa, conventional versus organic, was seeded. The plots germinated well with approximately 70-80% germination in the organic plot and 80-90% in the conventional plot. The plots were irrigated immediately after planting and thereafter as needed until the end of September. Ten irrigations were applied from April-September for a total of a 2.0 acre feet of water applied. Throughout the growing season the organic plot was treated with a solution of TeraGanix, Inc. EM-1®, a microbial inoculant soil conditioner, through the irrigation water. EM-1® complies with USDA organic standards. Applications were done every other irrigation at the recommended label rate.

During the growing season, both plots had a diversity of grass and broadleaf weeds. Weeds were controlled by mowing in both plots, and the conventional plot was also treated with herbicide 'Poast' (sethoxidim at a rate of 2 pints/acre) in an attempt to control grass weed species. No herbicide was applied in the organic plot. No forage production samples were collected during the establishment year. Forage production data will be collected during the growing season of 2011.

Germinating Alfalfa-May 2010

Alfalfa &Weeds-2010

Growing season 2011:

The organic plot was treated with TeraGanix, Inc. EM-1®, a microbial inoculant soil conditioner, all season. Applications were done every other irrigation at the recommended label rate. No fertilizer or any other amendment was applied to the conventional plot. Irrigation was applied as needed resulting in a total application of approximately 4 acre foot per plot. The plots were clipped five times and mowed ten times during the growing season. Four square meter samples were hand clipped at each cutting from the conventional and organic plot. The samples were air dried and weighed. . Forage yields are averaging 1.5 tons (100 % dry matter) per acre per cutting for both the conventional and organic plot. Results are presented in the following table.

2011Alfalfa forage yield in tons/acre (100% dry matter)

	Harvest Date						
	May -27	**June-28**	**Sep-1**	**Oct-18**	**Nov-23**	**Total Production**	**Average Production /Cutting**
Organic	1.34	1.72	1.62	1.30	1.54	7.52	1.50
Conventional	1.40	1.82	1.64	1.50	1.17	7.53	1.51

**All yields are an average of four replications*

Square meter before harvest

Square meter after harvest

Control of Buffelgrass (*Pennisetum cilicare*) at Santa Rita Experimental Range Study Plan

Study ID Code	AZPMC-T-0612-IN
Title	Control of Buffelgrass at the Santa Rita Experimental Range
National Project No.	Natural Areas 1.1 Rangeland 1.1
Study Type	Development of Establishment Technology
Study Status	Active
Location	AZPMC
Study Leaders	Mary E. Hershdorfer, Heather Dial, Ramona Garner AZPMC
Duration	2006 through 2010
Vegetative Practices	344 Critical Area Planting 645 Wildlife Upland Habitat Management 543 Land Reclamation, Abandoned Mine Land
Description	Control of Buffelgrass will take place within 13 ac PMC exclosure at the Santa Rita Experimental Range, as well as on associated satellite infestations around its borders Chemical spraying using tractor (for central infestation), and ATV sprayer and backpacks (for isolated smaller infestations) will be conducted, with attention to avoid native vegetation as much as possible. Experimental use of grass-specific herbicide in small plots will also take place. The majority of the infestation will hopefully be controlled in the first 3 years, followed by spot spraying in subsequent years, until only occasional treatments are necessary at the site.
Status of Knowledge	Little information is known about Buffelgrass (*Cenchrus ciliaris*) increase or control in southern Arizona. In recent years, significant increases along roadsides, other disturbed areas as well as undisturbed sites with certain conditions have been observed from Mexico to low desert areas of southern Arizona. This species is drawing increasing concern from land managers, researchers and widely by the general public. Based the records of numerous plantings conducted inside the PMC planting exclosure at the SRER since the 1930s, the current infestation of buffelgrass that has taken over much of the exclosure appears to stem from a planting conducted in 1985. The PMC has taken this opportunity to examine the effectiveness of chemical spraying of this species, as well as the responsibility of this particular infestation. Based on seed germination trials, the seed appears to survive 3 years in the soil. Hopefully after 3 consecutive years of careful treatments, this infestation will be significantly decreased and control efforts will be minimized. Following the success of the initial treatment year in 2006, the UA began a process to exterminate buffelgrass across the entire SRER.
Experimental Approach	Careful spraying of buffelgrass within the 13 ac fenced PMC exclosure at the SRER and associated satellite infestations beyond the fence line. Infestation within the plot as well as its spread to nearby washes and roads were plotted using a GPS before any treatment began. Three small (1000 sq ft) plots inside the exclosure (marked with colored rebar) along the western fenceline were reserved for experimentation with a grass-specific herbicide, Fluazifop which has been effective on seedlings and young grasses. A Tractor with an 18-ft boom is used for the central part of the infestation (a monoculture of approx. 7

ac), and the ATV sprayer and backpack sprayers are used for smaller isolated infestations, in order to avoid spraying of native vegetation- which will hopefully re-colonize the sprayed areas as buffelgrass populations are reduced.

Materials & Methods	Tractor, ATV and backpacks used for chemical applications. Spraying period begins once plants have sufficient green growth (as early as July), and ends well before they re-enter dormancy (before September). Ideally spraying begins in conjunction with summer rains, when the plants are most vigorously growing. Younger, less decadent plants are easier to treat. 5% Roundup applications (combined with dish soap and blue dye) were used to spray the buffelgrass. Approximately 130 gal of water was transported to the site to spray the densest section of the infestation (approx. 7 ac) with the tractor. To cover the entire infestation, approx. 240 gal of water may be required. A truck and trailer hauling the tractor, and a separate truck hauling four 60-gal water drums, chemical, ATV and other necessities, arrive at the site in the early morning. One person is needed for tractor work, and a 2 person crew operates the ATV (one driving, one spraying). Several days may be required to cover the entire infestation. The experimental plots were treated (complete coverage) with backpack sprayers according to label.
Final Evaluations	Document the decrease in infestation using GPS after 3 years, and every year following until spot treatments are reduced to very few. Reconnaissance efforts will continue as needed into the future.
Technology Transfer Products	Tech Note on Buffelgrass control, internal reports.
Literature Cited	• PMC Annual Technical Report – yr 2006, 2007 • Financial evaluation of spray equipment

Accomplishments/Results:

The following report is a synopsis of PMC activities concerning AZPMC-T-0612-IN from 2006-2011.

Santa Rita Experimental Range: Buffelgrass Control in PMC Exclosure

STUDY NUMBER: AZPMC-T-0612-IN

Introduction.

In recent years, significant increases in Buffelgrass (*Cenchrus ciliaris)* populations have been observed from Mexico to low desert areas of southern Arizona along roadsides, other disturbed areas, and undisturbed sites. These increases have drawn the attention of land managers, researchers and the general public. In 2006, Tucson Plant Materials Center (PMC) personnel noted that a 1985 Initial Evaluation Planting of Buffelgrass within the PMC exclosure at the Santa Rita Experimental Range (SRER) had taken over much of the exclosure and spread outside the exclosure. Little information was known about effective Buffelgrass control. The PMC took this opportunity to examine the effectiveness of chemical spraying of this species, as well as the responsibility of this particular infestation. Based on seed germination trials, the Buffelgrass seed appears to survive three years in the soil. We hypothesize that after three consecutive years of careful treatments, the infestation will be significantly decreased and continued control efforts will be minimized.

Materials & Methods

Control of Buffelgrass will take place within the 13 acre PMC exclosure at the SRER, as well as associated satellite infestations around its borders. Chemical spraying with a 5% Round-Up solution using a 150 gallon 18-foot boom sprayer pulled by a tractor (for the central infestation) and 30 gallon ATV sprayers and backpack sprayers (for isolated smaller infestations) will be conducted. Experimental use of a grass-specific herbicide (Fluazifop) in small plots within the exclosure will also take place. We expect the majority of the infestation will be controlled within the first three years of control. Thereafter, spot spraying will be conducted on remaining Buffelgrass plants until only occasional treatments are necessary at the site.

Results

2006-Buffelgrass Control

In August 2006, the University of Arizona and the AZPMC agreed it was time to contain the buffelgrass infestation in the test plot. In three days of spraying over a period of a month, using a variety of equipment and multiple individuals, the infestation was sprayed. On the first day, the tractor with an 18 ft boom was used for spraying, requiring a driver and two additional people for directing the tractor movement to assure good coverage. 130 gallons of 5% Roundup solution was used to cover approximately 7 ac, the area of densest infestation. The infestation was located with GPS, which was centered in the exclosure, but also spread to nearby washes and roads. For the following two days of work only ATV and backpacks were used to spray the smaller patches.

The first two visits occurred during the monsoon period, when the plants were growing vigorously. By the third visit a month later, the Buffelgrass was yellowing, entering dormancy. The first two days of spraying killed the Buffelgrass but the third visit was inconclusive.

Jace Householder sprays the infestation of Buffelgrass at SRER plot in 2006

Ramona Garner rejoices at her success two weeks after spraying Buffelgrass (June 2006)

2007 Buffelgrass Control

Early in April 2007, a visit to the SRER revealed two striking observations. The first was color throughout the plot: many native winter forbs were establishing in the plot. It was also clear that the third spray day in September had not likely been as successful as the previous two. Spraying during the height of buffelgrass growth had left the vegetation grey (dead), but spraying following the beginning stages of dormancy only turned many plants a suspicious straw color. It was not until the following visit in June, still early in the growing season and too dry to begin spraying, did the yellowed plants reveal life in the form of green leaves.

A patch of straw-colored buffelgrass with a sprig of green life, surrounded by dead buffelgrass (June 2007)

Needle grama grows densely in the open areas.

Jace Householder sprays the primary infestation with the tractor

In August, after the summer rains, the first of two spray days took place. This year the plot was a verdant green with needle grama (*Bouteloua aristidoides*) covering the ground in the open areas, feather fingergrass (*Chloris virgata*) came up under the drip line of trees, and young buffelgrass plants as seedlings covered the same area as it had the previous year. The seedbank of previous years had plenty of seed left to germinate. The treatment plan in this second year was to use the tractor in the same central infestation as last year, as well as the smaller patches surrounding it. The success with the previous tractor work made it clear that spraying with the tractor was preferable. Only the individual plants and small satellite patches outside the fenced plot were sprayed with the ATV. Many flourishing patches of native plants, particularly Arizona cottontop, were avoided. Three (1000 ft^2) experimental plots for testing a grass-specific herbicide (Fluazifop) were marked with rebar up against the western-fence line.

The truck and trailer carrying the tractor were brought to the plot, followed by a truck with four 30 gal drums of water and several containers of Round up, dish soap and blue dye. The tractor's spray tank was refilled once. The ATV's 30-gal tank was refilled multiple times. A two-person crew used the ATV, while the tractor required only one person.

In one day the entire area was covered. The experimental plots were sprayed with the grass-specific herbicide; however expectations were low because the grasses at this point were larger than anticipated. Grass-specific herbicide is more effective on seedlings, less so on mature plants.
In September a reconnaissance day was scheduled to visit the results of the previous spraying, and to follow up by spraying any missed individual patches or plants. The ATV and several back packs were transported, along with water and chemicals. Few patches needed spraying, however the experimental plots with grass-specific herbicide appeared unaffected. Fears were confirmed that the treatment did not work on plants at that stage of maturity.

An experimental plot for grass-specific herbicide did not kill the buffelgrass.

Leslie Wood sprays buffelgrass

The second year of spraying required treatment of similar acreage, but this is to be expected with an invasive plant such as buffelgrass. The seedbed has been establishing for the past 20 years, and the dead plants from 2006 left space and resources for establishment of seedlings the following year. The second year required less effort however, as the spraying of young plants as opposed to decadent 4 ft tall plants, cut the work by over half. These young plants were not quite young enough to make the grass-specific herbicide effective, however if attempted earlier, at a younger stage of growth, this treatment may be effective. The fact that in the second year feather fingergrass was found under the tree that previously had only buffelgrass was encouragement enough to feel success had been achieved. If greenhouse experiments on buffelgrass seed longevity of 3 years prove correct, then after a following year of spraying, we expect to see a marked decrease in the infestation by 2009.

Ramona Garner displays the feather finger grass in 2007 growing under the mesquite tree sprayed in 2006

2008 Buffelgrass Control

In April of 2008, a reconnaissance trip was made to the exclosure to determine the success of 2007's control efforts. While it was apparent that the infestation had been significantly reduced in both size and scope, patches of buffelgrass remained. The patches were concentrated in areas more difficult to reach with spraying equipment and/or those plants located in swales. It was determined that spraying would not be effective until later in the year as the majority of the buffelgrass plants were not exhibiting active growth.

Buffelgrass, growing within prickly pear plants, greening up in early 2008.

Rains prompted a second scouting trip in early July to determine if the buffelgrass plants were in the appropriate stage for effective spraying. Plants found growing within or underneath well-established existing vegetation were just beginning to show vigorous growth. Additionally, areas with large patches of dead buffelgrass showed the re-establishment of new buffelgrass from seed. However, it was interesting to note the increase in native species within the exclosure as compared to previous years. A spraying trip was scheduled for the following month.

Buffelgrass seedlings emerging from a large patch of dead, adult buffelgrass plants

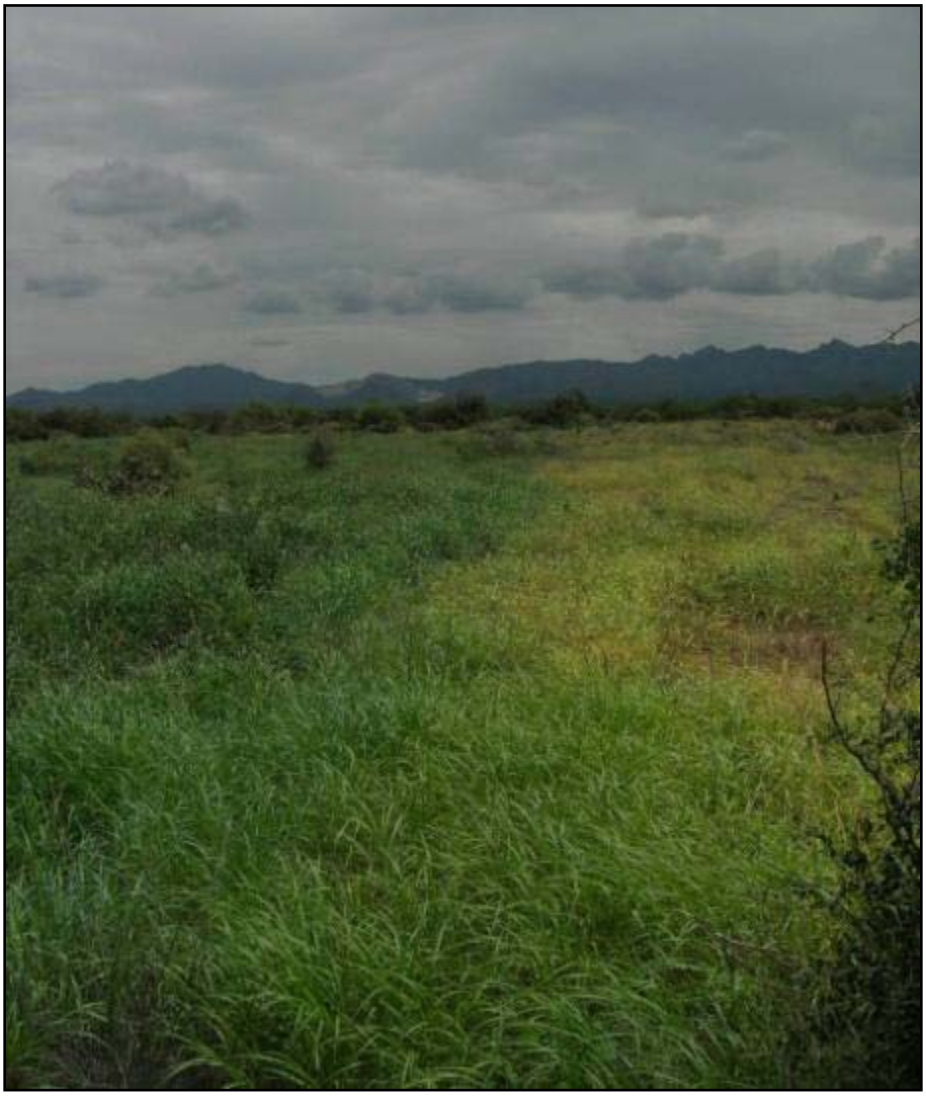
Buffelgrass control occurred on August 7. Ten gallons of Round-Up concentrate, 150 gallons of water, blue dye, and dish soap were transported to the site. As in previous years, a tractor to pull a 130 gallon 8 ft boom sprayer was taken to spray the larger patches of infestation. An ATV with a 30 gallon spray tank was also taken to concentrate on smaller patches of buffelgrass found outside the exclosure and within/underneath existing vegetation. After a brief walk through the exclosure to determine tractor pathing, spraying with both the ATV and boom sprayer began. After approximately 3.5 acres of the primary infestation had been sprayed with the boom sprayer, disaster struck. The boom spray tank pump lines were irreparably damaged when they were caught by low growing woody vegetation within the exclosure. For the rest of the day,

personnel worked with the ATV to spray patches found along the fenceline, over the fenceline and under/around existing vegetation. Approximately 2 gallons of grass specific herbicide were sprayed on the plots established in 2007 using a small hand pump sprayer. Due to the loss of the large boom sprayer, at the end of the day only three-quarters of the infestation had been sprayed.

Image shows the density of buffelgrass plants sheltering underneath woody vegetation

On August 12, the area was evaluated to determine what equipment would be necessary to finish the control. Buffelgrass sprayed the week before was already yellowing and allowed for an excellent contrast to the green plants missed during the previous spraying. It was determined that the larger boom sprayer and tractor would not be necessary for the second trip as most of the remaining green patches were found in difficult to reach places. Spraying was conducted again the following day. Two ATV's with 30 gallon spray tanks and 5 foot booms were transported to the site. Personnel sprayed areas missed the week before with the ATV booms and used the spray tank wands to reach plants growing within/underneath woody vegetation.

