Year 2009
Los Lunas Plant Materials Center
Annual Technical Report

By: LLPMC Staff

David Dreesen, Gregory Fenchel, Danny Goodson, and Keith White

United States Department of Agriculture
Los Lunas Plant Materials Center
1036 Miller Road
Los Lunas, NM 87031
Telephone: (505) 865-4684/FAX: (505) 865-5163

Table of Contents

Selecting the Appropriate Native Plants for Revegetation and Restoration Purposes in the Southwest 3

Revegetating Riparian Areas in the Southwest "Lessons Learned" 18

Boulder County Big Bluestem Seed Production 22

Chilili Seeding Trial 24

Veguita Bridge Longstem Transplant Study 37

Reinkin Bridge South Planting Workshops Demonstration Plantings 41

Production of Riparian Plant Materials for the Apache-Sitgreaves National Forests 49

Seed Production and Source-Identified Germplasm Release of Upland Grass Species from the Apache-Sitgreaves National Forest 53

Plant Materials Development and Production Activities New Mexico USDI-Bureau of Land Management 63

Cibola National Forest Production of Riparian Plant Materials for Watershed and Ecosystem Restoration Projects 70

Headquarters, United States Army Garrison Fort Bliss, Texas Seed Production and Source-Identified Germplasm Release of Mesa Dropseed and Spike Dropseed from Fort Bliss 76

Development of Legume *Dalea* for the Gila National Forest for Use in Burn Rehab Seed Mixtures in Southwestern Pinyon/Juniper Communities 80

Evaluation of Giant Sacaton for Use in Field Windstrip Plantings 84

'Tropic' Sunn Hemp Adaptability Trial 92

Bottlebrush Squirreltail – Intercenter Strain Trial 97

Blue Grama Variety Trial 99

Alkali Muhly Herbicide Trials 101

Giant Sacaton (*Sporobolus wrightii*) Windbreak Trial 113

Active Field Production Studies for 2009 at the Los Lunas Plant Materials Center 115

2009 LLPMC Annual Seed Production Report 124

Selecting the Appropriate Native Plants for Revegetation and Restoration Purposes in the Southwest

One of the most common questions confronting natural resources conservation specialists and land managers is what native plant species are appropriate for a particular revegetation or restoration project. Such projects typically aim to rehabilitate wildlands that have been disturbed by natural forces or human activities.

This document describes the following approaches for determining the selection of appropriate species:

- Using native plant lists or floras from nearby or similar sites.
- Using the NRCS Ecological Site Information System (ESIS) website to access Ecological Site Descriptions (ESDs) and Major Resource Land Areas (MLRAs).
- Using an NRCS State Website to access the Ecological Site Descriptions.
- Using the USDA-NRCS Web Soil Survey Website to access Ecological Site Descriptions
- Using the NRCS PLANTS Database to find the dominant species within an ecoregion having characteristics suitable for the revegetation site.
- Using the NatureServe Explorer website to find plant association information.

Using Native Plant Lists or Floras

There are numerous sources of native plant lists or floras. These sources often concentrate on a single location or area which would be useful if a project is located near one of these areas. Some of these types of sources are listed as well as examples:

Sources	For Example . . .
National parks	Grand Canyon National Park Vascular Plant List
Link: http://www.nps.gov/crca/naturescience/upload/GRCAVascular_Flora20051001.xls	
National monuments	White Sands National Monument Checklist of Plants
Link: http://www.nps/gov/whsa/naturescience/checklist-of-plants.htm	
Native plant societies	Native Plant Society of New Mexico
Link: http://npsnm.unm.edu/native_plant.html	
State parks and preserves	Native Plant Revegetation Guide for Colorado
Link: http://parks.state.co.us/NR/rdonlyres/00A97125-2219-4E68-A28F 6CC62300D43A/0/revegetation.pdf	
National forests	Plant Associations of Arizona and New Mexico Volume 1: Forests Edition 3, USDA Forest Service, Southwestern Region, Habitat Typing Guides
Link: http://www.nm.nrcs.usda.gov/technical/tech-notes/range/range99-publication-forests.pdf	
	Plant Associations of Arizona and New Mexico Volume 2: Woodlands Edition 3, USDA Forest Service, Southwestern Region, Habitat Typing Guides
Link: http://www.nm.nrcs.usda.gov/technical/tech-notes/range/range99-publication-woodland.pdf	

Sources	For Example . . .
Universities	Natural Heritage New Mexico - Floristic Survey of Cannon Air Force Base and Melrose Air Force Range New Mexico
Link: http://nhnm.unm.edu/vlibrary/pubs_archive/nhnm/nonsensitive/U95DEB01NMUS.pdf	
Herbariums	Herbarium University of New Mexico – Checklist of Vascular Plants in the Sandia and Manzano Mountains of Central New Mexico
Link: http://www.msb.unm.edu/publications/documents/OccPap-MSB-N10-Sivinski2007.pdf	

Using the NRCS Ecological Site Information System

When an adjacent flora is not available, another approach to determine appropriate species is the NRCS Ecological Site Information System (ESIS) to access the NRCS Ecological Site Descriptions (ESDs). These descriptions can be useful to help identify the dominant native plant species as well as other site factors that can influence species selection.

You can access the NRCS Ecological Site Information System (ESIS) from the webpage http://esis.sc.egov.usda.gov/ or from the NRCS PLANTS database http://plants.usda.gov/.

Once you have accessed the ESIS website, follow these steps:

Step	User Action
1	Click the Ecological Site Description box.
2	Click the Approved ESD Reports; the first input requirement is to determine the Major Land Resource Area (MLRA) of the project. The webpage has a button to access MLRA Explorer which will determine the desired Resource Area, and if needed output an MLRA Report.
3	Click MRLA Explorer.
4	Click the region (Continental U.S.)
5	Check the boxes next to areas of interest (for example, Check “Check/Clear all” for all ecological information.
6	Click “Click Select” to create a report for a single MRLA.
7	Click the area of the map for which you want to create a report.
8	Click “Create Report.” Figure 1 shows an example map created for MLRA 35 –Colorado Plateau.

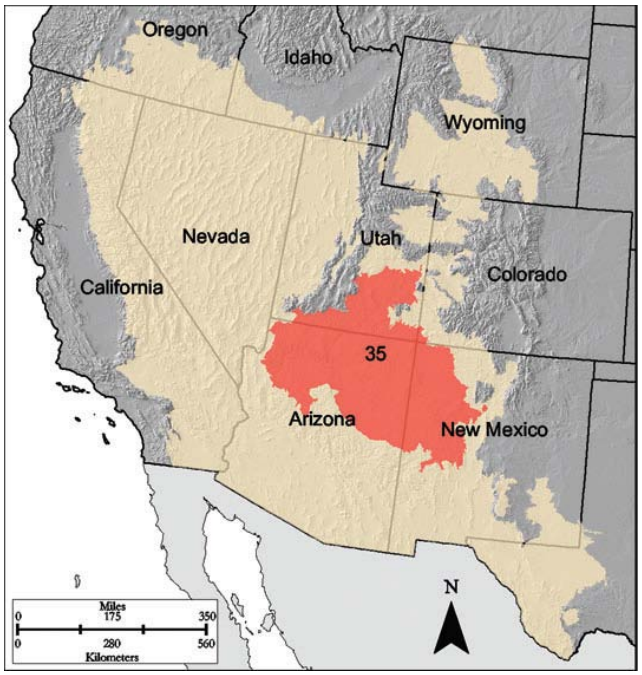

Figure 1: MLRA 35 – Colorado Plateau

When the appropriate MLRA is entered without a State designation, ESIS lists all the site descriptions for all states having this Resource Area (for MLRA 35, ESDs for New Mexico, Arizona, and Utah are listed). These site descriptions will be categorized by features including:

- Topography (e.g., bottomland)
- Slope (e.g., steep)
- Soil texture (e.g., clay)
- Soil chemistry (e.g., saline)
- Soil depth (e.g., shallow)
- Dominant vegetation (e.g., Pinyon – Utah Juniper)
- Geological features (e.g., malpais)

Using an NRCS State Website to Access Ecological Site Descriptions

Within each NRCS State website, it is possible to access ESDs, but the procedure varies by state:

Examples: Accessing Ecological Site Descriptions from an NRCS State Website

State	Link
New Mexico	http://www.nm.nrcs.usda.gov/technical/fotg/section-2/esd.html
Arizona	http://efotg.nrcs.usda.gov/references/public/AZ/ArizonaEcologicalSiteKeyMLRA35.doc Ecological Site Key (for example, MLRA 35)
Utah	http://www.ut.nrcs.usda.gov/technical/technology/range/ecosites.html

Examples: Accessing Ecological Site Descriptions from an NRCS State Website

State	Link
Colorado	http://www.co.nrcs.usda.gov/technical/ecs/ecs-index.html Electronic Field Office Technical Guide (eFOTG) Section II D. Ecological Site Descriptions for MLRA's 67B and 69 only

For the New Mexico website, the procedure is as follows:

Step	User Action	Result
1	Click the MLRA number on the map of the area for which you wish to create a report.	The MLRA Characteristics with associated MLRA numbers are listed.
2	Click the desired MLRA number	The MLRA Land Resource Units with associated numbers are listed.
3	Click the Land Resource Unit for the area you are investigating.	A Site Description list for the MLRA is displayed.
4	Select the Site Description best describing the project site and click the associated site number.	The Ecological Site Description webpage is displayed.
5	Click the type of information desired (located along the left side of the webpage). If you want a complete report, click "Complete Report."	The selected characteristics of the ESD are displayed.