During the 2009 spraying season, the grass specific herbicide trial will be discontinued as its success has been limited. There are also plans in place for the establishment of monitoring protocols to quantitatively track the success of the herbicide control throughout the life of the project.



The line of demarcation: the right side of the picture had been sprayed prior to the equipment breaking, the left side of the picture had not.

2009 Buffelgrass control

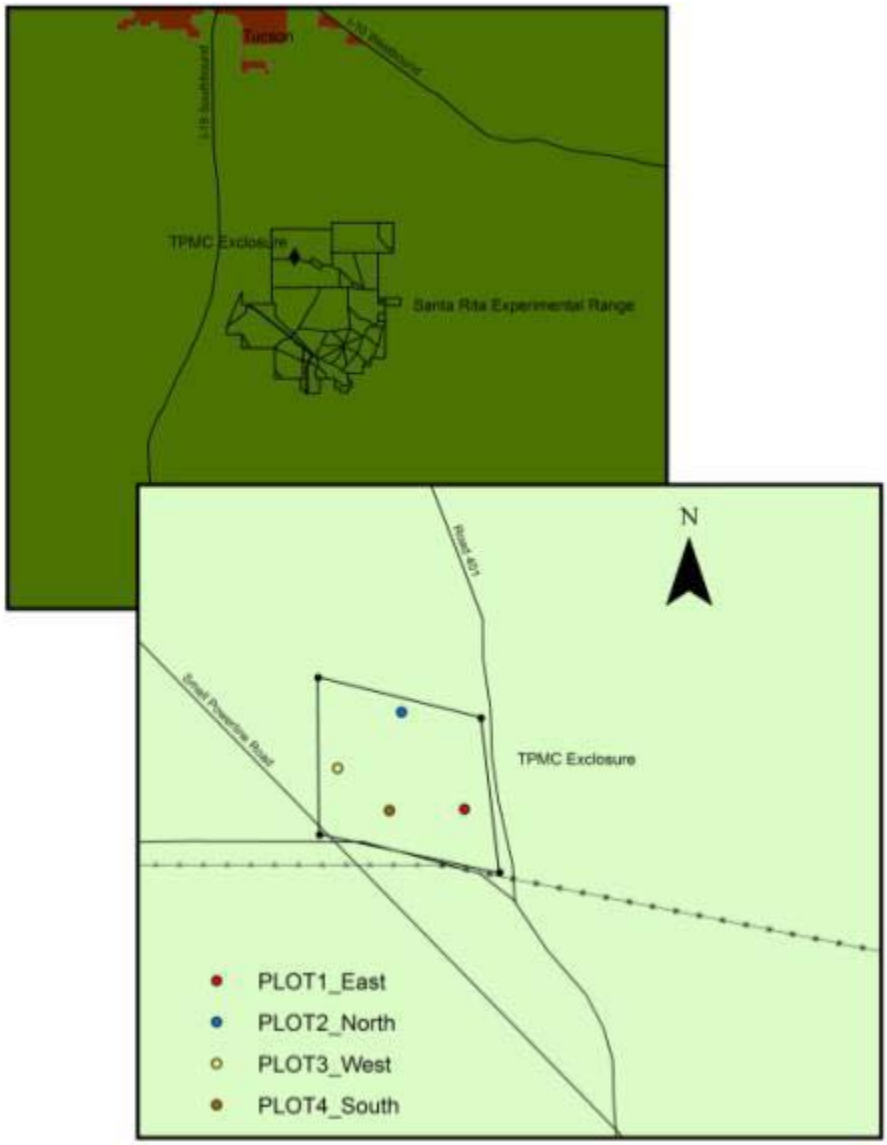
A scouting trip was conducted in April 2009 to plan for the year's control efforts. No significant "greening-up" was observed during this trip. A second trip to the site took place on June 29th. Plants were beginning to show their first growth and control efforts were scheduled for early July. A trip on the 13th of July showed vigorously growing plants and prompted full control efforts on the 15th. As in trips before, ten gallons of Round-Up concentrate, 150 gallons of water, blue dye, and dish soap were transported to the site. A tractor to pull a 130 gallon 8 ft boom sprayer was again taken to spray the larger patches of infestation. Two ATVs with 30 gallon spray tanks were also transported to the site to spray buffelgrass found outside the exclosure and within/underneath existing vegetation. Five personnel participated in the control spraying on the 15th.

A second trip with the same equipment and six personnel was made on the 22nd of July. During this trip, four monitoring plots (20' x 20') to evaluate herbicide effectiveness were established at the north, south, east, and west corners of the exclosure (please see the table and maps below). Each plot was sprayed with 5% glyphosate, the same treatment applied to the rest of the exclosure. The percent cover of buffelgrass within each plot was estimated on the 20th of August and will be compared to cover estimates taken during growing season 2010. Additional trips were made to the exclosure on August 11th and September 25th to monitor herbicide effectiveness.

SRER Monitoring Plots established 7/22/2009

PLOTS*	DATE OF EVAL	PERCENT COVER**	APPEARANCE OF PLANTS
1-EAST	8/20/09	50	BROWN/DEAD, NONE GREEN
2-NORTH	8/20/09	25	BROWN/DEAD, NONE GREEN
3-WEST	8/20/09	55	BROWN/DEAD, NONE GREEN
4-SOUTH	8/20/09	15	BROWN/DEAD, NONE GREEN

*Plot size = 20 feet X 20 feet ** Visual estimate of buffelgrass cover

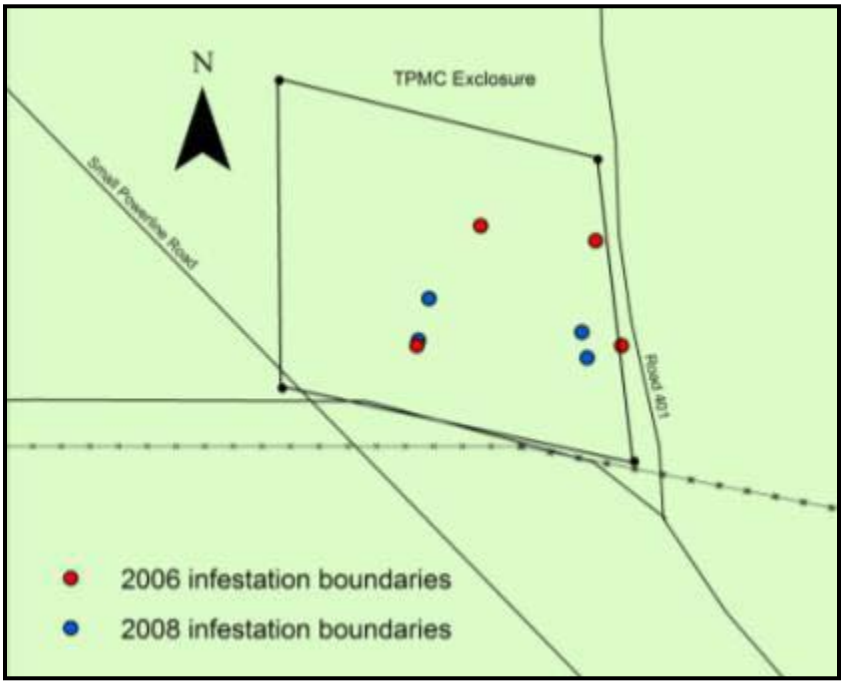


PMC exclosure, looking NW the first day of spraying

One month after spraying (11 August) PMC exclosure, looking NW

PMC personnel believe the original infestation area to have markedly decreased since the initial spraying efforts took place in 2006. GPS points were taken at the boundaries of the central infestation in 2006 and again in 2008. They are shown below. This preliminary data confirms the original hypothesis that after three consecutive years of herbicide treatment, the infestation would be significantly decreased and continued control efforts would be minimized.

Buffelgrass infestation boundaries: 2006 and 2008



Nevertheless, a continual effort must be maintained in order to ensure control of buffelgrass. Each year plants are missed during spraying efforts due to simple oversight by personnel, equipment failure, and/or timing. Even one missed plant can result in thousands of new seedlings the next year and beyond. During the growing season of 2010, PMC personnel will continue spraying and monitoring efforts.

2010 Buffelgrass control

A scouting trip was conducted in February 2010 to plan for the year's control efforts. Some sporadic greening up of buffelgrass was apparent and attributed to winter rains. PMC personnel spot sprayed green plants with 5% glyphosate near the fence on the east side of the exclosure. Three more site visits were made in March, May and July. During the July visit, it was determined that a full spraying trip should be made as soon as possible as the buffelgrass was exhibiting vigorous growth.

On August 10th, four personnel traveled to spray the entire exclosure. As in trips before, ten gallons of Round-Up concentrate, 150 gallons of water, blue dye, and LI-700, a spray adjuvant, were transported to the site. Two ATVs with 30 gallon spray tanks and an extra ATV were also transported to the site. Backpack sprayers were used to spray buffelgrass found outside the exclosure and within/underneath existing vegetation. A total of 5 quarts of glyphosate were used during this application. PMC personnel made a follow-up trip on the 23rd of August. Re-treatment was necessary in a shallow depression running from the west fence to the middle of the

exclosure. During the re-treatment, six gallons of glyphosate were used in backpack and hand pump sprayers.

A final trip was made on September 13th. Treated areas with dead plants were noticeable however; the herbicide application did not appear to be as effective during the 2010 season as in previous years. PMC personnel believe this to be the result of a heavy rain following the August 10th treatments. Percent cover within the four plots established in 2009 varied from trip to trip suggesting emergence of remaining seed in response to monsoon rains. Scouting, mapping and spray treatments will continue in 2011. In addition, permanent photo points will be selected to provide more consistent treatment data.

2011 Buffelgrass Control

A scouting trip was conducted in February 2011 to plan for the year's control efforts. There were no buffelgrass plants greening up within the exclosure. Additional site visits were made in May, July, and August. During the mid-August visit, it was determined that a full spraying trip should be made as soon as possible.

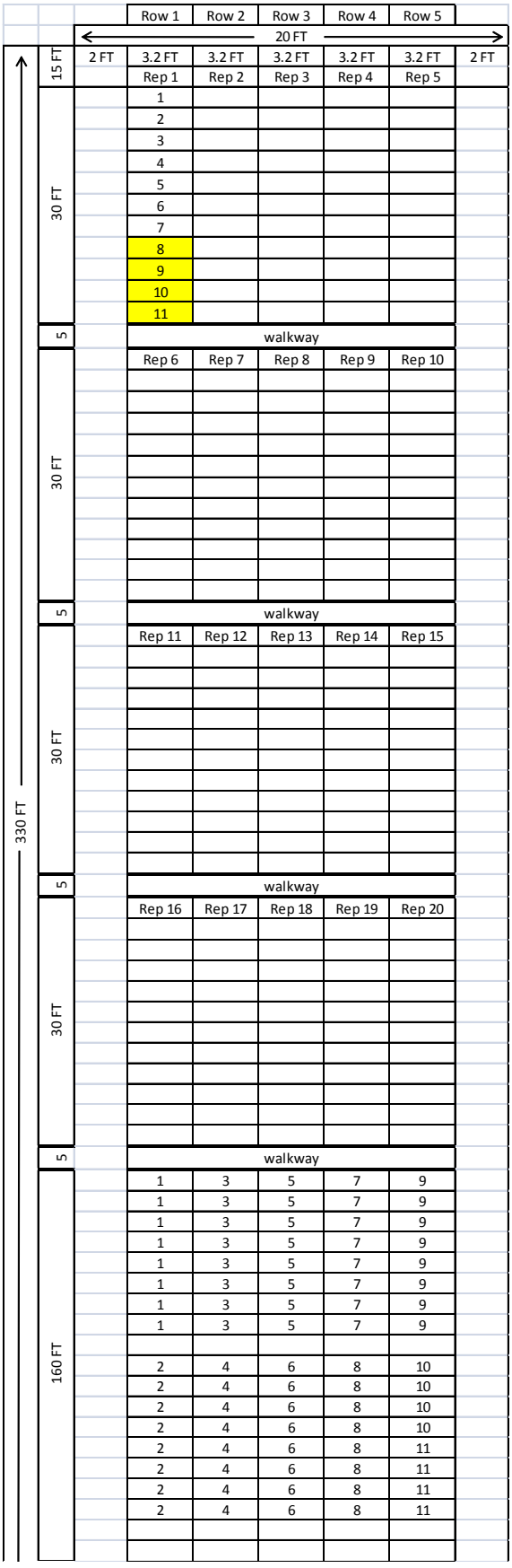
On August 25th, four personnel traveled to spray the entire exclosure. As in trips before, ten gallons of Round-Up concentrate, 150 gallons of water, blue dye, and LI-700, a spray adjuvant, were transported to the site. Two ATVs with 30 gallon spray tanks were transported to the site. Backpack sprayers were used to spray buffelgrass found outside the exclosure and within/underneath existing vegetation. A total of 5 quarts of glyphosate were used during this application. PMC personnel made a follow-up trip on the 9th of September. The herbicide application appeared to be effective. Scouting, mapping and spray treatments will continue in 2012. In addition, SRER personnel will be contacted regarding future plans for the exclosure including seeding trials involving PMC releases in development.

Development of a Big Galleta (*Pleuraphis rigida*) Population for Major Land Resource Area 30

Study ID Code	AZPMC-P-1101-RA
Title	Development of a Big Galleta (*Pleuraphis rigida*) Population for Major Land Resource Area 30
National Project No.	Natural Areas 1.1 Rangeland 1.1 Pastureland/hayland 2.1 Wildlife 1.1
Study Type	Population development
Study Status	Active
Location	AZPMC
Study Leaders	Manuel Rosales, Heather Dial
Duration	2011 through 2016
Description	To facilitate preliminary agronomic research and development of a pre-varietal release of *Pleuraphis rigida* and assist with its transition into the commercial market
Status of Knowledge	The Bureau of Land Management (BLM) Southern Nevada District and other land managers are in need of locally adapted native plant materials for rehabilitation and restoration projects. Limited availability, coupled with the need for large quantities of seed, has forced the BLM to rely on non-native species, cultivars, seed from outside of the Mojave Desert, or do nothing at all. There is currently no commercially available germplasm of *Pleuraphis rigida.*
Experimental Design	Randomized complete block with 20 replications.
Materials & Methods	Ten populations (seven from rhizomes and three from seed) will be hand transplanted to a flood irrigated field. Rows will be approximately 38 inches apart and spacing between plants will be approximately 24 inches. A secondary and primary plot is planned. The primary plot will be composed of 20 replications of a single plant of each accession. The secondary plot is not replicated and will be composed of ten plants of each accession. Cultural practices may include mechanical and chemical weed control, fertilization, and chemical control of pests. A genetic analysis of the populations will be conducted by USDA-ARS, Forage and Range Research Laboratory at Logan, Utah. Tissue from plants established in the field will be sampled to conduct the genetic analysis.
Final Evaluations	A composite seed harvest from the 10 populations will be assembled as a potential release depending on the results of the genetic analysis. Data on growth parameters such as flowering date, plant height, plant spread, seed yield and seed maturity date will be collected from ten replications within the crossing block.

Technology Transfer Products	Plant fact sheet, planting guide, internal reports, research article & presentations
Literature Cited	Flora of North America, Vol. 25; A Field Guide to the Grasses of New Mexico; Principles of Crop Improvement; Principles of Cultivar Development; Experimental Design, ANOVA and Regression.

Big galleta (AZPMC-P-1101-RA) Plot Plan



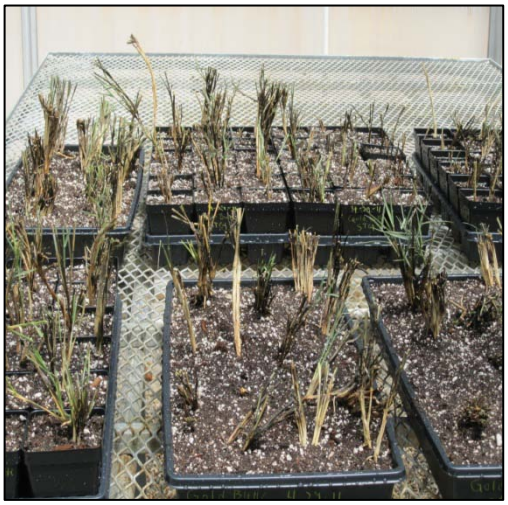
Population	Accession #	BLM Number	Location Description	UTM
1	9106356	Un1	Rainbow Gardens	4006436N 683983E
2	9106357	Un2	Bitter Springs	4024188N 715563E
3	9106358	361	Black Butte	4043620N 750949E
4	9106359	363	Frontage Road	4033657N 691381E
5	9106360	Un3	Jean Dry Lake	3960809N 660471E
6	9106361	Un4	Red Rock	3997525N 639552E
7	9106362	Un5	Sandy Valley	3984183N 625562E
8	9094137	*	Coyote Springs	4045659N 686292E
9	9094134	*	Piute Valley	3904828N 693755E
10	9094139	*	Lincoln	4071670N 727445E

*** Populations in yellow (8-10) were established from seed versus the other populations (1-7) which were established from vegetative cuttings (rhizomes).**

Accomplishments/Results

Growing Season 2011:

Out of the 10 populations collected from the Mojave Desert, seven were started from rhizomes and three from seed. Rhizomes and seed collections were received from BLM personnel in the spring of 2010. Vegetative increase of rhizomes was started in April 2010 and continued throughout the spring of 2011. Collected rhizomes were cloned by layering each accession in separate propagation flats. When sufficient root growth was obtained, rhizomes were clipped at the nodes and transferred into one gallon pots and/or other containers. Seed collections were germinated and grown in Jiffy Propagation Plugs. The plants are scheduled to be outplanted in the summer of 2012.



Galleta rhizomes

Galleta plugs from seed

Development of Technology for the Production of 'Tropic Sun' Sunn Hemp (*Croatalaria juncea L.*) Seed

Study ID Code	AZPMC-T-1101-CP
Title	Development of technology for the production of 'Tropic Sun' Sunn Hemp seed
Study Type	Technology Study
Study Status	Active
Location	AZPMC
Study Leaders	Manuel Rosales & Heather Dial
Duration	2011-2012
Vegetative Practices	340 Cover crop 328 Conservation crop rotation
Description	Sunn Hemp (*Crotalaria juncea)* has been touted as a great green manure and cover crop since the 1930s, when it was reported to be an excellent soil-improving crop. Sunn hemp produces high organic matter yields while fixing large amounts of nitrogen. However, the difficulty in acquiring seed and cheap fertilizer prices caused many farmers to abandon the use of this crop. Energy costs have brought leguminous cover crops back to the forefront for sustainable agriculture production and have led to efforts to increase production of sunn hemp seed.
Status of Knowledge	Previous studies concluded that Sunn hemp does not produce seed above 28 degrees N latitude (southern tip or Florida or Texas). However, plantings of Sunn hemp at the Tucson Plant Materials Center have produced viable seed. This study was designed for the purpose of determining the seed production potential of Sunn hemp within the Tucson climate. Data from this trial will aid in determining the potential for commercial seed production of Sunn hemp in areas with climatic conditions similar to Tucson.
Experimental Plan	Non –replicated observational trial
Materials & methods	Seed of 'Tropic sunn hemp' will be secured from the Hawaii PMC and planted into a flood irrigated field at the center. A Truax Flex –II no-till grass drill will be used for the planting. The seeding rate will be 20 pounds of seed per acre.
Technology Transfer Products	Technical reports, State technical notes, popular journal articles
Literature Cited	Rotar, P.P. and R.J. Joy. 1983. 'Tropic Sun' sunn hemp (*Crotalaria juncea* L.) Res. Ext. Ser. 36. Hawaii Inst. Trop. Agric. and Human Resour., Univ. of Hawaii, Honolulu. USDA-NRCS. 1999 Sunn Hemp: A Cover Crop for Southern and Tropical Farming Systems. Technical Note No.10 Soil Quality Institute, Auburn, AL

Accomplishments/Results

Growing season 2011:

In May 2012, an approximately 0.5 acre field was prepared for the seeding of sunn hemp. Preparation included termination of the cover crop (Seco Barley and hairy vetch) with glyphosate and mowing. On May 13, the 'Tropic Sun' sunnhemp seed was inoculated with N-DURE inoculant (*Sinorhizobium meliloti* and *Rhizobium leguminosarum biovar trifolii*) at the recommended rate of 2.5 oz per 50 lbs of seed and immediately planted at the rate of 20 pounds per acre with a Truax Flex-II no –till drill into the existing stubble. On May 16, the seedlings started to emerge. By August 2012, plant height averaged seven feet. The plants reached reproductive stage in September when the day length was approximately 12 hours. The 50% bloom date was October 5, 2012. Seed was harvested on January 2, 2012 with a Massey Ferguson MXP-8 combine. Plant height at the time of harvest averaged 12 feet which created difficulties with the cutting and reel on the combine. Despite of the height challenge, 274 lbs/acre of seed was harvested.

A second seed production trial is planned for late July or early August in 2012 to compare seed yields and plant growth rates.

Field prior to planting - May1, 2011

No-till drilling - May 13, 2011

Seedling emergence -May 16, 2011

Sunn hemp height at 7ft. tall-August 4-2011

Blooming and setting seed, October 20, 2011

Harvesting January 2, 2012

Development of Technology for the Establishment of Bush Muhly (*Muhlenbergia porteri*) With Hay Bales

Study ID Code	AZPMC-T-0502-CR
Title	Development of Technology for the Establishment of Bush Muhly (*Muhlenbergia porteri*) With Hay Bales
National Project No.	Natural Areas 1.1 Rangeland 1.1 Pastureland/hayland 2.1 Wildlife 1.1
Study Type	Technology
Study Status	Active
Location	AZPMC
Study Leaders	Heather Dial, Manuel Rosales
Duration	2005-2015
Description	Research and study to aid in the development of technology to establish bush muhly from hay bales rather than seeding. Evaluation of the performance of bush muhly releases in both MLRA 40 and 41.
Status of Knowledge	Bush muhly is a highly palatable bunch grass, even after dormancy, likely the reason it has retreated to the interiors of shrubs, where it is protected from grazing. Following winter dormancy, new growth begins at nodes at the tips of the stems, rather than from the base of the plant, which forms the plant into a bush like shape. Bush muhly is a highly desirable warm season bunchgrass throughout the desert southwest. No germplasm is currently available from commercial growers. This may in part be due to the difficulties encountered in the bush muhly seed cleaning process.
Experimental Design	Replicated plots representing various application rates (pounds/acre) depending upon the size available for the planting and hay bale quantities.
Materials & Methods	There are currently two bush muhly releases in development at the TPMC; one for MLRA 40 and the other for MLRA 41. Both of these research plots will be cut and baled at least once per growing season. Potential field planting locations will be identified and selected with the assistance of field office personnel within the TPMC service area. When a location is identified, a field planting of bush muhly will be established using hay bales. Bush muhly hay bales will be applied to plots representing both MLRA 40 and 41at varying rates with either a mulcher and/or flaked out over a set area and crimped in. Evaluations will be conducted annually for up to five years to determine the emergence and persistence of bush muhly using this method. The plots will also be evaluated to determine whether or not a particular bush muhly pre-release performs better in one location versus another.

Final Evaluations Data from at least three field planting locations across the TPMC service area will be compiled to determine whether or not bush muhly can be successfully established with bush muhly hay bales and at what application rates prove most efficient. Collected data will also be used to determine whether MLRA specific releases of bush muhly provide any appreciable advantage.

Technology Transfer Products Technical notes, Updated Plant Guides

Literature Cited

5. Fehr, Walter R. 1987. Principles of Cultivar Development, Vol. 1 Theory and Technique. Macmillan Publishing Company, New York.
6. Flora of North America Editorial Committee, eds. 2003. Flora of North America North of Mexico. Vol 72. New York and Oxford.
7. Jones, T.A. and D.A. Johnson. 1998. Integrating genetic concepts into planned rangeland seedings. Journal of Range Management 51: 594-606.
8. Kearney, T.H. and R.H. Peebles. 1969. Arizona flora. University of California Press, Berkely, CA.
9. USDA, NRCS. 2004. The PLANTS Database, Version 3.5 (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

Accomplishments/Results:

Growing season 2011:

The identification of appropriate field planting locations within the TPMC service area proved difficult during growing season 2011. A potential field planting plan was developed for land near Chandler, AZ, but because the land was unable to be protected from grazing, the field planting was not accomplished. The planting plan developed for the site is below. This plan will be used in future field trials.

<table>
<tr><td>0.10 acre ~200 lbs of MUPO (41)= ~2000 lbs/acre</td><td rowspan="2">TRIAL 1 = 0.20 acres MLRA 40 vs MLRA 41</td></tr>
<tr><td>0.10 acre ~200 lbs of MUPO (40) = ~2000 lbs/acre</td></tr>
<tr><td>0.15 acre ~600 lbs of MUPO = 4000 lbs/acre</td><td rowspan="2">TRIAL 2 = 0.3 acres varying pounds/acre</td></tr>
<tr><td>0.15 acre ~300 lbs of MUPO = 2000 lbs/acre</td></tr>
</table>

Development of Technology for Containerized Native Plant Production; Tonto National Forest

Study ID Code	AZPMC-T-0705-CR
Title	Development of Technology for Containerized Native Plant Production; Tonto National Forest
National Project No.	Natural Areas 1.1 Rangeland 1.1 Pastureland/hayland 2.1 Wildlife 1.1
Study Type	Technology
Study Status	Active
Location	AZPMC
Study Leaders	Heather Dial, Manuel Rosales
Duration	2007-2013
Description	Research and study to aid in the development of technology to produce containerized native plants for restoration/re-vegetation projects.
Status of Knowledge	Rangeland and forest fires are increasing in frequency and magnitude across the southwest, and native plant materials are required for rehabilitation. A case in point is the 2005 Cave Creek Complex Fire on the Tonto National Forest. Re-vegetation of many areas within the fire affected area could not be accomplished using traditional seeding methods and containerized plants for transplanting were highly desirable. However, knowledge of germination and successful production of many of the dominant species in the area were not known.
Experimental Design	Multiple replicated germination trials will be conducted to determine how to germinate and grow desirable species for use in re-vegetation projects.
Materials & Methods	Seed collected from the Tonto National Forest from 33 different species will be evaluated to determine efficient and successful propagation protocols. Various seed cleaning, mechanical and chemical scarification methods and growing mediums will be tested.
Final Evaluations	After a six month period, each of the various germination and containerized production protocols will be evaluated by the successful production of healthy plants.
Technology Transfer Products	Technical notes, Updated Plant Guides, Native Plant Network Propagation Protocols
Literature Cited	10. Flora of North America Editorial Committee, eds. 2003. Flora of North America North of Mexico. Vol 72. New York and Oxford. 11. Kearney, T.H. and R.H. Peebles. 1969. Arizona flora. University of California Press, Berkely, CA. 12. USDA, NRCS. 2004. The PLANTS Database, Version 3.5 (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

Accomplishments/Results:

Growing season 2011:

During growing season 2011, approximately 1700 containerized native plants were produced for the re-vegetation of the Cave Creek Complex within Tonto National Forest. The majority of these species did not have available propagation protocols. At the time of this report, propagation protocols for Arizona grape (*Vitis arizonica)* are being developed for submittal to the Native Plant Network Propagation Protocol Database (http://www.nativeplantnetwork.org/network/).

Conservation Effects Assessment Project

A joint ARS-NRCS effort to collect plant attribute data on
western grazing lands to support ALMANAC and CEAP

A Pilot Project of the NRCS Plant Materials Program
June 2009

Agency Context

NRCS initiated the Conservation Effects Assessment Project (CEAP) in 2003 with the intent to develop science supported methodologies that will allow NRCS to better estimate environmental benefits and effects attributable to NRCS conservation practices. Following discussions in 2006, CEAP efforts were expanded to go beyond estimating effects of practices to include developing new or improved tools and methodologies to enhance the effectiveness of conservation planning in meeting environmental goals. One of the specific objectives identified for CEAP is "reduce uncertainty in model estimates of conservation benefits" (Maresch et. al., 2008) which is the thrust of this proposal.

To assess the environmental benefits and effects of grazing lands practices the Rangeland Hydrology and Erosion Model (RHEM) is being developed as the tool to measure impacts and benefits of grazing lands practices (prescribed grazing; prescribed burning; brush management; rangeland seeding; pest management) within the CEAP. A model known as ALMANAC (Agricultural Land Management Alternative with Numerical Assessment Criteria) is an important component of RHEM. Plant communities represented by functional plant groups (short grass, tall grass, shrub, etc.) and their biophysical outputs (canopy cover, plant height, standing biomass, root distribution and mass, ground cover, etc.) (Weltz et. al., 2008) are the major drivers of the ALMANAC model and are key to accurate predictions of effects and ultimately better up-front conservation planning. The biophysical component requires attribute data over the many ecological zones found throughout the United States, at the Ecological Site Descriptions (ESD) scale, to be efficient and accurate.

In addition to providing good data to measure conservation practice impacts through CEAP, the field scale ALMANAC model could prove useful to NRCS field office staff, providing improved estimates of forage availability, potential wildfire fuel loads, and wildlife habitat suitability, as well as erosion potential on ecological sites. The data provided for use in the ALMANAC model is also expected to be of value in other modeling efforts such as SWAT (Soil and Water Assessment Tool), WEPS (Wind Erosion Prediction System) and assessment efforts such as those required in the Soil and Water Resources Conservation Act (RCA) of 1977.

Rationale for National Plant Materials Program Effort

The national network of 27 Plant Materials Centers (PMCs) are uniquely suited to undertake studies to measure and quantify plant growth parameters of various herbaceous and woody plant materials for various soil, plant, and water models due to having many of the desired species already growing at our facilities, a trained technical staff, and the ability to implement and complete these studies across a wide geographic area in a relatively short time. The Plant Materials Program has been collecting similar plant growth attributes of grasses, forbs, legume and woody plants through its network of PMCs to support conservation plant releases for over 70 years. By increasing the number of measured plant parameters, conservation planning

tools or models developed by the ARS can improve the accuracy and predictability of the conservation effects of conservation practices applied by NRCS through Farm Bill programs.

Initial efforts covered by this proposal are focused on the arid and semi-arid inter-mountain portions of the west, but it is anticipated that the project will be expanded. For the Plant Materials Program, this proposal represents a pilot effort to utilize the nationwide network of PMCs to directly contribute to improving NRCS technical vegetative recommendations and support the effects of conservation activities. It is proposed that PMCs located within the arid west 1) obtain data from existing plots where feasible and, 2) install new 3-5 year studies as required to collect accurate plant data. Plant growth parameter data would be provided to ARS staff in Temple, TX for inclusion in the ALMANAC model. PMCs located in Arizona, New Mexico, Nevada, Washington, Idaho, California, Colorado, and Montana are expected to participate.

Proposed Plant Materials Program Activities

PMCs will collect data using the following ARS protocols (Kiniry, 2009), summarized below, for selected species:

Utilize existing fields or stands of grasses, legumes, forbs and shrubs when possible:

- Subdivide field into irrigated and non-irrigated block (if feasible)
- Establish 4 replicated blocks in each subplot from which the following data will be obtained:
- Record date of growth initiation
- Record Leaf Area Index at 2 week intervals until 100% canopy closure. (Decagon ceptometer)
- Harvest biomass and obtain weights at specific plant growth stages
- Prepare and send tissue or biomass samples to ARS for wet chemistry analyses.
- Obtain and transmit weather data (temperature, solar radiation, and precip).

New plots as needed would be established to allow the same degree of data collection as described above which would begin in the second growing season.

Selected PMCs may undertake studies to determine effectiveness of remote photography to measure plant growth rates.

Time Line

May 2009: Basic needs, protocols, and equipment requirements identified
June 2009: ARS convene joint meeting with grazing lands experts and PM Representative to identify species to be measured.
June 2009: Equipment purchased
Summer 2009: PMC staff trained in protocols
Summer 2009 – 2011: Implement protocols

References

Kiniry, Jim. 2009. Personal communication. USDA Agricultural Research Service. Temple, Texas.

Maresch, Wayne, Mark Walbridge, and Daniel Kugler. 2008. *Enhancing conservation on agricultural landscapes: a new direction for the Conservation Effects Assessment Project*. Journal of Soil and Water Conservation. 63(6):198A-203A.

Weltz, Mark, Leonard Jolley, Mark Nearing, et.al. 2008. *Assessing the benefits of grazing land conservation practices.* Journal of Soil and Water Conservation. 63(6):214A-217A.

Accomplishments/Results:

Growing season 2011:

During growing season 2011, Leaf Area Index (LAI) data, clippings, and photos of two AZPMC releases, 'Loetta' Arizona cottontop and Moapa Alkali muhly, were collected in support of CEAP. Data was submitted to ARS staff in Temple, TX for inclusion in the ALMANAC model. Additionally, AZPMC staff was responsible for grinding all cuttings from other participating PMCs and forwarding them to NYPMC for processing.

Development of Technology for Containerized Agave (Agave palmeri) Production

Study ID Code	AZPMC-T-0901-CR
Title	Development of Technology for Containerized *Agave palmeri* Production
National Project No.	Natural Areas 1.1
Study Type	Technology study
Study Status	Active
Location	AZPMC
Study Leaders	Manuel Rosales and, Heather Dial AZPMC
Duration	2009 to 2013
Vegetative Practices	345 Critical Area Planting 544 Land Reclamation, Abandoned Mine Land 645 Wildlife Upland Habitat Management
Description	*Agave palmeri* belongs to the Agavaceae family. This family is characterized by succulent or semi-succulent leaves that form rosettes. These rosettes can range in size from a few inches to several feet in diameter. In *A. palmeri* the rosettes can be up to 3 feet tall by 4 feet wide. The leaves are lance shaped, about 2 feet long by 4 inches wide, with a terminal spine at the leaf tip up to 2 inches long. The flower stalk can range from 10 to 18 feet in height. Flowers are greenish yellow and clustered at the ends of the lateral branches. Full bloom usually occurs in midsummer.
Status of Knowledge	*Agave palmeri* is found on rocky hillsides and mesas in the Sonoran Desert zone from Southeastern Arizona into adjacent New Mexico and southward into Sonora, Mexico. *A. palmeri* has been reported in the literature with the common name "Palmer's Century Plant". This name implies that the plant life span is 100 years; however, the plant life span can range from 5-25 years. Agaves (including *A. palmeri)* are monocarpic, meaning that the plant flowers once and then dies. Most agaves have been used as sources of food, fences, rope, medicine and liquor. Two species of bats, the lesser long nose bat *(Leptonycteris yerbabuenae)* and the Mexican long tongued bat (*Choeronycteris mexicana*) rely on the agave nectar on their migration route from Mexico to the Sonoran desert. A. palmeri can reproduce by offsets (commonly called pups) or by seeds. Limited information is found in the literature regarding *Agave palmeri* propagation under nursery conditions. This study was designed to collect information on the culture and propagation of A. *palmeri* from seed, under nursery conditions, in the initial 3 years of growth and development.
Experimental Design	Randomized complete block with 3 replications
Materials &	A greenhouse /shade house study was initiated in July , 2009 in cooperation with

Methods the Coronado National Memorial. Seed collected by the Memorial will be germinated and transplanted to 45 in^3 wax containers. Containers will then be placed in trays holding 16 plants each. Three trays will be used to conduct the experiment. Each tray will serve as a replication and treatments (plants) will be assigned to each tray at random. Data will be collected from each plant at weekly or monthly intervals, depending on growth rate. Growth parameters such as rosette diameter, color of leaves, and other pertinent data associated with the culture of the plants will be recorded. Additional observational trials such as growing medias, watering schedules, pest control, etc., will be conducted to complement the data gathered from the growth rate study.

Final Evaluations The total growth of the agave rosettes will be taken at the end of the experiment. The irrigation schedules, fertilizers applied, and pesticides used during this period will be recorded and evaluated.

Technology Transfer Products Technical reports, growing protocols, and popular journal article.