After deciding on an appropriate ESD Site Description that matches the project site characteristics, you can create a report for the specified ESD with Physiographic Features, Climate Features, Water Features, Soil Features, Plant Communities, Site Interpretations, and Supporting Information.

Within the Plant Communities selection, a listing of the Historic Climax Plant Community Plant Species Composition is very useful in determining key plant species for the site (see the following table for an example). In addition, this selection often reports the Ecological Dynamics of the Site. In some cases, the site may have undergone such severe disturbance that the plant species listed in the Historic Plant Community cannot be successfully established. The Ecological Dynamics section can give some insight on what species might be appropriate for such a disturbed site.

Ecological Site Description Historic Climax Plant Community Plant Species Composition
***Example* - Site Type:** Rangeland, **Site Name:** Loamy, **Site ID:** R035XB001NM, **Major Land Resource Area:** 035 - Colorado Plateau

Common Name	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High
Grasses:			
James' galleta	*Pleuraphis jamesii*	55	83
Indian ricegrass	*Achnatherum hymenoides*	55	110
needleandthread	*Hesperostipa comata*	28	55
New Mexico feathergrass	*Hesperostipa neomexicana*	28	55
western wheatgrass	*Pascopyrum smithii*	17	28
squirreltail	*Elymus elymoides*	28	55
blue grama	*Bouteloua gracilis*	55	110
sand dropseed	*Sporobolus cryptandrus*	28	55

Ecological Site Description Historic Climax Plant Community Plant Species Composition
***Example* - Site Type:** Rangeland, **Site Name:** Loamy, **Site ID:** R035XB001NM, **Major Land Resource Area:** 035 - Colorado Plateau

Common Name	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High
sideoats grama	*Bouteloua curtipendula*	11	38
threeawn	*Aristida*	17	28
alkali sacaton	*Sporobolus airoides*	17	44
Forbs:			
threadleaf ragwort	*Senecio flaccidus var. flaccidus*	17	28
scarlet globemallow	*Sphaeralcea coccinea*	17	28
fleabane	*Erigeron*	17	28
woolly plantain	*Plantago patagonica*	17	28
Cuman ragweed	*Ambrosia psilostachya*	17	28
milkweed	*Asclepias*	17	28
aster	*Aster*	17	28
locoweed	*Oxytropis*	17	28
Shrubs:			
beardtongue	*Penstemon*	17	28
big sagebrush	*Artemisia tridentata*	28	83
fourwing saltbush	*Atriplex canescens*	28	55
Cutler's jointfir	*Ephedra cutleri*	17	28
winterfat	*Krascheninnikovia lanata*	17	28
yellow rabbitbrush	*Chrysothamnus viscidiflorus*	17	28
pale desert-thorn	*Lycium pallidum*	17	28
camphor tansy	*Tanacetum camphoratum*	17	28
spineless horsebrush	*Tetradymia canescens*	17	28

Using the USDA-NRCS Web Soil Survey Website

This USDA-NRCS website enables you to access soil data for the desired area and then select various reports including Suitabilities and Limitations for Use, Soil Properties and Qualities, and Ecological Site Assessment. One key benefit of using Web Soil Survey is its ability to generate an ESD using aerial photo maps without having to determine the appropriate MLRA. From this soil data you can generate an Ecological Site Description Report.

Use the following steps generate an ESD report for the area of interest:

Step	User Action	Result
1	Enter the following URL: http://WebSoilSurvey.nrcs.usda.gov/app/	Displays the Web Soil Survey Web page.
2	Click Start WSS	Displays the Area of Interest (AOI) page that contains the Area of Interest (AOI) Interactive Map.
3	For the purpose of this exercise, select “State and County” from the Quick Navigation list located on the left-hand side.	Displays the state and county region on the AOI Interactive Map.

Step	User Action	Result
	A. Click State and select New Mexico from the drop-down list; select San Juan County from the drop-down list. B. Click View.	
4	A. Click AOI Zoom In icon on the AOI Interactive Map. Place the cursor on desired area of the AOI map (the cursor becomes a crosshair). B. Click the left mouse button to zoom in on the area. C. Repeat clicking until the area of interest is more identifiable (3 or 4 times).	Displays a close-up view on the AOI Interactive Map.
5	A. Click the AOI Rectangle icon. B. Place the cursor over the desired area and hold down the left mouse button and drag to select the area of interest on the AOI Interactive Map.	Displays "Creating AOI" and "Clipping soils layer to AOI extent…" and outlines the area on the AOI Interactive Map. The Area of Interest Properties is displayed on the left-hand side of the page.
6	Click the "Soil Map" tab. **Optional:** Enter a project name in the Name box.	Displays the Soil Map on the right and the Map Unit Legend on the left-hand side of the page.
7	A. Click the "Soil Data Explorer" tab. B. Click "Ecological Site Assessment" tab.	Displays the Ecological Site Assessment on the top middle area of the page. Displays the Ecological Sites for the area of interest.
9	Select the appropriate Ecological Site type (such as loamy, sandy, etc.) for the site, then click "Historic Climax Plant Community.:	Displays plant community information.
8	A. Click "Add to Shopping Cart Options" at the top right-hand side of the page to include in the soils report. B. Click "Add to Shopping Cart." **Optional:** Enter a subtitle if desired. C. Click OK. D. Click Shopping Cart (Free) tab **Optional**: Enter a Subtitle in the Subtitle box.	Displays "Adding soil properties to the report…" and lists the "Report Properties" on the left-hand side of the page.
9	A. Click Checkout. B. Select Get Now and click OK in the "Checkout Options."	Displays "Generating custom soil resource report…" and displays the report in PDF format. You can now print or save the report.

Alternative Approach: An alternative approach provides the Ecological Site ID but does not directly access the ESD report as described above. Within Soil Data Explorer, select the Suitabilities and Limitations for Use tab. Click the Land Classification selection and then click the Ecological Site ID selection. This procedure will provide the Ecological Site ID as a Rating for each Map Unit identified in the Area of Interest.

Using the NRCS PLANTS Database - VEGSPEC

Another approach to selecting appropriate native species for a revegetation or restoration project involves the use of the NRCS PLANTS database. The PLANTS database delineates species characteristics for many of the dominant plant species in each ecoregion. Many of these characteristics are crucial in determining the suitability of a particular species for a certain site.

Within the PLANTS database, VEGSPEC allows a conservation specialist or land manager to use soil, plant, and climate data to select plant species that are:

1. Adapted to a specific site
2. Suitable for the selected practice (treatment)
3. Appropriate for the purposes and sub-purposes for which the planting is intended

> **Note for NRCS Users**
>
> Do not use VEGSPEC in place of the eFOTG recommendations. This tool is more applicable for use by state specialists who have the responsibility of evaluating output appropriate to site conditions for augmenting species in the Field Office Technical Guide.

Use the Site Specific selection to narrow down plant choices by state, MLRA, soil, and climate options:

Step	User Action…	and VEGSPEC…
1	Enter the NRCS PLANTS Database URL: http://www.plants.usda.gov/ and click VEGSPEC a the bottom of the left column.	Displays the VEGSPEC webpage.
2	Click Start VEGSPEC and specify the site information and the Soil Survey Area ID (usually designated by county) and Soil Map Unit (often available in the Ecological Site Description)	Lists soils information such as pH, texture, and salinity.
3	Specify the most appropriate climate station	Reports summary precipitation and temperatures data for that station.
4	Specify the conservation practice (such as critical area planting), purpose (for example erosion control and native plant community restoration), and plant type (such as grass).	Supplies a listing of potential plant species and cultivars
5	Select the most suitable candidates or add additional species to become the Selected Plant List.	The Selected Plants are listed.