Literature Cited

13. Dimmitt, M.A. 2000. A Natural History of the Sonoran Desert. ASDM Press
14. Epple, A.O and L. E. Epple. 1955. Plants of Arizona
15. Http:// ag.arizona.edu/Cochise/psc/agave_palmeri.htm
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17. Http://www.mineralarts.com/cactus/bigagave.html
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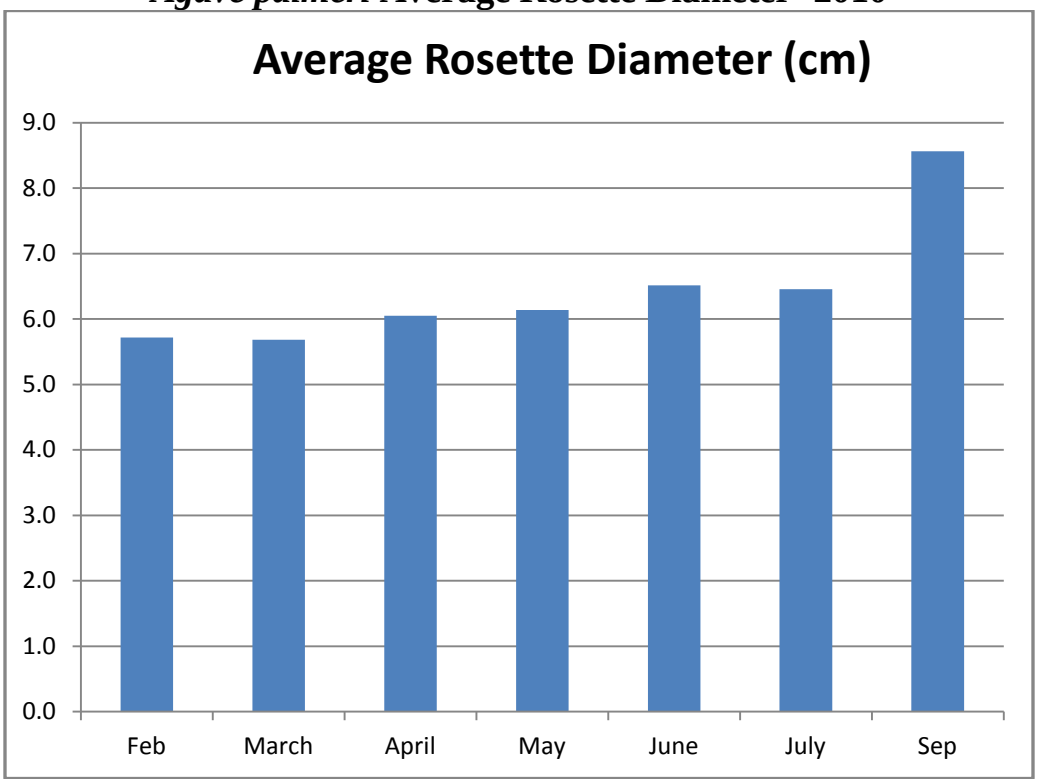
19. Shreve, F. and I.L Wiggins. 1964 Vegetation and Flora of the Sonoran Desert, Vol. 1
20. USDA, NRCS. 2009. The PLANTS Database, Version 3.5 (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

Accomplishments/Results

Growing seasons of 2010-2011:

Three replications of 16 plants were used for the study. Initially, leaf growth was recorded to measure growth. However, once the plants began forming rosettes, this task became time consuming and rosette diameters were recorded instead. Below is a figure illustrating average rosette diameter growth in centimeters for 16 plants from February through September 2010 (data was not collected for the month of August). Rosette diameter increased significantly during the late summer months.

***Agave palmeri* Average Rosette Diameter -2010**



These results indicate that agave *Agave palmeri* has an increased growth rate in the summer months when temperatures are above 90 F^0.

Agave palmeri grew faster in its second year and doubled its root mass (see pictures below). Plants initiated production of pups and increased the number of leaves from 6 the first year to 14 at the end of the second year. The average rosette diameter at the end of two years was 3.3 inches. Twelve of the two-year plants were transplanted into one-gallon containers to measure stem collar growth during the third year of growth.

A one year old agave plant in 2010

A two year old agave plant in 2011

Other observations:

Growing Media: A mixture of peat moss and perlite at a 1:2 ratio provided the best results for drainage and growth. A mixture of 3:1:1 of shredded bark, sand and peat moss did not work as well as the 1:2 ratio of peat moss and perlite. A mixture of medium texture field soil, peat moss and perlite (1:1:1) did not provide adequate drainage.

Irrigation Frequency: Ten minute irrigation frequencies of 3 days, 2 days and 1 day per week were compared to determine the optimum watering frequency for growth. Additional watering days per week did not improve growth rates but did result in a fungus gnat infestation in the greenhouse. An irrigation frequency of one ten minute watering per day per week provided sufficient water for plant growth and reduced the fungus gnat infestation

Development of Technology for Production of Nine Mojave Desert Forbs and Shrubs: BLM National

Study ID Code	AZPMC-T-1001-RA
Title	Development of Technology for Production of Nine Mojave Desert Forbs and Shrubs
National Project No.	Natural Areas 1.1
Study Type	Technology study
Study Status	Active
Location	AZPMC
Study Leaders	Manuel Rosales, Heather Dial
Duration	2010 to 2015
Vegetative Practices	346 Critical Area Planting 552 Range Seeding 545 Land Reclamation, Abandoned Mine Land 645 Wildlife Upland Habitat Management
Objective:	Preliminary research and development for the production of priority species beneficial to the Bureau of Land Management (BLM) and other land mangers for pre-varietal release into the commercial market.
Status of Knowledge	BLM and other land managers are in need of native species for restoration in the Desert Southwest. The availability of desired species in the commercial market is negligible. When available species are found in the market, they are extremely expensive, and the source of origin is unknown. The NRCS and BLM will conduct studies to determine the potential for commercialization of various priority species (grasses, forbs, shrubs) under agronomic conditions, as well as to develop propagation/establishment protocols to improve the availability and use of native species in the commercial market for restoration purposes.
Experimental Design	Observational screening trials
Materials & Methods	Nine native species: *Encelia virginensis*, *Camissonia brevipes* Subsp. Brevipes, *Eriogonum fasciculatum*, *Eriogonum wrightii*, *Eriogonum wrightii* var. Subscaposum, *Malacothrix glabrata, Colegyne ramosissima, Baileya multiradiata* and *Sphaeralcea ambigua*, were selected for this study. Due to the small amount of seed available, preliminary germination tests will be conducted to determine the viability of the seed (seed source: BLM Seeds of Success germplasm program) and to determine the best germination protocol for each species..After a suitable amount of seed has been germinated, seedlings will be transferred into individual plugs/containers for mechanical transplanting into TPMC fields. A target of 200 plants of each species of each species will be transplanted into a flood irrigated field. The plants will be transplanted in nursery rows, spaced at 38 inches between the rows and 24 inches between each plant within the row. A 5 ft buffer will be left between each species. The buffer will facilitate mechanical harvest and minimize seed mixing between species. The buffer will also facilitate application of pesticides or herbicides per species. The species will be harvested mechanically using the Woodward Flail-Vac seed stripper, a plot combine (Massey Ferguson MX-8) , a hand-held vacuum or hand harvested

Final Evaluations

Survivability of plants after transplanting will be recorded. Growth parameters such as flowering date, seed maturity date, height & spread of plant and seed yield will be evaluated for each species. Incidence of pests and diseases will be monitored and recorded. Applicability of mechanical harvest for each species will also be evaluated. Methods to process the seed after harvesting will also be evaluated and recorded. Seed quality after harvest will be determined by a qualified lab and documented. Any other criteria that will help in determining the feasibility of each species as potential candidates for commercialization will be evaluated.

Technology Transfer Products

Planting guide, internal reports, and commercial grower information (planting requirements, yield and number of years of production).

Literature Cited

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25. USDA, NRCS. 2004. The PLANTS Database, Version 3.5 (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

Accomplishments/Results

Growing season 2010-2011:

Germination tests for the nine species were conducted to determine viability of seed and to determine protocols to germinate the individual species in 2010. The table below presents the results.

2011 BLM Species Germination Protocols and Results

Species	Date started	Protocol	Date of germination	Percentage germination
Camissonia brevipes	17-Jun-10	400 seeds placed in moist soil (peat/perlite mix), placed in Hoffman germinator at 60°F	24-Jun-10	3%
Malacothrix glabrata	17-Jun-10	400 seeds placed in moist soil (peat/perlite mix), placed in Hoffman germinator at 60°F	22-Jun-10	3%
Coleogyne ramosissima	27-May-10	400 seeds placed in moist soil (peat/perlite mix), placed in Hoffman germinator at 40°F	11-Jun-10	50%
Encelia virginensis	21-May-10	100 seeds placed in moist soil (peat/perlite mix) and placed in greenhouse	27-May-10	53%

Eriogonum fasciculatum	27-May-10	100 seeds place in moist soil (peat/perlite mix) at 40°F	2-Jun-10	75%
Eriogonum wrightii(2 species)	27-May-10	200 seeds place in moist soil (peat/perlite mix) at 40°F	2-Jun-10	9%
Baileya multiradiata	17-Jun-10	400 seeds placed in moist soil (peat/perlite mix), placed in Hoffman germinator at 60°F	25-Jun-10	11%
Sphaeralcea ambigua	27-May-10	400 seeds added to boiling water, soaked for 1 hour, seed transferred to moist soil (peat/perlite mix) and placed in greenhouse	2-Jun-10	4%

Three of the species (*Encelia virginensis*, *Eriogonum fasciculatum* and *Sphaeralcea ambigua*) had sufficient germination percentages and growth to be out planted in November 2010. The three species survived the transplanting and progressed well during the growing season of 2011. Data collected on the survival percentage height and spread of the three species was collected September 16, 2011 and is presented in the following table.

BLM Species Evaluation in September 2011

Brittlebush (*Encelia virginensis*)			**Buckwheat (*Eriogonum fasciculatum*)**			**Globe Mallow (*Sphaeralcea ambigua*)**		
Number of plants alive = 47 (Transplanted 59) % survival = 80			Number of plants alive = 46 (transplanted 92) % survival = 50			Number of plants alive = 75 (Transplanted 105) % survival =71		
Plant Height (inches)	Plant Spread (inches)	Ht X SP inches	Plant Height (inches)	Plant Spread (inches)	Ht X SP	Plant Height (inches)	Plant Spread (inches)	Ht X SP inches
26	42	26 X32	15	24	15 X 24	19	41	19 X 41
23	42	23 X 42	13	16	13 X 16	17	30	17 X 30
17	33	17 X 33	10	14	10 X 14	18	30	18 X 30
22	35	22 X 35	14	13	14 X 13	19	35	19 X 35
23	36	23 X 36	17	18	17 X 18	23	34	23 X 34
21	34	21 X 34	16	15	16 X 15	23	28	23 X 28
Average of 6 entries								
22	37	22 X 37	14	17	14 X 17	20	33	20 X 33

Seed from *Encelia virginensis* and *Sphaeralcea ambigua* was harvested from October throughDecember2011. A table summarizing harvest dates, methods and weights is below. Harvested seed from these plots will be used to initiate ¼ acre seed increase plots in 2012. These larger plots will be used to evaluate larger harvesting equipment. BLM Seed Harvests 2011

Species	Common name	Date Harvested	Harvest Method	Field	Bulk Weight in Grams
Sphaeralcea ambigua	Globemallow	10/24/2011	hand/clipped	F4;2-3	9.56
Encelia virginensis	Brittlebush	10/24/2011	hand/clipped		764.52
Encelia virginensis	Brittlebush	10/28/2011	vacuum		32
Encelia virginensis	Brittlebush	11/4/2011	hand/pulled		169.5
Encelia virginensis	Brittlebush	11/9/2011	hand		155.63
Encelia virginensis	Brittlebush	11/18/2011	hand		466.24
Encelia virginensis	Brittlebush	12/20/2011	hand		133.24
Sphaeralcea ambigua	Globemallow	12/20/2011	hand		235

Sphaeralcea ambigua

Encelia virginensis

Eriogonum fasciculatum

Development of Technology for Purple Three Awn (*Aristida purpurea*) Seed Cleaning

Study ID Code	AZPMC-T-1101-RA
Title	Aristida purpurea Seed Cleaning Trial
National Project No.	Natural Areas 1.1 Rangeland 1.1 Wildlife 1.1
Study Type	Technology
Study Status	Active
Location	AZPMC
Study Leaders	Heather Dial
Duration	2011
Description	To determine whether or not mechanical seed cleaning decreases the seed viability of *Aristida purpurea* seed.
Status of Knowledge	It is a common assumption that standard seed cleaning technologies will reduce the viability of *Aristida purpurea*. This trial is designed to test that assumption.
Experimental Design	Randomized complete block with 4 treatments consisting of 4 replications of 100 seed each
Materials & Methods	-Standard native seed cleaning equipment to include a Westrup laboratory brush machine, a hammermill, a Forsberg seed scarifier and an office clipper -4 sets of 400 seed. Each set will be divided into 4 separate 100 seed trials. -1020 trays filled with sunshine mix #1 and perlite in a 1:1 ratio -greenhouse temps 80 day/70 night -greenhouse water 3 times/day for 2 minutes *Treatment one* (control): 4 sets of 100 seed. No seed cleaning. Seed placed in 1020 trays in the greenhouse *Treatment two* (brush machine): 4 sets of 100 seed passed through the brush machine to remove awns, office clipper if necessary, seed placed in 1020 trays in the greenhouse for germ *Treatment three* (hammermill): 4 sets of 100 seed passed through the hammermill to remove awns, office clipper if necessary, seed placed in 1020 trays in the greenhouse for germ *Treatment four* (Forsberg): 4 sets of 100 seed passed through the Forsberg to remove awns, office clipper if necessary, seed placed in 1020 trays in the greenhouse for germ -Each treatment will be monitored daily for germination for fourteen days. Total germinated seed will be recorded for each set within a replication.
Final Evaluations	ANOVA RCB analysis with Statistix 8 software
Technology Transfer Products	Internal reports

Growing Season 2011:

Seed cleaning for this trial was started the 9th of June 2011. All treatments and their replications were placed in the greenhouse for germination on 1 July 2011 with final counts of germinated seedlings taking place on 13 July. Results of the final count and their averages are in the table below.

	Total Germinated Seedlings				
Treatment	Replication 1	Replication 2	Replication 3	Replication 4	**Germinated Seedlings**
control	49	53	50	61	53.25
brush	60	50	51	62	55.75
hammer	13	24	14	31	20.5
forsberg	38	47	38	20	35.75

The data was entered into Statistix 8. Both the P value (0.11) and W statistic (0.90) indicated that the data was normally distributed. The Bartlett's test results (0.88) indicated that there was equal variance in the data. The ANOVA P value was less than 0.05 indicating differences in cleaning methods. The LSD all pair wise comparison test indicated that brush machine cleaning was significantly different than both Forsberg and hammermill cleaning but not significantly different than the control of no cleaning. The various test data is below.

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Statistix 8.1                                          9/27/2011, 4:46:29
PM
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Randomized Complete Block AOV Table for Germ

Source	DF	SS	MS	F	P
Replicati	3	82.69	27.56		
Method	3	3260.19	1086.73	13.50	0.11
Error	9	724.56	80.51		
Total	15	4067.44			

Grand Mean 41.313 CV 21.72

Tukey's 1 Degree of Freedom Test for Nonadditivity

Source	DF	SS	MS	F	P
Nonadditivity	1	22.853	22.8527	0.26	0.6235
Remainder	8	701.710	87.7137		

Relative Efficiency, RCB 0.84

Means of Germ for Method

Method	Mean
Brush	55.750
Control	53.250
Forsberg	35.750
Hammer	20.500

Observations per Mean 4
Standard Error of a Mean 4.4863
Std Error (Diff of 2 Means) 6.3446

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Statistix 8.1                                          9/28/2011, 8:42:18
AM
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LSD All-Pairwise Comparisons Test of Germ for Method

Method	Mean	Homogeneous Groups
Brush	55.750	A

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Control   53.250  A
Forsberg  35.750   B
Hammer    20.500    C

Alpha             0.05     Standard Error for Comparison  6.3446
Critical T Value   2.3     Critical Value for Comparison  14.352
Error term used: Replicati*Method, 9 DF
There are 3 groups (A, B, etc.) in which the means
are not significantly different from one another.
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Development of Technology for Seeding After Fire; Vaca Ranch

Vaca Ranch in the San Raphael Valley of Santa Cruz County (AZPMC-T-0616-CR)

**Previous Study Number AZPMC-F-0602-CR*

The Tucson NRCS Field Office assisted with this planting in July of 2006. This site was selected because sections of the ranch, which is dominated by exotic Lehmann lovegrass, had burned that summer. The hope is that by planting native species, using seed harvested from a local site, natives may have a higher rate of germination versus the invasives. The planting was conducted using the Truax II Seed Drill. A variety of species were planted, including: *Eragrostis intermedia, Bouteloua gracilis, B. hirsuta, B. eriopoda, B. curtipendula, B. chondrosioides, Bothriochloa barbinodis, Digitaria californica, Lycurus phleoides, Leptochloa dubia, Aristida spp., Sida filicaulis, Ipomoea coccinea, Viguiera annua, convolvulus equitans*. The seed mix was from a native harvest from the nearby Appleton-Whittell Research Ranch of the Audubon Society. This planting will be evaluated for persistence and species composition during the growing season of 2010.

Growing Season 2010:

This planting was evaluated on August 24, 2010. Two 100 foot transects were ran in the seeded plot and two were ran in an unseeded area. Dry weight rank was used to determine the percent species composition in the transects. Based on the results for the top three species (see below), the seeded plots had an almost 20% reduction in *Eragrostis lehmanniana* versus the unseeded areas. This field planting will be monitored again in 2011.

VACA: Treated

Species	1	2	3	*7	*2	*1	Weighted	% Comp
Lehmann lovegrass (*Eragrostis lehmanniana*)	50	25	18	350	50	18	418	0.42
Sprucetop grama (*Bouteloua chondrosioides)*	13	14	6	91	28	6	125	0.13
Cane bluestem (*Bothriochloa barbinodis*)	12	4	5	84	8	5	97	0.10
Blue grama (*Bouteloua gracilis*)	9	9	9	63	18	9	90	0.09
Spidergrass (*Aristida ternipes*)	5	20	10	35	40	10	85	0.09
Woolystar (*Eriastrum sp.)*	4	5	14	28	10	14	52	0.05
Curly mesquite (*Hilaria belangeri*)	3	5	4	21	10	4	35	0.04
Aster sp.	2	3	9	14	6	9	29	0.03
Arizona muhly (*Muhlenbergia arizonica*)	1	5	6	7	10	6	23	0.02
Hairy grama (*Bouteloua hirsuta*)	1	1	1	7	2	1	10	0.01
Purple mat (*Nama demissum)*		2	7	0	4	7	11	0.01
Annual three awn (*Aristida sp.)*	1	1		7	2	0	9	0.01
Arizona blue eyes (*Evolvulus arizonicus*)			6	0	0	6	6	0.01
Rosary bean		1		0	2	0	2	0.00

(*Rhynchosia senna)*								
Arizona cottontop (*Digitaria californica*)		1		0	2	0	2	0.00
hog potato (*Hoffmannseggia glauca)*			2	0	0	2	2	0.00
chinchweed (Pectis sp.)			1	0	0	1	1	0.00
Green sprangletop (*Leptochloa dubia*)			1	0	0	1	1	0.00
goldenrod (*Oligoneuron sp.)*			1	0	0	1	1	0.00
morning glory (*Ipomoea sp.)*			1	0	0	1	1	0.00

VACA: Untreated

Species	1	2	3	*7	*2	*1	Weighted	% Comp
Lehmann lovegrass (*Eragrostis lehmanniana*)	75	36	12	525	72	12	609	0.61
Sprucetop grama (*Bouteloua chondrosioides*)	10	23	3	70	46	3	119	0.12
Arizona muhly (*Muhlenbergia arizonica*)	5	10	4	35	20	4	59	0.06
Blue grama (*Bouteloua gracilis*)	4	8	6	28	16	6	50	0.05
Woolystar (*Eriastrum sp.)*		8	17	0	16	17	33	0.03
Spidergrass (*Aristida ternipes*)	3	4	2	21	8	2	31	0.03
hog potato (*Hoffmannseggia glauca)*			20	0	0	20	20	0.02
Weeping lovegrass *(Eragrostis curvula)*	2	3		14	6	0	20	0.02
Cane bluestem (*Bothriochloa barbinodis*)	1		3	7	0	3	10	0.01
Sida (*Sida abutifolia*)		1	8	0	2	8	10	0.01
Purple mat (*Nama demissum*)		1	8	0	2	8	10	0.01
Wolfstail (*Lycurus phleoides*)	1	1		7	2	0	9	0.01
Arizona blue eyes (*Evolvulus arizonicus*)			4	0	0	4	4	0.00
Aster sp.			3	0	0	3	3	0.00
Rosary bean (*Rhynchosia senna)*		1	1	0	2	1	3	0.00
Sideoats grama (*Bouteloua curtipendula*)		1	1	0	2	1	3	0.00
Talinum sp.			2	0	0	2	2	0.00
silverleaf nightshade (*Solanum elaeagnifolium*)			2	0	0	2	2	0.00
ragweed (*Ambrosia cordifolia*)			1	0	0	1	1	0.00
Hairy grama (*Bouteloua hirsuta*)			1	0	0	1	1	0.00
blazing star (*Liatris sp.*)			1	0	0	1	1	0.00
Matweed (*Guilleminea densa*)			1	0	0	1	1	0.00

Growing Season 2011:

The Vaca seeding was evaluated again on 15 November 2011. The results of the evaluation along with a comparison to the data collected in 2010 are below. The data still shows an approximate 20% reduction in *Eragrostis lehmanniana* in the seeded versus the unseeded plots. This planting will not be monitored further due to its age.

	2010	2010	2011	2011
Species	**Untreated**	**Treated**	**Untreated**	**Treated**
Lehmann lovegrass (*Eragrostis lehmanniana*)	61%	42%	88%	63%
sprucetop grama (*Bouteloua chondrosioides*)	12%	13%	0%	8%
cane bluestem (*Bothriochloa barbinodis*)	1%	10%	2%	2%
blue grama (*Bouteloua gracilis*)	5%	9%	4%	4%
spidergrass (*Aristida ternipes*)	3%	9%		14%
woolystar (*Eriastrum sp.)*	3%	5%		
curly mesquite (*Hilaria belangeri*)		4%		
Aster sp.		3%		
Arizona muhly (*Muhlenbergia arizonica*)	6%	2%		
hairy grama (*Bouteloua hirsuta*)		1%		
purple mat (*Nama demissum)*	1%	1%		
ARHA	2%		8%	
annual three awn (*Aristida sp.)*		1%	2%	
Arizona blue eyes (*Evolvulus arizonicus*)		1%		
rosary bean (*Rhynchosia senna)*				
Arizona cottontop (*Digitaria californica*)				
hog potato (*Hoffmannseggia glauca)*	2%		2%	
chinchweed (Pectis sp.)				
green sprangletop (*Leptochloa dubia*)				
sand dropseed (*Sporobolus cryptandrus*)			2%	
goldenrod (*Oligoneuron sp.)*				
wolftail (*Lycurus phleoides*)	1%			
weeping lovegrass (*Eragrostis curvula)*	2%			
sida (*Sida abutifolia*)	1%			
Arizona Panic (*Panicum arizonica)*				
morning glory (*Ipomoea sp.)*				

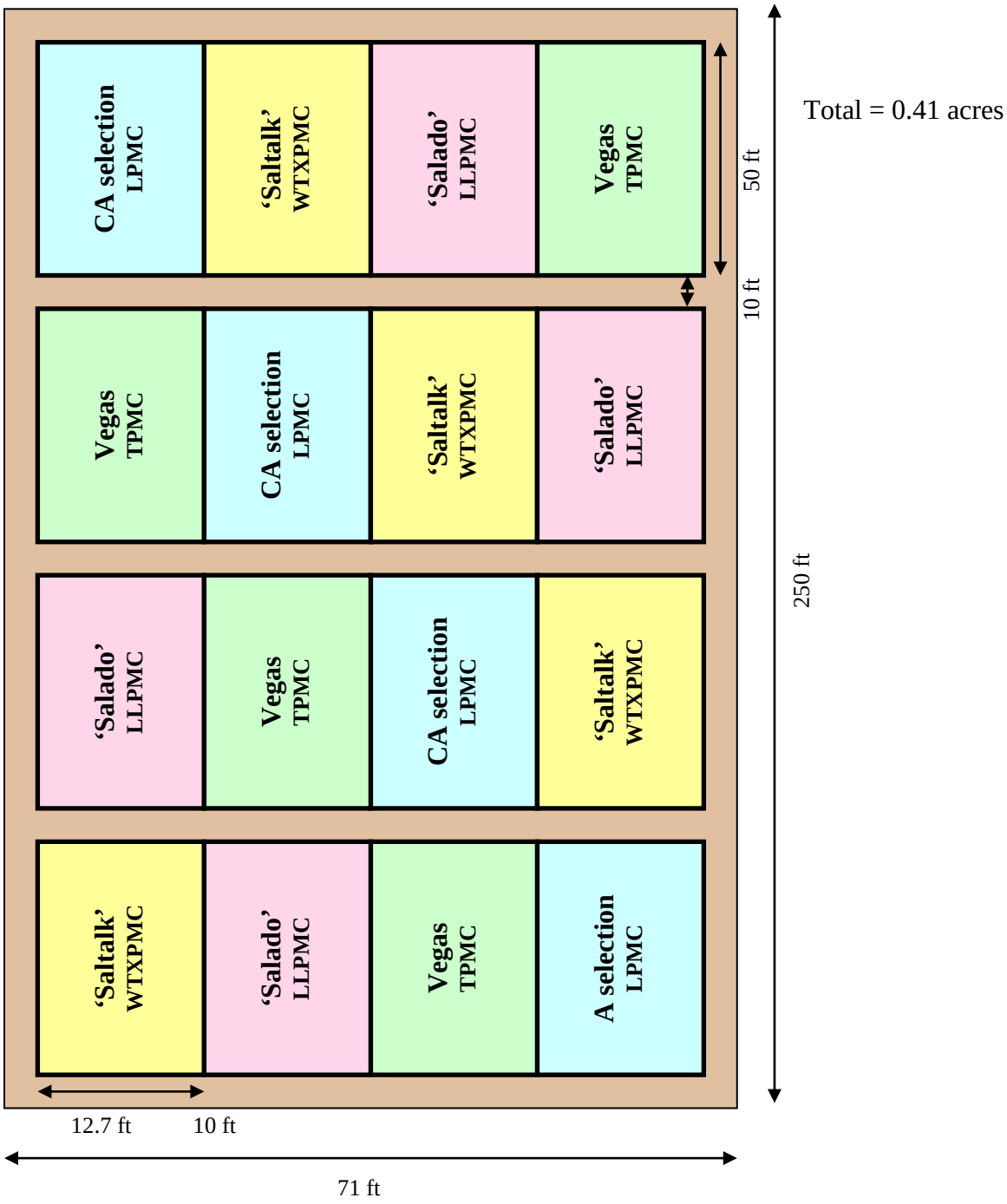
Intercenter Trials

Alkali Sacaton (Sporobolus airoides) Intercenter Strain Trial

Study ID Code	AZPMC-T-0701-ICST
Title	Alkali Sacaton (*Sporobolus airoides*) Intercenter Strain Trial
National Project No.	Natural Areas 1.1
Study Type	Advanced Evaluation
Study Status	Active
Location	AZPMC, NVPMC, WTXPMC, STXPMC, NMPMC, CAPMC
Study Leader	Heather Dial, AZPMC
Duration	2007 through 2012
Description	Alkali sacaton has multiple releases and accessions, either in commercial production, recently released or under current development. Intercenter strain trials are designed to refine and strengthen our understanding of these plants performance over broad geographic areas and further improve our recommendations to conservation practitioners
Status of Knowledge	 *Sporobolus airoides* typically grows on dry, sandy to gravelly flats or slopes, at elevations from 50 to 2350 m. It is usually associated with alkaline soils. Alkali sacaton grows in saline and nonsaline soils, sometimes in dense, pure stands. Alkali sacaton has been reported from sites with soil salinity ranging from 0.003% to 3%. It grows in soil textures from sand to clay, usually with low organic matter. It is tolerant of both drought and inundation by water. Alkali sacaton has a wide range of distribution throughout most states west of the Mississippi river.
Experimental Design	Randomized Complete Block Design (RCBD). 4 replications; 4 treatments (accessions) (See plot plan)
Materials & Methods	Samples of seed will be assembled by the AZPMCand distributed to participants. Seed will be planted by each participant at their location. The plots will consist of four, 50 ft long rows. Rows will be approximately 38 inches apart. Seeding rate will be approximately 20 seed/sq. foot. Seed/lb of each accession will be measured and used to determine accurate seeding. Each participant will receive packets with the correct amount of seed for a 50 ft. row. Cultural practices may include mechanical and chemical weed control, fertilization and chemical control of pests (to be determined by participants). The planting will receive irrigation as needed for establishment. After establishment irrigation will occur every 5 weeks. Data collection from center 2 rows and will include: 1st year - **s**tand evaluation at end of season, survival, photos of each plot, visual observations (protocols to be determined) 2nd year – date dormancy ends (if goes dormant), date of flowering , date of harvest, percent stand (30 days after dormancy breaks), forage (fresh and dry weight) 1 linear meter clipped from each row, seed production from each plot, photos, visual observations. Length of data collection to be determined. Each participant will receive data collection sheets for selected variables.

Final Evaluations Data will go to Jim Briggs (WRPMS) for analysis and reporting.

Technology Transfer Products Planting guide, internal reports, research article



Accomplishments/Results:

Growing season 2008:

Seed for this study was received from West Texas PMC ('Saltalk'), Los Lunas PMC ('Salado'), and Lockeford PMC (California selection) at the Tucson PMC. These seeds, along with the AZPMCrelease, Vegas, were then counted, packaged, and distributed by AZPMCpersonnel to cooperating Plant Materials Centers for planting. The trial will be planted at the AZPMCduring the 2009 growing season.

Growing season 2009:

The trial was established May 18 in field 3, borders 8-9 using a Kincaid Cone Planter. The planter was set with ¼" depth bands. Prior to planting, the field was leveled. The planting was irrigated in the months of May, June, July, and August for a total of 0.90 acre feet of application. The planting was evaluated on the 4th of June for germination. Germination of all accessions was spotty in blocks 1 and 2. These blocks are closest to irrigation outlets. Pressure from irrigation water may have caused the seeds to be pushed to blocks three and four which had excellent germination. Additionally, these blocks are shaded for a short duration in the morning hours.

V= Visible Germination NV= Not Visible

Date	4-Jun																Rep 4
	V	V	V	V	V	V	V	V	NV	NV	NV	NV	NV	NV	NV	NV	
Accession	1	1	1	1	4	4	4	4	3	3	3	3	2	2	2	2	
Date	4-Jun																Rep 3
	V	V	V	V	V	V	V	V	NV	NV	NV	NV	V	V	NV	NV	
Accession	4	4	4	4	3	3	3	3	2	2	2	2	1	1	1	1	
Date	4-Jun																Rep 2
	V	V	V	V	V	V	V	V	V	V	V	V	V	V	NV	NV	
Accession	3	3	3	3	2	2	2	2	1	1	1	1	4	4	4	4	
Date	4-Jun																Rep 1
	V	V	V	V	V	V	V	V	V	V	V	V	NV	NV	NV	NV	
Accession	2	2	2	2	1	1	1	1	4	4	4	4	3	3	3	3	
		Block 4				Block 3				Block 2				Block 1			

1=TX (Saltalk), 2=CA, 3=AZ (Vegas), 4=NM (Salado)

Growing season 2010-2011:

An interim report for the data collected during 2010-2011 at each participating PMC follows.

2011 Interim report of the evaluation of four alkali sacaton selections in four common gardens

November 2011

James Briggs[1/], H. Dial[2/], C. Smith[3/], G. Fenchel[4/], M. Smither-Koppperl[5/], B. Carr[6/]

Abstract

Alkali sacaton, *Sporobolus airoides,* is a native warm season grass which grows throughout most states west of the Mississippi river. Alkali sacaton is considered valuable forage for domestic livestock and wildlife in arid-semi-arid environments and can be moderately grazed without ill effect. It is reported to be somewhat tolerant of fire, with recovery in 2-5 years after a burn. Alkali sacaton is frequently used for reseeding and has special applicability in revegetation of sites disturbed by oil exploration due to its ability to remove selenium from contaminated soils. The purpose of this study was to document performance differences among cultivars 'Saltalk' and 'Salado, Vegas Germplasm, and a California experimental line 9083020 in common gardens located at sites representing diverse western habitats.

Results from the Arizona, California, New Mexico trials shows no significant ($P < .05$) difference in yield among accessions. Vegas Germplasm and accession 9083020 did have the highest dry wt. biomass yield at the Arizona and California PMCs. Onset of active spring growth patterns at the Arizona PMC may indicate the ability of Vegas Germplasm and accession 9083020 to be able to better utilize limited soil moisture.

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2/ H. Dial, Assistant Manager. USDA-NRCS, Tucson Plant Materials Center, Tucson, Arizona.

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4/ G. Fenchel, Manage. USDA-NRCS Los Lunas Plant Materials Center, Los Lunas, New Mexico

5/ M. Smither-Kopperl, USDA-NRCS California Plant Materials Center, Lockeford, California

6/ B. Carr, Agronomist. USDA-NRCS James "Bud"Smith Plant Materials Center, Knox City, Texas

Introduction

Alkali sacaton, *Sporobolus airoides*, is a native warm season grass which grows throughout most states west of the Mississippi river. It typically grows on dry, sandy to gravelly flats or slopes, at elevations from 50 to 2350 m. It is usually associated with alkaline soils. Alkali sacaton grows in saline and nonsaline soils, sometimes in dense, pure stands and is frequently the dominant grass in the landscape. Alkali sacaton is rated as saline Tolerant which indicates it can tolerate approximately EC_e 6-10 dS/m without reduction in yield and EC_e 15-21 dS/m with only a 50% reduction in yield (Maas 1990). It grows in soil textures from sand to clay, usually with low organic matter. It is tolerant of both drought and inundation by water.

Alkali sacaton is considered valuable forage for domestic livestock and wildlife in arid-semi-arid environments and can be moderately grazed without ill effect. It is reported to be somewhat tolerant of fire, with recovery in 2-5 years after a burn. Alkali sacaton is frequently used for reseeding disturbed sites and has special applicability in revegetation of sites disturbed by oil exploration due to its ability to remove selenium from contaminated soils. The seed remains viable for up to 7 years. (Hatch 2004)

The purpose of this study was to document performance differences of the selections in common gardens located at sites representing diverse western habitats.

Materials and Methods

Seed of two cultivars, one selected class germplasm, and one experimental line of alkali sacaton were planted at the Tucson, Arizona, Knox City, Texas; Lockeford, California, and Los Lunas, New Mexico PMCs. The two cultivars are 'Salado', originally collected south of Claunch, NM at an elevation of 1170 m and annual precipitation of 300 mm; and 'Saltalk', which originated near Erick, Oklahoma (Alderson 1995). The selected class germplasm is 'Vegas' which is a composite of materials collected in Clark, Lincoln, and Nye Counties in southern Nevada (USDA1 undated). The California experimental line, 9083020, was collected near the Kern Nat'l Wildlife Refuge in Wasco, Kern County (southern San Joaquin Valley, MLRA 17). Each PMC is able to evaluate performance in different habitats described by Major Land Resource Areas (MLRA) (USDA 3 2006) and EPA eco-regions. The Tucson PMC is located in MLRA 40 (EPA Eco-region 81), the Knox City PMC is in MLRA 78 (EPA Eco-region 26), Los Lunas PMC is in MLRA 35 (EPA Eco-region 22), and the California PMC is in MLRA 17 (EPA-Ecoregion 7).