The following Example shows an abbreviated VEGSPEC report for a hypothetical, critical area revegetation project for a natural gas well pad site in northwest New Mexico having an ESD the same as in Table 1. VEGSPEC also allows the user to perform seeding mix calculations based on a 40 Pure Live Seed (PLS) per square foot or user-defined specifications. If the user has germination and purity data on their seedlots, VEGSPEC will calculate the bulk seed requirements. A Conservation Practice Job Sheet 342 (located on the New

Mexico NRCS website) also provides an interactive spreadsheet which provides seed mix calculations: http://efotg.nrcs.usda.gov/references/public/NM/js342.xls

VEGSPEC will respond with attributes of the selected species that indicate the mix might require some revision based on attributes such as seedling vigor, season of growth, vegetative rate of spread, or moisture use. The highlighted sentences in Example 1 present the species with attributes that are not consistent with the rest of the species mix.

Example: VEGSPEC Critical Area Planting Report

User Name:	Land Manager	**Site Name:**	Natural Gas Development -Well Pad Example
Project Location:	San Juan County	**State:**	NM

Landscape Information

Site Aspect:	
Water Receiving:	N
Irrigation:	None
Exposure:	Full Sun

Soil Information

Soil Survey Area ID:	SAN JUAN COUNTY, EASTERN PART, NEW MEXICO: 618
Soil Map Unit:	Doak loam, 1 to 3 percent slopes: Db
Soil Component:	Doak:90%

Soil Attributes

Slope Percent:	1	3	2.0	
Salinity (mmhos) most saline layer in 12 inches:	0	0	0	L
pH (lowest and highest):	7.4	9.0		

MLRA:	0037:San Juan River Valley Mesas and Plateaus
Hydric Soil:	N
Surface Texture:	L
Surface Texture Class:	M
Tax Class:	NON-AQUIC
Average Water Capacity (avg. layer, top 40 inches, perm;.06 inches/hr)	6.58
Soil Classification:	NON-UDIC

Climate Information

Climate Station:	**Id:** NM0692 **Name:** AZTEC RUINS NATL MONUME
Last Frost Date:	5/ 8
First Frost Date:	10/14
Growing season length (days):	159

Climate Attributes

Avg. Annual Precipitation:	10.31		
Estimated Annual Average Precipitation (EAAP) inches:	7.72	**Average derived from:**	2IN10
Minimum temperature	-10.0		

Average Temperature and Precipitation by Month

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Temperature	28.0	35.0	41.6	49.4	58.4	67.9	74.4	72.1	64.1	52.9	40.1	30.0
Precipitation	0.87	0.79	0.89	0.68	0.6	0.36	0.99	1.17	1.03	1.17	0.89	0.87

Planting Objectives

Practice: 342-Critical area planting

Purposes(s) Selected
Native Plant Community Restoration
Water Erosion Control
Wind Erosion Control

Plant Type: Grass

Plant Selection

Potential Plants

Common Name	Scientific Name	Release Name
alkali sacaton	Sporobolus airoides	Salado
Arizona cottontop	Digitaria californica	n.a.
beardless wheatgrass	Pseudoroegneria spicata ssp. inermis	Whitmar
beardless wildrye	Leymus triticoides	Rio
black grama	Bouteloua eriopoda	n.a.
bluebunch wheatgrass	Pseudoroegneria spicata ssp. spicata	Goldar
bluebunch wheatgrass	Pseudoroegneria spicata ssp. spicata	n.a.
bluebunch wheatgrass	Pseudoroegneria spicata ssp. spicata	Secar
Indian ricegrass	Achnatherum hymenoides	n.a.
Indian ricegrass	Achnatherum hymenoides	Paloma
sideoats grama	Bouteloua curtipendula	n.a.
squirreltail	Elymus elymoides	n.a.
streambank wheatgrass	Elymus lanceolatus ssp. lanceolatus	n.a.

Selected Plants

alkali sacaton: Sporobolus airoides: Salado: SPAI
beardless widlrye: Leymus triticoides: Rio: LETR5
black grama: Bouteloua eriopoda: n.a.: BOER4
bluebunch wheatgrass: Pseudoroegneria spicata ssp. spicata: Secar: PSSPS
Indian ricegrass: Achnatherum hymenoides: Paloma: ACHY
sideoats grama: Bouteloua curtipendula: n.a.: BOCU
squirreltail: Elymus elymoides: n.a.: ELEL5
streambank wheatgrass: Elymus lanceolatus ssp. Lanceolatus: n.a.: ELLAL

Seeding Rate Calculations

Seeding Method:	Drill
Row spacing:	12.0
Acres to seed:	1.0
Rate Calculation method:	Vegspec Seed Rate Rules

Species	Release	Mix %	Standard Seeding Rate(lb/acre)	Standard Seeds/ft2	Actual Seeding Rate(lb/acre)	Actual Seeds/ft2	Total lb PLS	Germ %	Purity %	Total lb. Bulk
alkali sacaton	Salado	10	0.99	40.0	0.09	4.0	0.09	÷	÷	=
beardless wildrye	Rio	5	10.23	40.0	0.51	2.0	0.51	÷	÷	=
black grama	n.a.	10	1.3	40.0	0.13	4.0	0.13	÷	÷	=
bluebunch wheatgrass	Secar	5	13.86	40.0	0.69	2.0	0.69	÷	÷	=
Indian ricegrass	Paloma	20	10.76	40.0	2.15	8.0	2.15	÷	÷	=
sideoats grama	n.a.	20	10.94	40.0	2.18	8.0	2.18	÷	÷	=
squirreltail	n.a.	20	9.07	40.0	1.81	8.0	1.81	÷	÷	=
streambank wheatgrass	n.a.	10	11.38	40.0	1.13	4.0	1.13	÷	÷	=

Total Mix:	100
Total Seeds/ft2:	40.0
Total Seed (required(lb):	8.69
Total Seeds per linear ft:	40.0

The seeding mixture contains species with both low and high vigor ratings. This may cause difficulty in the successful establishment of the low vigor species. (Indian ricegrass and streambank wheatgrass have high vigor).

The seeding mixture contains grasses and/or forbs that have different active growth periods. The mixture may not be compatible or may require specialized management. (e.g., squirreltail actively grows in spring only).

The seeding mixture contains species that have different rates of vegetative spread. This may cause difficulty in the successful establishment of the slow spreading species due to competition for water and nutrients. (beardless wildrye and streambank wheatgrass have rapid vegetative spread).

The seeding mixture contains species that are comparatively high users of available moisture. This may cause difficulty in the long-term maintenance of these species on sites with less than adequate available moisture or they may cause difficulty in the establishment other species in the mixture that have lower moisture use characteristics. (e.g., beardless wildrye is a high moisture user).

Using the NRCS PLANTS Database – Advanced Search Download

Another approach to using the NRCS PLANTS database involves the Advanced Search Download feature. This feature allows the user to select criteria in the PLANTS Core Data Fields including **Distribution, Taxonomy, Ecology** (such as Duration, Growth Habit, Native Status)**,** and **Legal Status.** About 2,500 important species have Conservation Plant Characteristics Data which allows the user to select among the following characteristics:

- **Morphology/Physiology** (e.g., Active Growth Period, Fire Resistant, Growth Form, Growth Rate, Height at Maturity, Lifespan).
- **Growth Requirements** (e.g., Adapted To Coarse Textured Soils, Adapted To Medium Textured Soils, Adapted To Fine Textured Soils, CaCO3 Tolerance, Fertility Requirement, Fire Tolerance, Moisture Use, Precipitation Minimum, Precipitation Maximum, Root Depth Minimum, Salinity Tolerance, Shade Tolerance, Temperature, Minimum (°F)).
- **Reproduction** (e.g., Bloom Period, Commercial Availability, Fruit/Seed Abundance, Fruit/Seed Persistence, Seed Per Pound, Seed Spread Rate, Seedling Vigor, Vegetative Spread Rate).
- **Suitability/Use** (e.g., Palatable Browse Animal, Palatable Graze Animal, Protein Potential).

You can export the output into an Excel spreadsheet; all the data will be imported into the first column of the spreadsheet. By selecting this column and using the Data – Text to Column feature, the spreadsheet can be populated by specifying quotation marks (“”) as delimiters.