Alkali sacaton entries were planted into plots replicated 4 times using a Randomized Complete Block design. Each plot consists of four 50 foot long rows spaced 38 inches apart. Planting dates were variable and were appropriate to the site. Seeding rate was 20 Pure Live Seed (PLS) per foot. Plots were irrigated, as needed, to insure establishment. Irrigations after establishment occurred every 5 weeks as required. Weed and other pest control measures as well as fertilization were applied as needed.

Accessions were evaluated for stand and survival in the first year. In year 2-4 green-up, anthesis, and seed maturity dates were documented, stand evaluated, ocular evaluation of seed production, and air-dry biomass production determined by harvesting a 1 meter sample from interior plot rows that was representative plot growth.

Results and Discussion

Texas PMC plots were planted fall 2008. Stand estimates in 2009 and 2010 were highly variable (trial CVs of 94 and 107) and generally poor. Plant stand was estimated at 13-14% in 2009 and 2010 respectively, with no apparent relationship to accession. In efforts to control weeds in 2009 several plots were damaged. No differences in flowering dates (June 9-8 and June 15-18 in 2009 and 2010 respectively) or spring green-up (April 10 and April 12 in 2009-2010 respectively) was observed among accessions.

Arizona plots were established in 2008. Some plots had variable initial plant establishment, but this appeared related to irrigation rather than a difference in accessions. None of the accessions entered full dormancy during the 2009 winter period and all accessions were vigorously growing by mid March of 2009. 2010 yields (Table 1) were not significantly different ($P < .05$) among accessions and averaged 1.3 tons/ac for Salado to 2.2 tons/ac for Vegas Germplasm. 2010 results at the Arizona PMC are similar to an earlier study (Alba-Avila 1988) which showed that soil texture and depth of seeding had significant ($P < .01$ and .001) effects on above and below ground biomass production, while differences in biomass yield associated with the cultivars Salado and Saltalk were non-significant ($P < .05$).

In 2011 plots in Arizona and California were not irrigated during the growing season in an effort to evaluate accession performance under natural rainfall conditions (Table 1). Early spring moisture prior to active growth appeared to have little impact on performance of accessions as the Arizona PMC received less than 0.5 inches of rainfall prior to active growth and the California PMC received 8.5 inches during the same period, yet biomass yields were similar at both locations. Precipitation during the active growing period , April through July and August, depending on location, was 1.6 and 2.4 inches at the Arizona and California PMCs respectively.

Table 1. Average monthly precipitation during growing season at the Arizona, New Mexico, and California Plant Material Centers in 2011.

Month	Arizona PMC	California PMC	New Mexico PMC
	----------Inches----------		
Jan	0.0	1.0	0.1
Feb	0.3	3.2	0.0
Mar	0.1	4.3	0.0
Apr	0.0 – Growth begins	0.2 – Growth Begins	0.0
May	0.4	1.2	0.1
June	0.0	1.0	0.0
July	1.2 - Harvest	0.0	0.8
Aug	N/A	0.0 - Harvest	0.4
Sep	N/A	N/A	0.4
Oct	N/A	N/A	Harvest
Nov	N/A	N/A	
Dec	N/A	N/A	
Season total	2.0	10.9	
Active growing season total	1.6	2.4	

Initial spring growth at the Arizona PMC varied by accession. Vegas Germplasm began growth the earliest at mid-March, 9083020 late March, Saltalk mid-April, and Saltalk not fully

showing active growth until late May. In California none of the accessions became fully dormant; however, active spring growth began uniformly among all accessions beginning late in March through mid April. The trigger for the larger variation in spring growth in the Arizona plots is likely due to the ability of the Vegas Germplasm and accession 9083020 to utilize very low amounts of moisture; they are better adapted to low moisture conditions. Saltalk and Salado sources come from regions with more precipitation (12-19 inches) and more severe winters 0-5^{o} degrees F (zone 7a) while Vegas Germplasm and accession 9083020 are from regions with very little precipitation (2-8 inches) and mild winters with low temperatures of 20-25^{o} F. (zone 9A) (USDA4, 2011). All the sources are from similar latitudes Saltalk and accession 9083020 are from sites at 35 ^{o} N. latitude and Salado is from 33^{o} N, and Vegas is composed of material collected from locations at 37^{o} N latitude.

Yields (Table 2) in 2011 were not significantly different (P <.05) between accessions at the Arizona, New Mexico, or California PMCs. Accession 9083020 and the Vegas Germplasm had the greatest biomass yield at 2.4 and 1.6 tons per acre, respectively, at the Arizona and California PMCs under non-irrigated conditions. Accession 9083020 and Vegas Germplasm appear stemmier which may provide greater drought tolerance, but may have less value as a livestock forage than the cultivars Salado or Saltalk, which had the same mean yields, 1.2 tons/acre, in 2011 at the Arizona and California PMCs under non-irrigated conditions. The New Mexico plots received three irrigations in 2011 (April, May, and June) which resulted in larger yields than at Arizona and California.

Table 2 . Mean yields of Vegas Germplasm, 'Salado', 'Saltalk', and 9083020 alkali sacaton accessions at the Arizona, New Mexico, and California Plant Materials Centers 2010-2011.

Accession	Tucson, AZ PMC		Lockeford, CA PMC		Los Lunas, NM PMC		Mean Yield	
	tons/acre (dry wt.)							
	2010*	2011**	2010	2011**	2010*	2011*	Irrig.	Non-Irrig.
Salado	1.3	1.1	-	1.2	2.0	2.6	2.0	1.2
Saltalk	1.9	1.6	-	0.7	1.8	3.2	2.3	1.2
Vegas Germplasm	2.2	2.4	-	0.8	1.7	2.7	2.2	1.6
9083020 (Ca sel)	1.9	2.1	-	1.2	2.7	4.0	2.9	2.4
LSD (P=<.05)	NS	NS		NS	NS	NS		

*Irrigated throughout growing season as needed **No irrigation through growing season.

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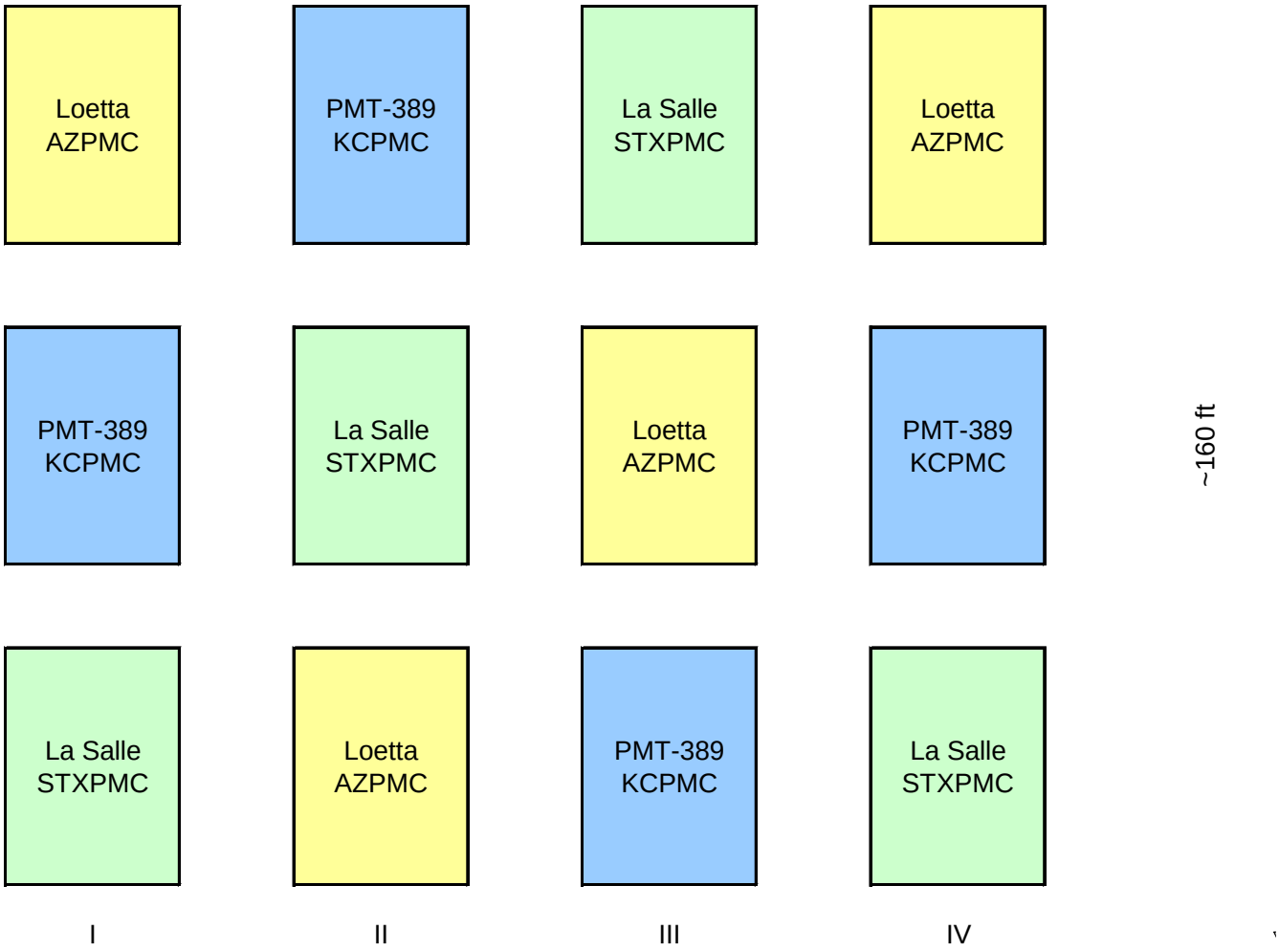
Arizona Cottontop (Digitaria californica) Intercenter Strain Trial

Study ID Code	AZPMC-T-0702-ICST
Title	Arizona cottontop (*Digitaria californica*) Intercenter Strain Trial
National Project No.	Natural Areas 1.1
Study Type	Advanced Evaluation
Study Status	Active
Location	AZPMC, KCPMC
Study Leader	Bruce Munda, Heather Dial, AZPMC
Duration	2009 through 2012
Cooperators	AZPMC, KCPMC
Description	AZ cottontop has multiple releases and accessions, either in commercial production, recently released or under current development. Intercenter strain trials are designed to refine and strengthen our understanding of these plants performance over broad geographic areas and further improve our recommendations to conservation practitioners
Status of Knowledge	Arizona cottontop is a native, perennial bunchgrass that contributes considerable range forage in the Southwest, from southern Colorado to Texas, Arizona, and northern Mexico. This species can be found in the oak woodland, chaparral, and semi-desert grassland types, between 300 and 1,800 m. 
Experimental Design	Randomized Complete Block Design (RCBD). 4 replications; 3 treatments (accessions) (Attachment 1)
Materials & Methods	Samples of seed from STX PMC (La Salle), KCPMC (PMT-389), and AZPMC (Loetta), will be planted by each participant at their location. The plots will consist of four, 50 ft long rows. Rows will be approximately 40 inches apart. Seeding rate will be approximately 20 seed/sq. foot. Seed/lb of each accession will be measured and used to determine accurate seeding. Cultural practices may include mechanical and chemical weed control, fertilization (50 au of N/season) and chemical control of pests. All cultural practices will be recorded. The planting will receive irrigation as needed for establishment. After establishment, irrigation will occur every 5 weeks. Data collection will be from center 2 rows and will include: 1st year – visual observations will include % stand establishment at the beginning of the season and % survival at end of season. Photos of each plot should be taken to document stand observations. 2nd year –date dormancy ends (if it goes dormant); date of flowering; date of harvest; percent stand (30 days after dormancy breaks); forage (fresh and dry weight) to be determined from 1 linear meter clipped (to ~4" height) from designated rows; seed production (lbs) from each plot (seed to be harvested with FlailVac); photos/ visual observations Data collection will continue until the end of the growing season 2012. Each participant will receive data collection sheets for selected variables.

Final Evaluations	Data will go to Jim Briggs (WRPMS) for analysis and reporting.
Technology Transfer Products	Planting guide, internal reports, research article



Growing season 2009:

The planting was established the 18th of May in field 4, border 5 with a Kincaid cone planter. The planter was set with ¼" depth bands. Prior to planting, the field was leveled. The planting was irrigated in the months of May, June, July, and August for a total of 0.62 acre feet of application. The planting was evaluated on the 5th of June for germination. All three accessions had visible germination in all blocks. However, the middle rows of all blocks were very hard to distinguish. Later in the growing season, it became apparent that the middle rows of all blocks would not germinate. It is possible that the repeated trips over the middle rows during the planting process created too much compaction for the seedlings to survive.

Growing season 2010:

The following data was collected during 2010: date dormancy ended, date of flowering, percent stand (30 days after dormancy breaks), and fresh and dry weight of forage. The data is reported in the table below.

					Forage	
Plot #	**Date Dormancy Ended**	**% Stand (30 days after dormancy breaks)**	**Harvest Date**	**Flowering Date**	**Fresh wt.**	**Dry wt.**
1	15-Mar-10	100	6-Aug	12-Apr-10	1.92	0.93
2	15-Mar-10	100	6-Aug	12-Apr-10	1.26	0.53
3	15-Mar-10	100	6-Aug	12-Apr-10	1.84	1.05
4	15-Mar-10	100	6-Aug	12-Apr-10	1.84	1.11
5	15-Mar-10	100	6-Aug	12-Apr-10	2.42	1.39
6	15-Mar-10	100	6-Aug	12-Apr-10	2.16	1.00
7	15-Mar-10	100	6-Aug	12-Apr-10	2.82	1.45
8	15-Mar-10	100	6-Aug	12-Apr-10	1.86	0.90
9	15-Mar-10	100	6-Aug	12-Apr-10	1.78	0.96
10	15-Mar-10	100	6-Aug	12-Apr-10	1.56	0.78
11	15-Mar-10	100	6-Aug	12-Apr-10	1.68	0.81
12	15-Mar-10	100	6-Aug	12-Apr-10	1.46	0.79

Growing Season 2011:

An interim report for the data collected during 2010-2011 at each participating PMC follows.

2011 Interim report of the evaluation of three Arizona cottontop selections in two common gardens

November 2011

James Briggs1/, H. Dial2/, B. Carr3/, M. Rosales4/, G. Rea5/

Abstract

Arizona cottontop, Digitaria californica, is a native warm season grass found from southern Colorado to Texas, Arizona, and northern Mexico. The species responds quickly to spring and summer rains thereby providing good quality early forage when it is green (Arizona Range Grasses 1960). The purpose of this study was to document performance differences of the 3 NRCS selections in common gardens located at sites representing diverse western habitats. Results from the Texas and Arizona trials show no significant (P=<.05) differences in biomass yields at either location in 2010 or 2011. At the Texas PMC PMT-389 produced the most biomass (1.8 t/acre) in 2010; in 2011 PMT-389 produced 0.6 t/acre, while Loetta and La Salle produced 0.6 t/acre and 0.5 t/acre respectively. At the Arizona PMC La Salle produced the most biomass (2.3 t/acre) in 2010 and Loetta produced the most biomass (3.2 t/acre) in 2011. Loetta produced significantly (P=<.05) more seed (235 lb/acre) than La Salle in 2010;and significantly more seed (233 lb/acre) than both La Salle Germplasm and PMT-389 in 2011. Arizona data was not statistically analyzed, however, Loetta also was the best producer in 2011. Seed production at the Texas PMC far exceeded production at the Arizona PMC among all accessions. In 2011, Loetta produced 233 lb seed per acre at Texas and 98 lb/acre at the Arizona site. The large yield difference is likely due to number of harvests and fertility.

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5/ G. Rea, Manager. USDA-NRCS James "Bud"Smith Plant Materials Center, Knox City, Texas

Introduction

Arizona cottontop, Digitaria californica, is a native warm season grass found from southern Colorado to Texas, Arizona, and northern Mexico. This species can be found in the oak woodland, chaparral, and semidesert grassland types, between 300 and 1,800 m.
Arizona cottontop is a commonly found growing with gramas (Bouteloua spp.), three awns (Aristida spp.) , and beardgrass (Andropogon barbinodis) and typically makes up 2-5% of the total ground cover (USDA, USFS. 1988). This species responds quickly to spring and summer rains thereby providing good quality early forage when it is green. The species is both self- and cross- pollinated, with selfing the predominant methodology; seed development is indeterminate throughout the summer period (Pitman, 2004).
The purpose of this study is to document performance differences of the 3 NRCS selections in common gardens located at sites representing diverse western habitats.

Materials and Methods

Included in this trial was accession PMT-389, a single source collection from Culberson county, Texas, informally released to commercial industry in the 1970's, La Salle Germplasm (Smith 2009), a 12 source composite developed for use in southern Texas, and 'Loetta'(USDA1, NRCS) a single source cultivar released for use in southeastern Arizona.

The plots consist of four, 50 ft long rows at the Texas location; the Arizona location has 2 50 ft long rows. Rows are approximately 40 inches apart and Seeded at a rate of approximately 20 seed/linear foot. Weeds were controlled using mechanical and chemical methods. Texas and Arizona plots were fertilized in the spring of 2010 and 2011 at 50lbs of actual N per acre and 20 lbs actual N per acre respectively. Plots at Texas and Arizona received supplemental irrigation in the establishment year (2010); the Arizona plots received supplemental irrigation, estimated at 1.6 acre feet) in the 2011 year, the Texas plots did not. The following data was collected:

1st year – visual observations including percent establishment and percent stand at the beginning of the season and percent survival at end of season.

2nd year – date dormancy ends (if it goes dormant); date of flowering; date of harvest; percent stand (30 days after dormancy breaks); forage (fresh and dry weight) to be determined from 1 linear meter clipped (to ~4" height) from designated rows; seed production (lbs) from each plot (seed to be harvested with FlailVac).

3nd year – date dormancy ends (if it goes dormant); date of flowering; date of harvest; percent stand (30 days after dormancy breaks); forage (fresh and dry weight) to be determined from 1 linear meter clipped (to ~4" height) from designated rows; seed production (lbs) from each plot (seed to be harvested with FlailVac).

Results and Discussion

Plots were evaluated in 2010 and 2011 for various parameters including biomass produced, stand, seed production, date when dormany ended, and flowering date. At the Texas PMC plants began spring growth mid April (April 14) in 2010 and early April (April 4) in 2011; in Arizona spring growth began in early March in 2010 and 2011.

Stands were ranked 100% in 2010 and 2011 in Arizona while Texas ranked the average stand as being 75% in 2010 and 70% in 2011. First flowering date was uniform among all entries and was similar in both years with Texas plots first flowering end of May-beginning of June, while Arizona first flowering dates were noted as occurring mid-April in 2010 and early May 2011. Texas harvested seed twice mid-June and mid-July 2010 and 2011; Arizona had a single harvest on May 26, 2011. At the Texas PMC Loetta had significantly (P=<.05) higher seed yield (233 lb/ac) than PMT-389 and La Salle in 2011; in 2010 Loetta was significantly higher (235 lb/ac) than La Salle (173 lb/ac) (Table 1). Arizona seed yields were not statistically analyzed; however, Loetta was the best seed producer in 2011 at 98 lb/ac, while LaSalle yielded 90 lbs/ac, and PMT-389 82 lb/acre. The large difference in seed yield between the Texas and Arizona sites likely due to number of harvests: Arizona's one versus two at Texas; and fertility with Texas having applied 50 lbs actual N per acre while Arizona applied 20 lbs. actual N per acre. Fertilizer was applied as a single application at both sites and in both 2010 and 2011 growing seasons.

Table 1 . Mean seed yields of La Salle Germplasm, 'Loetta', and PMT-389 Arizona cottontop accessions at Knox City, Texas Plant Materials Center 2010-2011.

Accession 2010 2011 Mean Yield

Accession	2010	2011	Mean Yield
	----------lb/acre----------		
Loetta	235	233	234
PMT-389	207	184	196
La Salle	173	153	163
LSD (P=<.05)	43	43	

No significant (P=<.05) differences in biomass yield (Table 2.) were found at either location in 2010 or 2011. Arizona biomass yields in 2011 (3.0 t/ac) were higher than 2010 (1.9 t/ac). Texas 2011 biomass yields (0.6 t/ac) were substantially less than 2010 (1.5 t/ac). Biomass yield appears related to total moisture the crops received through natural rain or supplemental irrigation (Table 3). In 2011 Texas received approximately 5.1 inches of moisture during the growing season which yielded an average of 0.6 t/ac among all entries whereas in 2010, during the same growing period 7.5 inches of moisture was received which yielded an average of 1.5 t/ac among all entries.

Table 2 . Mean biomass yield of La Salle Germplasm, 'Loetta', and PMT-389 Arizona cottontop accessions at the Tucson, Arizona; and Knox City, Texas Plant Materials Centers 2010-2011.

Accession	Tucson, AZ PMC		Knox City, TX PMC		Mean Yield	
	2010	2011	2010	2011	2010	2011
	----------t/acre----------					
La Salle	2.3	3.1	1.2	0.5	1.8	1.8
Loetta	1.8	3.2	1.5	0.6	1.6	1.9
PMT-389	1.7	2.8	1.8	0.6	1.8	1.7
LSD (P=<.05)	NS	NS	NS	NS	NS	NS

Arizona plots received approximately 7.2 inches of moisture during its March thru August growing season and yielded an average of 1.9 t/ac biomass in 2010; in 2011 the plots received approximately 13.9 inches of moisture which yielded an average of 3.0 t/ac biomass. Although biomass yield appears closely related to available moisture seed yield was not affected.

Table 3. Average monthly precipitation during growing season at the Tucson, Arizona and Knox City, Texas Plant Material Centers in 2010-2011.

Month Tucson, AZ PMC Knox City, TX PMC

Month	Tucson, AZ PMC				Knox City, TX PMC			
	2010 rainfall	2010 Irrigation *	2011 rainfal l	2011 irrigation *	2010 rainfall	2010 Irrigation *	2011 rainfall	2011 irrigation *
	----------inches----------							
Jan	1.8	0.0	0.0	0.0	3.1	0.0	0.1	0.0
Feb	1.9	0.0	0.3	2.0	2.8	0.0	0.8	0.0
Mar	0.4	2.0	0.1	2.0	1.7	0.0	0.2	0.0

Apr	0.1	0.0	0.0	0.0	4.7	0.0	0.0	4.0
May	0.0	0.0	0.4	4.0	2.8	0.0	1.1	0.0
June	0.0	2.0	0.0	4.0	1.5	0.0	0.2	4.0
July	0.7	2.0	1.4	2.0	10.8	0.0	0.0	4.0
Aug	1.5	2.0	0.8	4.0	1.2	0.0	0.0	4.0
Sep	0.1	0.0	2.6	0.0	6.5	0.0	0.3	4.0
Oct	0.3	0.0	-	-	1.0	0.0	2.8	0.0
Nov	0.0	0.0	-	-	0.4	0.0	-	-
Dec	0.5	0.0	-	-	0.1	0.0	-	-
Total	7.3	8.0	5.6	18.0	36.4	0.0	5.4	30.0

*= individual irrigation applications are estimates.
0 = growing season prior to harvest of crop biomass

References:

Pitman, W.D., C.G. Chambliss, and J.B. Hacker. 2004. Digitgrass and Other Species of Digitaria. p. 715-743 In L.e. Moser, B.L. Burson, and L.E. Sollenberger (ed.) Warm Season (C4) Grasses. Agronomy Monograph 45. ASA, CSSA,SSSA. Madison, WI

Smith, F.S., P.D. Maywald, S.D. Maher, A.W. Scott Jr, and J. Garza. 2009. Notice of Release of La Salle Germplasm Arizona Cottontop selected class of natural germplasm. Native Plant Journal 10(1) Spring 2009.

USDA, USFS. 1988. Range Plant Handbook. p 203-204. Dover Publications Inc. , New York. Reprinted , originally issued by the USFS 1937.

USDA 1, NRCS. Undated. 'Loetta' Arizona Cottontop (Digitaria californica) Release brochure

Conservation Trials

Native Seed Growers Demonstration; Douglas, AZ

Study ID Code	AZPMC-F-1001-RA
Title	Educational & promotional planting for new native seed growers
National Project No.	Range Land 2.1
Study Type	Conservation Field Trial
Study Status	Active
Location	Cochise County
Study Leaders	TPMC and Douglas Field Office
Duration	2010to 2015
Vegetative Practices	347 Critical Area Planting 552 Range Planting 645 Wildlife Upland Habitat Management
Purpose	Field planting for field demonstration and education
Status of Knowledge	The Tucson Plant Materials Center has released various native grasses to be used in restoration/revegetation projects throughout the service area which includes parts of the Chihuahuan, Sonoran and Mojave Deserts. However, these releases are not being fully utilized by land managers due to the lack of available commercial seed and native seed growers. This field planting is an initial step to motivate interested growers, as well as land managers to start using some of these available native grass releases.
Materials & Methods	Five releases from the TPMC will be compared to commercially available seed of the same species purchased from well known seed producers in the Southwest (some of the commercially available native species are of unknown origin). The seed will be direct seeded into ¼ acre plots. The plots will be irrigated and cared for by the local cooperator.
Evaluations	The plots will be evaluated from 2011 to 2015. Evaluations will be conducted by the TPMC in cooperation with field office personnel and the local cooperator. Evaluations will include: plant stand, vigor, incidence of pests, and seed yield (if available). A representative sample of 1 square meter will be hand-clip from each plot to estimate seed yield...
Technology Transfer Products	Annual reports on data collection will be included in the TPMC Annual Technical Report. Newsletter articles on the progress of the planting will be published by the Douglas Field Office and the TPMC. At least one tour and/or field day for local growers and land managers will be arranged by the Douglas field office and the local cooperator during the study years (2011-2015). A plant materials technical note summarizing the findings will be prepared by the Arizona Plant Materials Specialist or the TPMC.

Accomplishments/Results

Growing season 2011:

On July 1, 2011, TPMC personnel visited the site and met with the cooperator. The purpose of the visit was to evaluate the performance of the newly planted species which were established on August 27, 2010. Plots are flood irrigated as needed during the growing season. A visual estimation of the plant stand for each plot was conducted. Most of the grass species germinated well, however, the forb desert zinnia, had almost no germination. The table below summarizes the evaluation results.

Plot Number[1] (North-South)	**Entry**	**Seeding Rate Lb/acre (PLS)**	**TPMC Release or Commercial[3] Name**	**Percent Plant Stand[2]**
1	Desert zinnia(*Zinnia acerosa*)	2.2	Batamote Germplasm	1
2	Desert zinnia(*Zinnia acerosa)*	2.2	Batamote Germplasm	2
3	Pima pappusgrass(*Papophorum vaginatum*)	3	Pima Germplasm	75
4	Pima pappusgrass(*Papophorum vaginatum*)	3	Pima Germplasm	75
5	Spike dropseed(Sporobolus contractus)	1	Cochise Germplasm	65
6	Spike dropseed(Sporobolus contractus	1	Commercial	65
7	Arizona cotton top(*Digitaria californica*)	4	'Loetta'	60
8	Arizona cotton top(*Digitaria californica*)	4	Commercial	55
9	Plains lovegrass(*Eragrostis intermedia*)	1	Bonita Germplasm	35
10	Plains lovegrass(*Eragrostis intermedia*	1	Commercial	40

1. Plot size is approximately 0.25 acre
2. Visual plant stand based on entire plot
3. Commercial seed available in the market with no specific variety name(common seed)

General view of plots

Pollinator Garden

Study ID Code	AZPMC-T-0901-OT
Title	Pollinator garden
Project Number	National Action Plan: Pollinators
Study Type	Initial
Study Status	Active
Location	AZPMC
Study Leader	Bruce Munda, Heather Dial
Duration	2009-2014
Cooperators	North American Pollinator Protection Campaign (NAPPC)
Land Use	Cropland 2.1 Natural Areas 1.1

Vegetative Practices

Primary	Field border
Secondary	Conservation Cover

Resource Concern(s)

Resource	Consideration/Problem
Pollinator habitat	Information is needed on native plants that will provide pollinator habitat on/in agricultural lands and complement the bloom of insect-pollinated crops.

Long Range Plan

Objective 2.3: Increase the alternative and specialized uses of conservation plant releases to meet emerging needs.

Description

Demonstration/study of native plants that can be used to provide pollinator habitat. One barrier to pollinator conservation identified by many who work in the field with landowners is the need for tested prescriptions for how to incorporate diverse plant mixes in different regions and different cropping systems (National PMP Pollinator Conservation Action Plan). Our demonstration planting will provide data on potentially suitable native plants for pollinator habitat and a visual reference for those landowners looking for ways to increase pollinator habitat.

Status of Knowledge

Native pollinators provide pollination services estimated to be worth about $3 billion dollars/year. However, many agricultural areas today lack sufficient habitat to support native pollinators. The need for this habitat is well documented as are the ways to increase it: increase foraging habitat, create nesting sites, and reduce risk to pollinators from the use of insecticides and herbicides (Farming for

Pollinators, pg. 13). The knowledge that is lacking is that of native plants that will be conducive to providing pollinator habitat in agricultural areas of the desert Southwest.

Materials and Methods

Native plants (forbs and shrubs) purchased by NAPPC will be planted in a 0.13 acre border on the Tucson Plant Materials Farm in the summer of 2009. The plants will be chosen based upon their potential and/or documented attractiveness to pollinators and their commercial availability. The plantings will follow a hedgerow design (see attached plot plan). Between the forbs and shrubs hedgerows, native grasses will be planted to provide habitat for pollinators and potentially food for certain species of moths native to the Sonoran desert (Farming for Pollinators, pg. 13).

The planting will be flood irrigated as needed for plant establishment. Irrigation during the life of the planting will be minimal and directed to best mimic water availability of Southwestern agricultural lands. Flood irrigation is not recommended for pollinator plantings due to its potential to saturate ground nesting bee nests. However, adjacent fallow fields, ditch banks, and/or farm lands not used for cultivation within the average foraging distance of native bees (50 feet to a half-mile) may provide ground nesting bee habitat.

Weed control during the life of the planting will be hand rouging and/or mowing. Chemical and/or mechanical control of weeds (cultivating, rotovating) will not be used in order to best protect pollinator habitat.

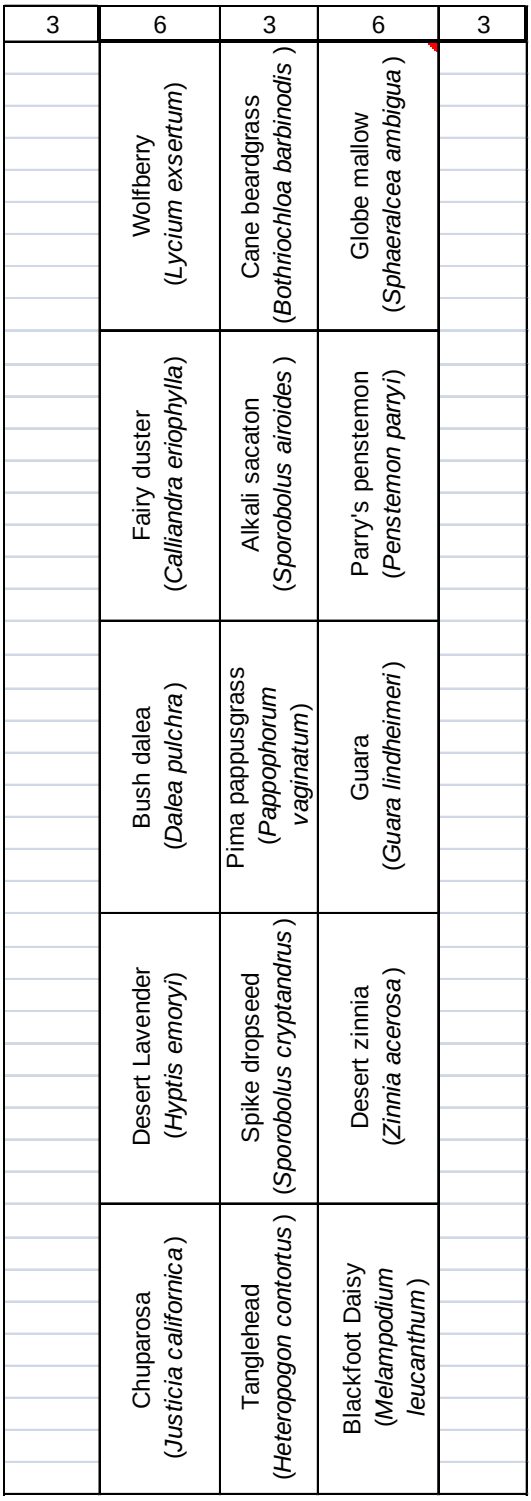
PMC data collection will include amount of water applied for establishment, time spent on weed control during establishment, flowering date, drought resistance, and dates of use of the plants by pollinators. PMC personnel do not have the expertise to identify native pollinators by species however, we can document whether or not the plant is being visited by pollinators.

In the future, an adjacent border may be planted to a common Southwestern crop (cotton, chili, etc) to gauge the effect of native pollinators. In this scenario, one part of the crop field would be protected from use by all but the European honey bee while the second part of the crop field would be left open to any native pollinators. This project would be conducted with support/assistance from NAPPC.

Literature Cited

Farming for Bees; Pollinators of the Sonoran Desert; USDA NRCS National Pollinator Conservation Action Plan; Selecting Plants for Pollinators, American Semidesert and Desert Province; Southern Arizona Nature Almanac, Native Arizona Plants, Steve Buchmann

Pollinator Garden (AZPMC-T-0901-OT) Plot Plan:



Growing Season 2010-2011:

The pollinator garden was established in October 2009 in field one, border four. Field preparation consisted of cultivation, herbicide control of emerging weeds and laser leveling. The field was pre-irrigated before planting. Approximately 50 one gallon containerized plants of each forb species, 7 one gallon containers of each shrub species and 20 jiffy plugs of each grass species were used for the initial planting. In growing seasons 2010 and 2011, approximately 1 acre foot of water was applied. The flowering periods of the shrub and forb species were recorded in 2010 and are shown below.

Observed Flowering Periods of AZPMC Pollinator Garden Species 2010

	Flowering Period											
Species	January	February	March	April	May	June	July	August	September	October	November	December
Desert lavender (*Hyptis emoryi*)												
Chuparosa (*Justicia californica*)												
Bush dalea (*Dalea pulchra*)												
Wolfberry (*Lycium exsertum*)												
Guara (*Guara lindhiemeri*)												
Blackfoot Daisy (*Melampodium leucanthum*)												
Parry's penstemon (*Penstemon parryi*)												
Desert zinnia (*Zinnia acerosa*)												
Globe mallow (*Sphaeralcea ambigua*)												
Fairy Duster (*Calliandra eriophylla*)												

At the end of 2010, all species present in the garden had an approximately 95% survival rate. Guara was the highest performer and had filled in all interspaces in the plot by June of 2010. Desert lavender, bush dalea, chuparosa, and wolfberry had extensive growth while the fairy duster, zinnia and chuparosa exhibited much slower growth rates.

In February 2011, the unusually cold temperatures (18°F) resulted in a die-off of all planted desert lavender and a majority of the blackfoot daisy, guara and chuparosa. Throughout growing season 2011, weed control became difficult due to the large holes left in the planting block by the plant die-off. In the late summer of 2011, all dead material was pulled from the garden and pre-emergent (3 quarts/acre pendimethalin) was applied. Additionally, containerized *Lotus rigidus* and *Eriogonum fasciculatum* were started in the greenhouse to serve as replacements for the guara and blackfoot daisy.

Two separate pollinator friendly seeding trials were also established in June of 2011. The mixes used are shown in the table below. Approximately one week after the seed for the trials was broadcasted into the end of field one, border four and watered, emergence of *Lotus rigidus* was seen in trial one. However, in July of 2011, the trials were destroyed when PMC personnel unintentionally drove over the seeding location. The trials will be re-established in 2012.