To illustrate the use of the Advanced Search Download, an example will be presented to determine native perennial grasses of San Juan County, New Mexico.

Selections made for this Advanced Search include:

- County Distribution - New Mexico: San Juan
- Family – Poaceae
- Duration – Perennial
- Native Status – L48 Native

Identify any characteristics to be used for sorting or information purposes. Check the display box next to these characteristics (for example, scientific name, national common name, drought tolerance, moisture use, and precipitation [minimum]).

A total of 70 perennial species in the Poaceae family were found; of these, 40 species had Plant Characteristics Data. Using Excel, the data can be sorted according to user needs. For instance, if the user wanted to select those

grasses which can grow in the lowest precipitation regions, a sort using the Precipitation Minimum will yield 26 species which can persist in areas of 10 inches or less annual precipitation, and 16 of these 26 species are Low Moisture Use and High Drought Tolerance, and 9 of these16 are typically commercially available and are highlighted in yellow. Sandberg bluegrass and bluebunch wheatgrass cultivars are commercially available, but the origins are all from northern latitudes (i.e., Wyoming and Oregon and further north) and may not be adapted to Northwest New Mexico. The species, drought tolerance, moisture use and precipitation minimum are presented for the 40 species in the following table.

Results of a PLANTS Database Advanced Search Download
Example - County Distribution - New Mexico: San Juan; Family – Poaceae; Duration – Perennial; Native Status – L48 Native

Scientific Name	Common Name	Drought Tolerance	Moisture Use	Precipitation (Minimum)
Aristida purpurea var. longiseta	Fendler threeawn	High	Low	2
Elymus elymoides	squirreltail	High	Low	5
Hesperostipa comata ssp. comata	needle and thread	High	Low	5
Sporobolus airoides	alkali sacaton	High	Low	5
Sporobolus flexuosus	mesa dropseed	High	Low	5
Achnatherum hymenoides	Indian ricegrass	High	Low	6
Pleuraphis jamesii	James' galleta	High	Low	6
Bouteloua eriopoda	black grama	High	Low	7
Bouteloua hirsuta	hairy grama	High	Low	7
Elymus lanceolatus ssp. lanceolatus	thickspike wheatgrass	High	Low	8
Muhlenbergia pungens	sandhill muhly	High	Low	8
Poa secunda	Sandberg bluegrass	High	Low	8
Pseudoroegneria spicata ssp. spicata	bluebunch wheatgrass	High	Low	8
Sporobolus cryptandrus	sand dropseed	High	Low	8
Leymus salinus	saline wildrye	High	Low	10
Poa fendleriana	muttongrass	High	Low	10
Festuca arizonica	Arizona fescue	Medium	Low	10
Bouteloua gracilis	blue grama	High	Medium	8
Elymus trachycaulus ssp. trachycaulus	slender wheatgrass	High	Medium	8
Pascopyrum smithii	western wheatgrass	High	Medium	8
Agrostis exarata	spike bentgrass	Low	Medium	6
Sphenopholis obtusata	prairie wedgescale	Low	Medium	10
Distichlis spicata	saltgrass	Medium	Medium	5
Sporobolus wrightii	big sacaton	Medium	Medium	5
Bouteloua curtipendula	sideoats grama	Medium	Medium	6
Leymus triticoides	beardless wildrye	High	High	7
Andropogon gerardii	big bluestem	High	Low	12
Muhlenbergia asperifolia	scratchgrass	Low	High	12

Results of a PLANTS Database Advanced Search Download
Example - County Distribution - New Mexico: San Juan; Family – Poaceae; Duration – Perennial; Native Status – L48 Native

Scientific Name	Common Name	Drought Tolerance	Moisture Use	Precipitation (Minimum)
Phragmites australis	common reed	Low	Medium	12
Schizachyrium scoparium	little bluestem	High	Low	12
Muhlenbergia montana	mountain muhly	High	Medium	13
Koeleria macrantha	prairie Junegrass	High	High	14
Phleum alpinum	alpine timothy	Low	Medium	16
Alopecurus aequalis	shortawn foxtail	Low	High	18
Bromus inermis	smooth brome	Medium	Medium	18
Elymus canadensis	Canada wildrye	Medium	Medium	20
Hordeum brachyantherum	meadow barley	Medium	Medium	20
Poa pratensis	Kentucky bluegrass	Low	High	24
Puccinellia nuttalliana	Nuttall's alkaligrass	Low	Medium	24
Phalaris arundinacea	reed canarygrass	Low	High	30
Elymus virginicus	Virginia wildrye	Medium	Medium	36

Using the NatureServe Explorer Website to Find Plant Association Information

Disclaimer

The NatureServe Explorer example is included for the information and convenience of the reader and does not imply endorsement or preferential treatment by the USDA-NRCS. NatureServe has granted permission to include the following example in this technical note.

NatureServe represents an international network of biological inventories-known as natural heritage programs or conservation data centers-operating in all 50 U.S. states, Canada, Latin America and the Caribbean. NatureServe Explorer is an authoritative source for information on more than 70,000 plants, animals, and ecosystems of the United States and Canada.

If the dominant plant species are known for a site, these species can be used to define a probable vegetation association using NatureServe Explorer. This association will often provide a listing of other plant species that are typically found in this plant community. Refer to the following steps:

Step	User Action	Result
1	Access the website: http://www.natureserve.org/explorer	Displays the NatureServe webpage.
2	Click the Search tab and select Ecological Communities and Systems	Displays the selection criteria choices.
3	Enter the name of any ecological unit (e.g., galleta big sagebrush). Select among Systems, Associations, Alliances, or All	Association or Alliance Records are reported based on search results (e.g., only two New Mexico Association Records are displayed with:

Step	User Action	Result
	(e.g., All) and click Search Now	1. Basin Big Sagebrush / James' Galleta Shrubland and 2. Basin Big Sagebrush / Blue Grama - James' Galleta Shrubland)
4	Click the link for the species for which you wish to generate a report (e.g., Basin Big Sagebrush–James' Galleta Shrubland)	An Ecological Association Comprehensive Report is downloaded and includes a Summary, Classification, Distribution, Vegetation, Environmental Setting, Use Guidelines and Citations (see Example 2 for sections from the above association record).

Example 2: Ecological Association Comprehensive Report

***Artemisia tridentata ssp. tridentata / Pleuraphis jamesii* Shrubland**
Translated Name: Basin Big Sagebrush / James' Galleta Shrubland
Unique Identifier: CEGL001015
Classification Approach: International Vegetation Classification (IVC)
Summary: This association has been described from the Colorado Plateau in southeastern Utah and may occur in parts of Colorado, New Mexico and Arizona. Most stands occur on valley floors, alluvial flats and on the terraces of intermittent drainages. A few stands have been reported from mesas. Sites are located between 1866 and 2200 m (6122-7220 feet) elevation on level to gentle slopes (<5%). Up to 80% of the unvegetated surface is covered by bare ground. Soils are generally deep, calcareous and alkaline sandy loams or clay loams derived from alluvium. This association occupies dry sites on valley floors in the Colorado Plateau. Total vegetation cover is variable; some disturbed stands may appear to be sparsely vegetated with total vegetation cover less than 10%. Stands are characterized by an open shrub canopy (5-35% cover) dominated by *Artemisia tridentata ssp. tridentata*. Associated shrubs may include *Chrysothamnus viscidiflorus, Ephedra viridis, Ericameria nauseosa, Gutierrezia sarothrae, Opuntia polyacantha, Atriplex* spp., and *Krascheninnikovia lanata*. Total woody canopy ranges from 5-35% cover. The sparse herbaceous layer (5-15% cover) is dominated by graminoids such as *Pleuraphis jamesii (= Hilaria jamesii), Achnatherum hymenoides, Aristida purpurea, Bouteloua gracilis, Elymus elymoides*, and *Sporobolus cryptandrus*. Forbs are sparse and variable; species recorded from plots include *Castilleja linariifolia* and *Psoralidium lanceolatum*.