Pollinator Friendly Seeding Trial One 2011

	Trial 1			
	Seeds/lb	Seeding rate, 100% of mix (PLS lbs/acre)	Percentage of mix	Seeding rate, percentage of mix (PLS lbs/acre)
SHRUBS				
fairy duster (*Calliandra eriophylla*)	16400	3.5	0.03	0.105
bush dalea (*Dalea pulchra*)	290000	8	0.03	0.24
FORBS				
Parry's penstemon (*Penstemon parryi*)	500000	2.2	0.1	0.22
desert zinnia (*Zinnia acerosa*)	392500	0.6	0.25	0.15
globe mallow (*Sphaeralcea ambigua*)	500000	2.2	0.1	0.22
shrubby deervetch (*Lotus rigidus*)	428324	2.5	0.25	0.625
desert senna (*Senna covesii*)	62000	2	0.03	0.06

Pollinator Friendly Seeding Trial Two 2011

	Trial 2			
	Seeds/lb	Seeding rate, 100% of mix (PLS lbs/acre)	Percentage of mix	Seeding rate, percentage of mix (PLS lbs/acre)
SHRUBS				
wolfberry (*Lycium exsertum*)	250000	11	0.03	0.33
buckwheat (*Eriogonum fasciculatum*)	300000	3.6	0.03	0.108
FORBS				
Parry's penstemon (*Penstemon parryi*)	500000	2.2	0.1	0.22
desert zinnia (*Zinnia acerosa*)	392500	0.6	0.25	0.15
globe mallow (*Sphaeralcea ambigua*)	500000	2.2	0.1	0.22
desert marigold (*Baileya multiradiata*)	1060000	1	0.25	0.25

National Parks Agreements Progress Reports

CANYON DE CHELLY NATIONAL MONUMENT

FY2011 Annual Summary Report
Prepared by

NATURAL RESOURCES CONSERVATION SERVICE
PLANT MATERIALS CENTER
TUCSON, ARIZONA

INTRODUCTION – This project involves the production of 145 PLS lbs of *Sporobolus airoides* and 140 PLS lbs of *Aristida purpurea*. Seed produced will be used for revegetation of disturbed areas in Canyon de Chelly National Park. The original agreement (IA No.: 1211-08-002) was signed the 14th of November, 2007 with the project ending the 30th of September, 2010. In September of 2010, an amendment was signed that extended this agreement until December 31, 2012 to allow for additional seed collection and production time.

ACCOMPLISHMENTS – In June 2008, 0.36 acres were planted to *Sporobolus airoides* using seed collected by park personnel in 2006. Harvest totals for years 2008-11 are shown in table 1.

Table 1: *Sporobolus airoides* harvest totals 2008-2011

	2008	2009		2010		2011	
Bulk lbs.	15.00	29.30	19.25	10.84	5.96	31.88	2.44
Cleaned lbs.	5.06	20.87	12.46	9.38	1.38	21.13	NA*
Germination %	84	74	58	83	50	79	
Purity %	99.20	84.47	99.4	94.57	23.23	90.58	
Test date	3/19/2012	3/19/2012	3/16/2012	3/19/2012	3/19/2012	3/19/2012	
PLS %	83.33	62.51	57.65	78.49	11.62	71.56	
PLS lbs.	4.22	13.05	7.18	7.36	0.16	15.12	

NA* Cleaned weights and seed quality report not available at time of this report

In March of 2010, approximately 3,700 *Aristida purpurea* plants were started from seed received at the center in 2009. In June 2010, these plants were used to establish a 0.54 acre seed production field. Harvest totals for years 2010-2011 are shown in table 2.

Table 2: *Aristida purpurea* harvest totals 2010-2011

	2010		2011			
Bulk lbs.	11.00	11.82	62.94	29.13	21.12	11.75
Cleaned lbs.	10.58		NA*	NA*	NA*	0.5
Germination %	86					NA*
Purity %	88.73					
Test date	3/13/2012					
PLS %	76.31					
PLS lbs.	8.07					

NA* Cleaned weights and/or seed quality report not available at time of this report

TECHNOLOGY DEVELOPMENT – In June of 2011, a randomized complete block experiment was conducted to determine whether or not *Aristida purpurea* seed viability is significantly reduced by commonly used seed cleaning methods. Seed harvested in 2010 was processed through one of three initial seed cleaning machines (Westrup Brush Machine, Forsberg Seed Scarifier, Hammermill) and then ran through an Eclipse Model 324 Seed and Grain Cleaner. Cleaned seed was then placed in a standard germination trial. Germination counts were compared against a control of uncleaned *Aristida purpurea* seed.

Results of the trial indicate that seed cleaned with the Westrup Brush Machine had a significantly higher germination percentage than seed cleaned with the Hammermill or Forsberg Seed Scarifier. However, the germination percentage of seed cleaned with the Westrup Brush Machine did not differ significantly from the control of uncleaned seed.

Field of Aristida purpurea

ZION NATIONAL PARK

FY2011 Annual Report
Prepared by

NATURAL RESOURCES CONSERVATION SERVICE
PLANT MATERIALS CENTER
TUCSON, ARIZONA

INTRODUCTION - This project involves the production of 900 PLS lbs of *Sporobolus cryptandrus* to be used for revegetation of disturbed areas in Zion National Park. The last signature on the agreement was the 8th of January 2007, with the project originally extending until the 30th of September 2009. In August of 2009, a modification was completed which extended the agreement until December 31, 2011. A sub agreement was signed in August 2010 to produce an additional 130 PLS of *Sporobolus cryptandrus*, increasing the total amount of seed to be produced for this project to 1030 PLS lbs. The sub agreement ends December 2011 to coincide with the project extension.

ACCOMPLISHMENTS – In October of 2007, 1.68 acres of land was planted to *Sporobolus cryptandrus* at the center. The acreage was increased to a total of 5.25 in March of 2009. For the increase, approximately 16,000 *Sporobolus cryptandrus* plants were grown in our greenhouse from the seed originally sent to the center in November 2006. Harvest totals for 2008-2011, along with their germination and purity results, are presented in the table 1. In August of 2009, 170 pounds of bulk seed (154 PLS pounds) was sent via Fed Ex ground to Great Basin Seed, Ephraim, Utah, as requested by park personnel.

Table 1: *Sporobolus cryptandrus* harvest totals for years 2008-2011:

	2008	**2009**		**2010**		**2011**			**Total lbs.**
Bulk lbs.	34.69	265.62	208.48	296.36	342.10	174.06	231.70	242.79	**1795.80**
Cleaned lbs.	16	154.00	151.78	249.02	257.20	99.98	147.75	162.19	**1237.92**
Germination %	94	91	80	66	64	7**	29**	25**	
Purity %	99.21	99.77	99.32	99.88	99.96	99.76	97.65	99.39	
Test date	5/17/2010	8/14/2009	3/18/2011	3/18/2011	3/18/2011	4/23/12	4/23/12	4/23/12	
PLS %	93.26	90.79	79.46	65.92	63.97	68.83	74.21	74.54	
PLS lbs.	*14.92	*139.82	120.60	164.16	164.54	68.82	109.64	120.90	**903.40**

* These totals have been shipped to Zion and are no longer maintained at the Tucson Plant Materials Center

**Note: Germination was lower due to seed dormancy.

TECHNOLOGY DEVELOPMENT – Center personnel continue to use a Massy Ferguson MXP plot combine for harvesting *Sporobolus cryptandrus*. Personnel have experimented with various fan settings on the combine to maximize seed collected and minimize the collection of extraneous materials. Combine settings used successfully during the 2011 harvest season are detailed in table two.

Table 2: Massy Ferguson MXP combine settings for 2011 sand dropseed harvests

Fan speed	Cylinder	Concave	Sieve Plate
400 RPM	700 RPM	9	10 mm

Field of sand dropseed in August 2011

Combine harvest of sand dropseed in August 2011

CORONADO NATIONAL MEMORIAL

FY2011 Annual Report
Prepared by

NATURAL RESOURCES CONSERVATION SERVICE
PLANT MATERIALS CENTER
TUCSON, ARIZONA

INTRODUCTION - This agreement (IA 1211-09-005) was initiated July 17, 2009 and is expected to be completed by September 30, 2013. The Tucson Plant Materials Center (TPMC) will propagate a total of 5000 containerized plants of agave (*Agave palmeri*) during the course of the contract. Approximately 1500-2000 plants will be delivered to the Memorial each year in order to meet the amount stipulated in the agreement. The agave plants will be out-planted in an area disturbed during the construction of the border fence along the Arizona - Mexico border. At present, there is limited information available on growth protocols for this species. Therefore, the TPMC has initiated studies to collect data on optimal propagation techniques.

ACCOMPLISHMENTS - Seed collected at the Memorial in October 2008 was cleaned with a South Dakota seed blower and production of plants was initiated in July 2009. The first batch of seeds was pre-soaked in water for 12 hours, drained and then placed in the greenhouse at 70 ^{0}F to germinate. Germination took place over 7-14 days with excellent results. Approximately 1700 seedlings were transplanted to 3" x 5" Zipset™ Plant Band containers (45 cubic inches in volume) during the first production year, 2010. The procedure was repeated for production year 2011. See table 1 for the total number of plants delivered since agreement initiation. The final 1500 plants are scheduled to be delivered in late summer of 2012. This final delivery will complete the contract.

Table 1: Total Number of Plants Delivered to Coronado National Memorial

Delivery Date	Number of Plants	Pot size (inches)	Average Rosette Diameter(inches)
July 16, 2010	1600	3 X 5	1.5-2.5
August 9, 2011	1900	3 X 5	1.5-2.5
Total Delivered	**3500**		

TECHNOLOGY DEVELOPMENT - Limited information is available in the literature regarding *Agave palmeri* culture under nursery conditions. The AZPMC initiated observational trials and a growth rate study to find out more about the cultural requirements for this plant. The following are some of the observations recorded during the first and second year of the grow-out.

Growing Media: A mixture of peat moss and perlite at a 1:2 ratio provided the best results for drainage and growth. A mixture of 3:1:1 of shredded bark, sand and peat moss did not work as well as the 1:2 ratio of peat moss and perlite. A mixture of medium texture field soil, peat moss and perlite (1:1:1) did not provide adequate drainage.
Irrigation Frequency: Ten minute irrigation frequencies of 3 days, 2 days and 1 day per week were compared to determine the optimum watering frequency for growth. Additional watering days per week did not improve growth rates but did result in a fungus gnat infestation in the

greenhouse. An irrigation frequency of one ten minute watering per day per week provided sufficient water for plant growth and reduced the fungus gnat infestation.

Fertilization: Plants were fertilized approximately once per month with 200 parts per million of 20-20-20 Peters Professional® Water Soluble Fertilizer.

Growth Rate Study: A greenhouse/shade house growth rate study was initiated soon after the agave plants were transplanted into individual containers. Observations and data collected so far indicate that *Agave palmeri* has an increased growth rate in the summer months when temperatures are above 90 F^0. *Agave palmeri* grows faster in its second year and doubles its root mass (see pictures below). Plants initiated production of pups and increased the number of leaves from 6 the first year to 14 at the end of the second year. The average rosette diameter at the end of two years was 3.3 inches. Twelve of the two-year plants were transplanted into one-gallon containers to measure stem collar growth during the third year of growth.

Figure 1. A one year old agave plant in 2010.

Figure 2. A two year old agave plant in 2011.

SAGUARO NATIONAL PARK

FY2011 Annual Report
Prepared by

NATURAL RESOURCES CONSERVATION SERVICE
PLANT MATERIALS CENTER
TUCSON, ARIZONA

INTRODUCTION – This project involves the production of 690 containerized plants to be used for the revegetation of two disturbed areas of Saguaro National Park: Hope Camp and Scenic Drive. The last signature on the agreement was the 17th of May 2009, with the project extending until the 30th of September, 2011. Plant Materials personnel provided expertise on growing methods for multiple species of plants, as well as the maintenance, inputs and space for the growing plants.

ACCOMPLISHMENTS – Plant materials personnel provided assistance to park personnel in the selection and purchase of growing mediums and containers in early July 2009. Park personnel and volunteers arrived at the Plant Materials Center (PMC) in late July to begin work on the propagation of the forb and grass species listed in table 1. In September, park personnel returned to the PMC to propagate the tree and shrub species listed in table 2. In both instances, seed was placed in trays, allowed to germinate, and transplanted into pots when at the appropriate growth stage.

Some of the species propagated by park personnel exhibited very low germination rates. Those species included cane beardgrass, creosote bush, odora, paperflower, and Desert globemallow. To compensate for the lower germination rates, park personnel increased the transplanted numbers of some of the other species. Additionally, in mid-August, park personnel propagated two additional species, *Digitaria californica* and *Dyssodia tenuloba*, to ensure enough plants were available for revegetation.

All of the species listed in table one were outplanted by park personnel in January/February of 2010. Approximately half of the species listed in table two were picked up by park personnel in February of 2011 while the others remained in holding at the PMC at the request of park personnel until March of 2012. All plants have been picked up at the time of this report, and this agreement is considered complete.

Table 1. Species started in July 2009

Common name	Scientific name	Number propagated
Purple threeawn	*Aristida purpurea*	30
Cane beardgrass	*Bothriochloa barbinodis*	30
Creosote bush	*Larrea tridentata*	80
Menadora	*Menadora scabra*	80
Odora	*Porophyllum gracile*	80
Paperflower	*Psilostrophe cooperi*	80
Desert senna	*Senna covesii*	30

Common name	Scientific name	Number propagated
Desert globemallow	*Sphaeralcea ambigua*	80
Totals		**490**

Table 2. Species started in September 2009

Common name	Scientific name	Number
Whitethorn acacia	*Acacia constricta*	30
Catclaw acacia	*Acacia greggii*	40
Fairy duster	*Calliandra eriophylla*	10
Foothills paloverde	*Cercidium microphyllum*	50
Ocotillo	*Fouquieria splendens*	20
Mesquite	*Prosopis velutina*	50
Totals		**200**

Acacia greggii, Cercidium microphyllum, Prosopis velutina, and others in April 2011.

SAGUARO NATIONAL PARK

FY2011 Annual Report
Prepared by

NATURAL RESOURCES CONSERVATION SERVICE
PLANT MATERIALS CENTER
TUCSON, ARIZONA

INTRODUCTION – This project involves the establishment of 0.5 acres of *Aristida purpurea* and 0.25 acres of *Abutilon incanum*. Seed harvested from the fields will be used in revegetation projects within Saguaro National Park. The final signature on the agreement was in June of 2011 with the project continuing until September 30, 2015.

ACCOMPLISHMENTS – PMC personnel received both the *Aristida purpurea* and *Abutilon incanum* seed for this project in March of 2011. There were 35 individual *Aristida purpurea* collections with varying collection years (1999-2010). The total *Aristida purpurea* seed received was 519 grams. Approximately 1900 plugs of *Aristida purpurea* were started in July of 2011 using 26 of the individual seed collections. A 0.5 acre field of *Aristida purpurea* was established in September of 2011. Individual collections were planted into known distinct locations within the field. Field observations in late 2011 indicate that collections 825 and 865, both collected in 2002, were heartier with more vegetative production than the other collections. The first composite harvests of this field are expected in 2012.

Germination trials of the 20 individual *Abutilon incanum* seed collections were started in July of 2011. The total *Abutilon incanum* seed received was 137 grams with collection years varying from 2001-2010. During the trials, it became apparent that a majority of the seed collected had significant insect damage. This information was communicated with park personnel and it was determined that efforts would be made to establish new seed collections in the fall of 2011. When a sufficient amount of viable *Abutilon incanum* seed is received, efforts to establish the 0.25 acre production field will commence.

PMC staff planting the Aristida purpurea field in September 2011.

Freshly planted Aristida purpurea plants in September of 2011.

Field Plantings

Sierra Vista School Planting

In May 2008, the AZPMC was invited by the Hereford Conservation District and NRCS Soil Conservationist, Art Meen, to assist Apache Middle School in Sierra Vista, AZ with a native plant demonstration. The goal was multifaceted: to enhance the school's grounds, teach the students about conservation, and provide examples of native grasses to the community as alternatives for landscaping. Placed at the entrance of the school, it is an ideal location for showcasing eight of the most common native grasses found in southeast Arizona: Blue grama, Arizona cottontop, Sideoats grama, Plains lovegrass, Pima pappusgrass, Bush muhly, Cane beardgrass, Spike dropseed and Alkali sacaton. Several teachers and staff, members of the Conservation District and thirty students participated in the planting of grass plugs into eight distinct plots, as well as seeding a mixed species plot. This planting will continue to be monitored by Art Meen.

This planting was visited in April of 2010. It continues to be well cared for and has an almost 100% survival of all plants. The planting will continued to be monitored in 2011. The demonstrational planting was visited in June 2011 by PMC personnel and all plots are still performing very well. The Sierra Vista School maintenance crew has taken over the maintenance of the plots.

Sierra Vista School planting

Sells Demonstration Garden

In late May, PMC staff traveled to Sells, Arizona on the Tohono O'odham Indian Reservation to plant six native grass species, (*Bouteloua curtipendula*, *Papphophorum vaginatum*, *Eragrostis intermedia*, *Digitaria californica*, *Sporobolus contractus*, and *Bothriochloa barbinodis*) and one native forb (*Baileya multiradiata*) as part of a demonstration garden. The planting date coincided with a mini-workshop on backyard garden irrigation systems hosted by the Farm and Food Group. Workshop participants planted the native grasses and forb and laid the drip irrigation line to water the garden. The garden area was originally fenced and installed in 1997 with 18 native species. Over the years, most of the native grass species initially planted had died out. The garden is frequently used by the Tohono O'odham Nation Soil and Water Conservation District during their annual Range Day celebration to illustrate what native plants can be found on the range in Sells. With the re-establishment of the native grasses, the plant identification skills of Range Day participants will be enhanced.

The demonstration garden will be monitored and expanded in future years.

Sells Demonstration Garden Plot Plan