Vegetation Summary: This association occupies dry sites on valley floors in the Colorado Plateau. Total vegetation cover is variable; some disturbed stands may appear to be sparsely vegetated with total vegetation cover less than 10%. Stands are characterized by an open shrub canopy (5-35% cover) dominated by *Artemisia tridentata ssp. tridentata*. Associated shrubs may include *Chrysothamnus viscidiflorus, Ephedra viridis, Ericameria nauseosa, Gutierrezia sarothrae, Opuntia polyacantha, Atriplex* spp., and *Krascheninnikovia lanata*. Total woody canopy ranges from 5-35% cover. The sparse herbaceous layer (5-15% cover) is dominated by graminoids such as *Pleuraphis jamesii (= Hilaria jamesii), Achnatherum hymenoides, Aristida purpurea, Bouteloua gracilis, Elymus elymoides*, and *Sporobolus cryptandrus*. Forbs are sparse and variable; species recorded from plots include *Castilleja linariifolia* and *Psoralidium lanceolatum*.

Floristic Composition									
Species Name	**Stratum**	**Growth Form**	Char-acter-istic	Domi-nant	Con-stant	**Cover Class %**	**Min Cover %**	**Max Cover %**	**Con-stancy %**
Chrysothamnus viscidiflorus	Short shrub/sapling	Broad-leaved deciduous shrub	✓						
Ericameria nauseosa	Short shrub/sapling	Broad-leaved deciduous shrub	✓						
Artemisia tridentata ssp. *tridentata*	Short shrub/sapling	Broad-leaved evergreen shrub	✓	✓					
Opuntia polyacantha	Herb (field)	Dwarf-shrub							
Achnatherum hymenoides	Herb (field)	Graminoid							
Pleuraphis jamesii	Herb (field)	Graminoid	✓	✓					

Use Guidelines and Citation

Copyright Notice: Copyright © 2009 NatureServe, 1101 Wilson Boulevard, 15th Floor, Arlington Virginia 22209, U.S.A. All Rights Reserved. Each document delivered from this server or web site may contain other proprietary notices and copyright information relating to that document. The following citation should be used in any published materials which reference the web site.

NatureServe. 2009. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: April 9, 2009).

Summary

With many of these search strategies, inappropriate species for a particular site may be downloaded. The use of ESIS and Ecological Site Descriptions should provide the most reliable information if an ESD can be well matched to the revegetation or restoration site.

Web Soil Survey allows a site to be precisely located on aerial photo maps and the ESD's to be determined for a particular area of interest.

VEGSPEC can report some inappropriate species or cultivars, but if care is taken in examining the characteristics of suspect species or the origin of suspect cultivars, then many of these concerns will be addressed.

The Advanced Search Download can determine appropriate species if vital characteristics can be identified to sort the candidate species.

If the dominant plant species are known for a site, using NatureServe Explorer can help you to define the probable vegetation association.

After identifying the appropriate species, the next step is to determine if the species are commercially available and who are the vendors. The Native Seed Network can provide vendor names for particular species (http://www.nativeseednetwork.org/). Other vendor lists are available from native plant organizations (e.g., The Arboretum at Flagstaff, http://www.thearb.org/seed_sources.htm) and from NRCS Plant Materials Centers (e.g., Tuscon Plant Materials Center, ftp://ftp-fc.sc.egov.usda.gov/AZ/PMC/NativeSeedVendors-2008.pdf)

Revegetating Riparian Areas in the Southwest "Lessons Learned"

The efforts to control invasive tree species and revegetate riparian areas along New Mexico's rivers and streams have led to important "lessons learned" based on both successful and failed projects. The information in this technical note is intended to concisely address the concerns that you should consider when planning and developing riparian revegetation projects.

These considerations can be lumped into several broad categories:

- Treatment and planning – Controlling invasive species, removal of dead biomass, land use/landscape objectives, advanced planning for plant materials.
- Hydrologic considerations – Wet meadow sites, depth to ground water, soil characteristics, scouring potential, and inundation potential.
- Site factors – Annual weed infestations, connecting new plantings to the capillary fringe, and planting concerns.
- Maintenance and monitoring of the planting **–** Irrigation, herbivores, and pest control.

Naturally diverse riparian plant community in the Middle Rio Grande Valley including giant sacaton, *baccharis*, New Mexico olive, and cottonwood.

Controlling Invasive Woody Species on Floodplain Sites

The proliferation of invasive woody species on low-elevation floodplain sites has required intensive and long-term control efforts to allow the revegetation of native riparian plant communities. The methodology for initial control of invasive woody species has been well established. A long-term commitment for spot spraying of resprouts must be part of any control program. Monitoring of the site will reveal resprouting invasive woody plants (including saltcedar, Russian olive, Siberian elm, and tree of heaven) and should prompt the application of herbicide before the sprouts become too large. The same is true for recurring noxious perennial weeds.

Removing Dead Biomass from Treated Stands

The dead biomass can be burned in slash piles for interspersed invasive woody plants or by crown fires in monoculture stands. The removal of large diameter biomass as firewood is another alternative. Mulching biomass is expensive, but the benefits of the wood chips may make it worthwhile. Mulch will reduce wind and water erosion, will reduce moisture loss to aid reseeding efforts, and may provide enhanced salt leaching by reducing evaporation and increasing infiltration. A mulch layer will also retard the growth of weeds that commonly occurs after clearing operations. An existing layer of mulch can interfere with seeding by preventing seed contact with mineral soil.

Desired Landscape Objectives after Controlling Invasive Woody Species

On river floodplain sites that no longer experience flooding, the self-perpetuation of cottonwoods and tree willows cannot be assumed due to the lack of natural recruitment. Riparian forest communities that have been established through intensive planting approaches will evolve towards xeric shrublands/grasslands if flooding is not re-established. These types of sites will require perpetual planting and management if the landscape goal is a park-like setting with groves or stands of riparian trees. Other landscape objectives to be considered include the fuel load that will be acceptable from the re-established plant community, and the need for firebreaks and emergency access within the restored area. Wildfire concerns may necessitate a landscape goal more comparable to a savannah than of a gallery forest.

Planning in Advance for Plant Materials and Stock Types

Many riparian restoration projects, whether in low elevation floodplains or montane riparian sites, will require unconventional native species and/or stock sizes. To achieve a suitably diverse native plant community, growers of native plant materials will need to be identified well in advance to produce the amount of plant materials required for a large restoration project. Those planning revegetation projects need to consider the costs versus the benefits of different stock sizes. The calculation of advantages of large versus small stock will be influenced by the availability and cost of labor and equipment used for planting and long-term irrigation/maintenance.

Woody Riparian Plant Communities versus Wet Meadow Communities

Due consideration is required to evaluate whether a site is truly a wet meadow environment and not appropriate for woody vegetation. Shallow depth to ground water, fine-textured organic-rich or anaerobic soils, and low stream gradients are some of the factors consistent with wet meadow environments. On low elevation floodplains, saltgrass or alkali muhly meadows are inappropriate for revegetation with woody species because of shallow groundwater as well as generally high levels of soil salinity.

Depth to Ground Water and Water Table Fluctuation

For revegetation projects, seasonal measurement of depth to ground water is highly recommended to determine appropriate species, planting depth, and the most effective stock type regarding stem length, container depth, or pole length. Inexpensive shallow monitoring wells will confirm the depth and seasonal fluctuation of the water table. Extreme depths to groundwater (for example, greater than eight feet) may indicate the only practical restoration goal is revegetation with xeric shrubs and grasses rather than riparian species.

Revegetation Limitations Due to Soil Chemistry and/or Soil Texture Extremes

Salinity or sodicity of floodplain soils can profoundly influence species suitable for revegetation. Restrictive soil layers can be important factors that constrain the selection of species and stock type for revegetation. Soils with high percentages of cobble can be impossible to auger; whereas augered holes in dry sands and gravels will often collapse before planting.

Loss of Planting Stock from the Scouring Action of High Flood Flows

High flow flood events can easily erode shallowly planted containerized and cutting stock. In arroyo systems, this can often be a more limiting factor to revegetation than the ephemeral nature of surface flow in these drainages. Extreme channel instability coupled with either severe sediment aggradation or degradation should preclude revegetation attempts until some semblance of channel stability can be achieved through natural geomorphological processes or human intervention. Dormant pole and whip cuttings planted to substantial depths can resist the extractive forces of flood flows. Willow whips with their inherent flexibility are more appropriate for higher flow regimes and less stable channel systems. Many riparian species grown with long stems can be deep planted for anchorage and contact with the capillary fringe; many riparian species are adapted to this planting method which is comparable to natural burial by sediment deposits.

Inundation of Low Floodplain Areas

High flows, particularly in the spring, can inundate low floodplain areas and if flows persist and surface and subsurface drainage is impaired these sites can remain underwater for many weeks. Anaerobic soils resulting from saturated conditions will be lethal to newly planted poles and transplants. More established plants may survive this inundation if not too lengthy. Riparian plant species are adapted to short-term inundation, a common occurrence in proper functioning riparian systems.

The Effect of Weed Competition on Revegetation

Annual weeds should be prevented from going to seed at the end of the first growing season after treatment of invasive woody plants. If annual weeds have invaded the site and have been allowed to disperse new seed, it is vital to the revegetation project to reduce weed seed in the soil seed bank before reseeding native grasses. Large dense weed stands that shade seedlings and deplete soil moisture can overwhelm the seeding of native grasses and forbs as well as the survival and growth of small containerized stock. For severe weed infestations on disturbed sites, several years of herbicidal control may be appropriate before reseeding to maximize the revegetation success.

Connecting Transplants to the Capillary Fringe

Obligate riparian plants are phreatophytes which subsist on soil moisture in the capillary fringe resulting from the capillary rise of water above the water table. Establishing phreatophytes requires immediate connection to the capillary fringe or frequent watering until the roots reach the capillary fringe. The application of water can be a prolonged endeavor depending on the depth of the capillary fringe, the depth of planting, soil texture, and soil compaction. Immediate connection can be attained using dormant pole cuttings, dormant whip cuttings, and by deep-planting longstem transplants.

Planting Methods

Planting containerized woody plants in the fall offers the benefits of lower evapotranspiration and of continuing root growth while soil temperatures remain moderate. Dormant pole and whip cuttings need to be planted before budbreak; therefore, a late winter to early spring planting window is required. Reseeding low elevation floodplain sites should be timed to take advantage of anticipated summer rains. The stock type will greatly influence the planting equipment required. Sites with deep water tables may require long augers to access ground water for pole plantings. Willow whip cuttings can be effectively planted in most stream bank soils with three-foot long, one-inch diameter rotary hammer drill bits. Large equipment requires site access which can be restricted by ditches, arroyos, levees, soft sand, or steep slopes. One unanticipated problem with equipment access, which has been identified with the recent upsurge in saltcedar clearing, is the ubiquitous presence of cut stumps which can easily flatten the equipment's tires if they are not foam-filled.

Watering Planted Containerized Stock

With the exception of poles and whips which are planted into the water table, containerized plants should be watered at the time of installation. Establishment of containerized stock could require from one-to-many water applications depending on initial contact with the capillary fringe as determined by stock size, soil moisture conditions, and watering method. Conventional water basins can be used, but high evaporation losses, difficulty in getting the moisture deep into the soil profile, and promotion of weed growth are problems with this irrigation method. The use of embedded watering tubes can aid in getting the water around and below the root ball and in recharging deep-soil moisture. Watering tubes are usually perforated at root ball depth to allow rapid and thorough distribution of water and are fabricated from PVC pipe. Larger diameter pipes (3" – 4") are helpful if starch-based hydrogels are going to be applied. The hydrogel is costly and more difficult to apply than water because of its viscosity, but the slow release of moisture will probably reduce the number of water applications required for plant establishment. You also must consider the ease of vehicle access to the site for watering operations as well as planting and seeding.

Protecting and Maintaining Revegetated Sites

A number of other considerations will require post-planting attention: resprouting of invasive woody species, protection from grazing and browsing animals, and controlling defoliating insects. The continued spot spraying of invasive woody sprouts and any other invasive weeds will be required for an indefinite period. Protection from cattle will require adequate fencing and periodic monitoring of fence integrity. The presence of beaver necessitates poultry-wire tree guards around individual pole plants as well as protection of unplanted poles and whips placed in streams or ditches for hydration. Controlling defoliating insects is crucial for pole plantings during the initial growing seasons; cottonwood leaf beetle occasionally will require control. The destruction of plantings by vandals should also be considered when planning revegetation projects

Conclusion

Cost effective and successful riparian revegetation can be achieved through diligent efforts during the planning stage. Although there is not a precise recipe that will guarantee success in riparian revegetation, understanding site limitations and the potential methods of resolving them is the most important step in the planning process.

Boulder County Big Bluestem Seed Production

Study Number: NMPMC-S-0701-OT

In September of 2006, big bluestem (*Andropogon gerardii*) seed was collected by the Boulder County Parks Department and sent to the NRCS Los Lunas Plant Materials Center. The intent was to establish d⅓ -acre seed production field.

Big bluestem is a native, warm-season, perennial bunchgrass commonly found in prairies, dry soils, open woods in the southwest, and in zones that receive more than 14 inches of annual precipitation. This species is an excellent forage species that is highly palatable to all classes of livestock and elk. It does however, become coarse in texture late in the season.

Big bluestem transplants were produced by hand seeding 5,000 plug cells (¾" x ¾" x 2 ½") on June 21, 2007. The plug soil mix contained two parts of Sunshine #1 media to one part of perlite. One pound of a three-month controlled release fertilizer (17-6-12) was added per four-cubic feet of the plug soil mix.

After nine days, most of the seed had germinated and seedlings had emerged. The seedlings were kept damp with an automated sprinkler system on a bench for three weeks, and then moved to the nursery to harden off and grow out for an additional four weeks.

On August 2, 2007, the seedlings were transplanted into Field 16 at the Los Lunas Plant Materials Center.

Figure 1: Big bluestem in Field 16 at the Los Lunas Plant Materials Center

This field was hand-hoed approximately every three weeks during the growing season (April – November). Other field maintenance activities for 2007 and 2008 are described in the following tables:

Field Maintenance Activities – 2007

Activity	08/02	08/10	08/23	09/10	10/26
Irrigation	2"application	2"application	2"application	2"application	2"application
Fertilized	70 lbs N 40 lbs P				

Field Maintenance Activities – 2008

Activity	02/19	04/01	05/05	06/07	07/02	07/25
Irrigation		2”application	2”application	2”application		2”application
Fertilized	40 lbs N 40 lbs P					40 lbs N
Herbicide					2,4-D	

To maintain seed purity, the field is managed by adhering to foundation seed standards. In July 2008, the field was inspected by New Mexico Seed Certification for isolation and noxious weeds.

As of today, August 20, 2008, the seed-head height on many of the plants is above 70 inches, and foliage height is near 25 inches. Seed maturity ranges from anthesis to seed ripe. Less than one percent of the flowers have ripe seed; the seed crop will be indeterminate. The crop will be harvested with a Flail-Vacuum Seed Harvester several times during the month of September. This machine is mounted to a front-end loader tractor and contains an elongated, seed-striping rotary brush that creates a vacuum when in operation. This machine will harvest mainly ripe seed without destroying immature seed heads. As seed is harvested, it will be placed on an air drying table to prevent molding. During the winter of 2009 the seed will be cleaned and sent to Boulder County.

Chilili Seeding Trial

Study Number: NMPMC-T-0905-RA

Introduction

Local ecotypes, improved plant materials, new technology and careful planning are key elements to successfully revegetate rangelands. These elements are especially critical for successful restoration in the southwest due to low precipitation and high temperatures which significantly contribute to the harsh environment.

In an effort to improve seeding of disturbed lands in the Estancia, NM area and areas with similar environments, the USDA Natural Resources Conservation Service (NRCS) in cooperation with the Estancia NRCS Field Office, East Torrance Soil and Water Conservation District, and the Edgewood Soil and Water Conservation District initiated this seeding study in 2009.

This study is located on a Witt loam soil with a 2-3 percent north facing slope at an elevation 6,600 feet in Chilili, New Mexico on the Lindeman Ranch. The area receives a mean annual precipitation of 13 inches, with 75 percent occurring from April to October. The wettest months on average are July and August. Most of the precipitation during this period comes in the form of summer high-intensity, short-duration thunderstorms.

The potential plant community of this site is mixed grassland of medium to short stature warm-season and cool-season perennial grasses, and includes the following:

- western wheatgrass
- blue grama
- James galleta
- squirreltail
- sideoats grama
- little bluestem
- vine mesquite
- black grama
- spike dropseed
- sand dropseed
- alkali sacaton
- threeawn
- plains lovegrass

Woody species may occupy a minor component and include:

- Bigelow sagebrush
- fringe sagewort
- prickly pear cactus
- pinyon pine
- Utah juniper
- algerita

Forbs include:

- Rocky Mountain beeplant
- marigold yarrow
- ragweed
- wooly Indianwheat
- whorled milkweed
- tansymustard
- Indian paintbrush.

The study site is currently dominated by very short (less than 6-inches in height) blue grama with western wheatgrass occupying the low water catchment and drainage areas where additional soil moisture exists.

This site was farmed for dryland pinto bean production from the 1940s to 1980s, and for dryland small grains for forage or grazing until about 2000. No prior grass seeding attempts have been done on this site. After summer precipitation, field bindweed typically begins to dominate the interspaces between colonies of blue grama and western wheatgrass. The surrounding mountains and foothills in the area recently experienced a 4,500 acre wildfire in 2008. The burned areas may benefit from the results of this study if future seedings look promising and are planned.

Soil moisture is the most critical factor that limits seedling establishment in the arid southwest. Even seedlings of drought tolerant species require moist soil conditions during the three- to four-week period of emergence to establishment. Often if a seedling can establish roots below a 4-inch depth (the zone below rapid soil surface evaporation), the seedling can be considered established. A surface, straw-mulching treatment provides for a moist/cool soil surface microclimate. This reduces soil moisture evaporation, seedling evapotransporation and reduces surface erosion by enhancing water infiltration. However, purchasing the mulch materials and applying the mulch may triple the cost of seeding when applied at the recommended rate of two tons per acre (the recommended rate required for a single layer of straw to cover the soil surface).

Extensive research has been conducted as early as the 1950's exploring use of organic polymers for soil property amendments (Azzam, 1980) such as water retention. These compounds are estimated to hold 40 – 800 times their own weight in water. With precise placement of the polymer in the seed furrow, surface moisture retention may be enhanced enough to allow for seedling establishment during the arid periods between rainfall events. In theory, when precipitation hydrates the dry powder polymer material, the seed lying in contact would be able use this moisture. The polymer 'Celanese' at the rate of 1/100 in potting soil was able to reduce water use and irrigation frequency of *Zinnia* plants (Fruta and Autio, 1988). The dry powder of a polyacrylamide has been applied at the rate of 4 lbs. per acre on irrigated cantaloupe fields in Colorado to improve water use efficiency (James Valliant (Colorado State University), personal communication, 2009). Because many of the polymer moisture retention products sell for less than $7.00 per dry pound, the potential exists to significantly reduce dryland seeding cost with this substitution for hay mulch. Subsequently, the NRCS Estancia Field Office requested the testing of hydrophilic polymers in this seeding study.

Fifty-two plant species accessions (cultivars, germplasm or population ecotypes) were seeded and are being evaluated for performance (shown in Table 1). All but four entries are grasses. The non-grasses are fourwing saltbush and winterfat which are shrubs, and 'San Juan' and 'Richfield' penstemon species which are forbs. This planting is part of a regional trial, with the germplasm being provided by NRCS Plant Materials Centers (PMCs) in Idaho, Colorado, Montana and New Mexico and the Agricultural Research Service (ARS) in Logan, Utah. Other similar plantings may be installed by these participants.

Table 1: Cultivar/Accession Performance (seedlings/2-row subplot)

Species	Common Name	Cultivar or Accession	Hydrogel Plots	Control Plots	Hydrogel Plots	Control Plots	Mean
Achnatherum hymenoides	Indian ricegrass	CSU-10	32	10	17	8	16.8
Achnatherum hymenoides	Indian ricegrass	9024741	7	12	7	12	9.5
Achnatherum hymenoides	Indian ricegrass	Paloma	6	5	3	0	3.5
Achnatherum hymenoides	Indian ricegrass	9024749	1	3	0	3	1.8
Achnatherum hymenoides	Indian ricegrass	9024661	6	0	7	1	3.5
Achnatherum hymenoides	Indian Ricegrass	Starlake	7	11	53	13	21
Agropyron cristatum x desertorum	Hybrid crested wheatgrass	Hycrest	34	6	10	0	12.5
Agropyron fragile	Siberian Wheatgrass	Valvilov II	4	9	16	20	12.2

Table 1: Cultivar/Accession Performance (seedlings/2-row subplot)

Species	Common Name	Cultivar or Accession	Hydrogel Plots	Control Plots	Hydrogel Plots	Control Plots	Mean
Agropyron fragile	Siberian Wheatgrass	Valvilov	6	9	15	13	10.8
Atriplex canescens	Fourwing saltbush	Snake River	7	1	7	3	4.5
Bothriochola barbinoides	Cane bluestem	Grant Germplasm	0	7	7	0	3.5
Bouteloua curtipendula	Sideoats grama	Vaughn	6	8	13	2	7.2
Bouteloua eriopoda	Black grama	Nogal	0	0	0	3	0.8
Bouteloua gracilis	Blue grama	Hachita	10	15	4	0	7.2
Elymus elymoides	Bottlebrush squirreltail	Tusas Germplasm	56	42	31	26	38.8
Elymus lanceolatus	Streambank wheatgrass	Sodar	19	53	58	38	39.5
Elymus lanceolatus	Thickspike wheatgrass	Utah Experimental	25	58	36	11	32.5
Elymus trachycaulus	Slender wheatgrass	First Strike	30	26	47	46	37.2
Elymus trachycaulus	Slender wheatgrass	Pryor	40	78	62	53	58.2
Lemus cinereus	Basin wildrye	Magnar	31	4	7	13	13.8
Lemus cinereus	Basin wildrye	Continental	8	29	13	9	14.8
Lemus cinereus	Basin wildrye	9092288	22	1	18	0	10.2
Lemus cinereus	Basin wildrye	Trailhead	5	6	23	20	13.5
Lycurus phleoides	Wolftail	9066720	32	81	5	5	30.8
Leymus salinas	Salina wildrye	9043501	42	74	62	42	55
Nassella viridula	Green needlegrass	Cuchurus	6	16	24	0	11.5
Nassella viridula	Green needlegrass	Lodorm	8	14	38	4	16
Krascheninnikovia lanata	Winterfat	Northern Cold Desert	0	0	11	0	2.8
Pascopyrum smithii	Western wheatgrass	Arriba	144	109	94	33	95
Pascopyrum smithii	Western wheatgrass	Rosana	117	35	52	20	56
Pascopyrum smithii	Western	9092278	108	60	44	9	55

Table 1: Cultivar/Accession Performance (seedlings/2-row subplot)

Species	Common Name	Cultivar or Accession	Hydrogel Plots	Control Plots	Hydrogel Plots	Control Plots	Mean
	wheatgrass						
Pascopyrum smithii	Western wheatgrass	Recovery	29	37	80	33	44.8
Penstemon angustifolius	Broadbeard beardtongue	San Juan Germplasm	0	0	0	0	0
Penstemon eatonii	Eaton's Penstemon	Richfield	3	0	-	-	1.5
Pleuraphis jamesii	Galleta grass	Viva	21	20	7	0	12
Poa sandbergii	Sandberg bluegrass	9092282	85	22	0	1	27
Poa sandbergii	Sandberg bluegrass	High Plains	16	11	0	4	7.8
Psathyrostachys juncea	Russian wildrye	Bozoisky II	74	5	15	6	25
Psathyrostachys juncea	Russian wildrye	Mankota	21	33	16	10	20
Pseudoroegneria spicata	Bluebunch Wheatgrass	Anatone	77	49	120	9	63.8
Pseudoroegneria spicata	Bluebunch Wheatgrass	BHP	33	15	32	8	22
Pseudoroegneria spicata	Bluebunch Wheatgrass	Discovery	42	26	33	7	27
Pseudoroegneria spicata	Bluebunch Wheatgrass	P-7	31	34	23	5	23
Pseudoroegneria spicata	Bluebunch Wheatgrass	P-33	20	36	10	31	24
Pseudoroegneria spicata	Bluebunch Wheatgrass	9092281	13	17	4	6	10
Pseudoroegneria spicata	Bluebunch Wheatgrass	9092287	3	17	8	9	9.2
Schizachyrium scoparium	Little bluestem	Pastura	3	0	23	2	7
Sporobolus airoides	Alkali sacaton	Salado	10	1	7	0	4.5
Sporobolus flexuosus	Mesa dropseed	Fort Bliss	17	9	0	0	6.5
Thinopyrum intermedium	Intermediate wheatgrass	Rush	91	19	48	24	45.5
Thinopyrum intermedium	Intermediate wheatgrass	Manifest	84	66	37	47	58.5
Thinopyrum	Tall	Jose	14	43	13	3	18.2

Table 1: Cultivar/Accession Performance (seedlings/2-row subplot)

Species	Common Name	Cultivar or Accession	Hydrogel Plots	Control Plots	Hydrogel Plots	Control Plots	Mean
intermedium	wheatgrass						
Thinopyrum intermedium	Tall wheatgrass	Largo	18	20	38	47	30.8
Mean			**28.3**	**23.4**	**24.5**	**12.3**	**22.1**

Methods

In June of 2009, about three weeks prior to seeding, the site preparation consisted of tractor boom spraying about one-acre with a mixture of glyophosate and 2,4-D Amine, both at the rate of two quarts per acre; mainly to control field bindweed. Initially, the planting area size was underestimated and we had to spot-treat an additional 0.25 acres with a two-percent mixture of glyophsate and 2,4-D Amine about four hours before planting. Because soil surface bulk density and weed control was ideal, neither disking nor harrowing was necessary.

Seeding took place on July 22–23, 2009 using a 3-point, 4-row, 'Kincaid' belt driven, cone seeder (Figure 1). Seed was weighed and packaged about a month earlier for calibration at 30 pure live seeds (PLS) per linear ft. for both grass and forbs species.

Figure 1: Plots were sown with a 4-rowed, 'Kincaid' belt-driven cone seeder

The shrub species (fourwing saltbush and winterfat) were sown at the rate of 20 PLS per linear ft. Ten grams, equivalent to the application rate of 10 lbs/acre of 'Soil Moist' (a starch polymer manufactured by JRM Chemicals, Cleveland, OH), was added to one-half of the seed packets. The starch polymer was sown with the seed by dropping it through the seeder and placing it in contact with the seed at a ½-inch depth at the bottom of the furrow (Figure 2). Each plot consisted of four, 20-ft. rows spaced on 1½ ft. centers.

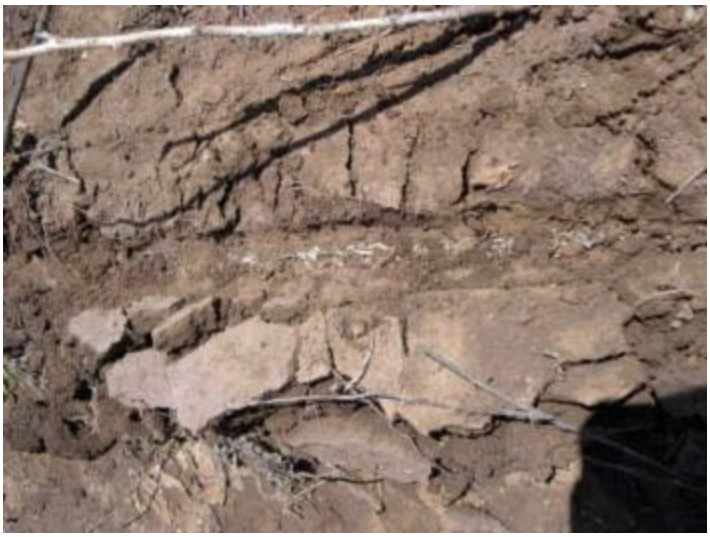

Figure 2: Grass seed with hydrogel powder in open furrow before closure by the packer wheels of the seed drill

Experimental design is a two-replicated Split-Plot (Attachments 1 and 2). Each main plot consists of 53 subplots, either with or without "Soil Moist;" the subplots are the plant material entries. For evaluations, the corners of each main plot were staked so the plots can be precisely relocated with a measuring tape (Figure 3).

Figure 3: Overview of project site (center) after installation

The plots were evaluated October 14–19, 2009 by counting all emerged seedlings in the center two rows, a 20 sq. ft. area. Statistic 8.1 software [Analytical Software, Tallahassee, FL (2003)] was used to evaluate seedling densities. Data distribution for normality was tested using the 'Shapiro-Wilk Test.' Data transformations were performed for the conversion to a normal distribution. Data was analyzed using the 'Friedman Two-Way Nonparametric Analysis of Variance' and the 'Kruskal-Wallis One-Way Nonparametric Analysis of Variance.'

Relative performance of the starch polymer treatment will be judged by comparing the performance of wood straw mulch which was hand broadcasted (Figure 4) at the rate of about two tons per acre over the surface of 30 plots that were sown with the same plant materials using the same methods as used in the polymer trial (Figure 5).

Figure 4: Applying wood straw mulch after seeding on trial plots

Figure 5: Overview of wood straw trial plots after installation

Straw mulching is the standard soil surface treatment after seeding in the arid southwest and is generally required for successful seedling establishment. Wood straw mulch should persist much longer than grain straw and with its greater weight, resist movement by wind and water. These plots were not evaluated because many of the seedlings were partially covered in the straw and difficult to find. These plots will be measured during the 2010 evaluation.

The closest weather station is located in Estancia, New Mexico, about 20 miles northeast of Chilili, New Mexico. Table 2 shows the monthly rainfall for the 2009 summer season.

Table 2: Monthly Rainfall in Estancia, New Mexico

	Jul	Aug	Sep	Oct
Rainfall (inches)	2.64	1.79	2.37	1.6

Results

The average seedlings per plot were 22. The ten best performing entries, considering only seedling emergence were C3, cool-season grasses of the genera *Elymus*, *Leymus*, *Pascopyrum*, *Pseudoroegneria*, and *Thinopyrum* (Table 3 and Figure 6). The best performing warm-season grass (C4) was *Pleuraphis jamesii* (Galleta) averaging 12 plants per plot. These plants were the most robust of all other entries, averaging more than 6-inches in height and consisting of more than 10 leaves per plant (Figure 7).

Table 3: The 10 Best Accessions for Seedling emergence October 2009

Species	Common Name	Cultivar	Seedlings/plot
Pascopyrum smithii	Western wheatgrass	Arriba	95
Pseudoroegneria spicata	Bluebunch wheatgrass	Anatone	64
Thinopyrum intermedium	Intermediate wheatgrass	Manifest	58
Elymus trachycaulus	Slender wheatgrass	Pryor	58
Pascopyrum smithii	Western wheatgrass	Rosana	56
Leymus salinas	Salina wildrye	9043501	55
Pascopyrum smithii	Western wheatgrass	9092278	50
Thinopyrum intermedium	Intermediate wheatgrass	Rush	45
Pascopyrum smithii	Western wheatgrass	Recovery	45
Elymus elymoides	Bottlebrush squirreltail	Tusas	39

Figure 6: Arriba western wheatgrass, best performing entry, averaging 95 seedlings per plot (October, 2009)

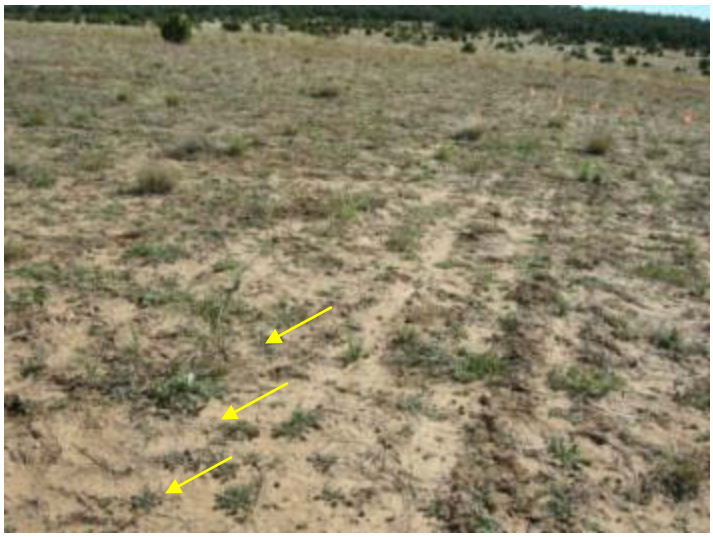

Figure 7: Galleta grass plants by October 2009

The data from mean seedling counts from the plots was not normally distributed (p = 0.0000). The starch polymer did not significantly (p = .0041) have an effect on seedling density. However, the control plot of the second replication had significantly less seedlings (p = 0.1353) than the starch polymer plots. This may not have been the effect of the treatment, but was caused by a colony of prairie dogs, gophers, and other mammals digging burrows and foraging on the emerging seedlings (Figure 9).

Mean seedling density was not significantly different (p = .0027) among the entries even though individual mean seedling counts on plots ranged from 0 to 95 plants.

Discussion

Because the study had 53 accession entries (species/cultivars/populations), it is common for large variety trails such as this to fail normality tests. The seedling response for each species/cultivar may have its own independent normal distribution. However, if enough replications are conducted, it is possible to have a normal distribution. Consequently, the data of many varieties with few replications often resembles a leptokurtic distribution and does not respond to data transformations, as was the case for this data (Figure 8).

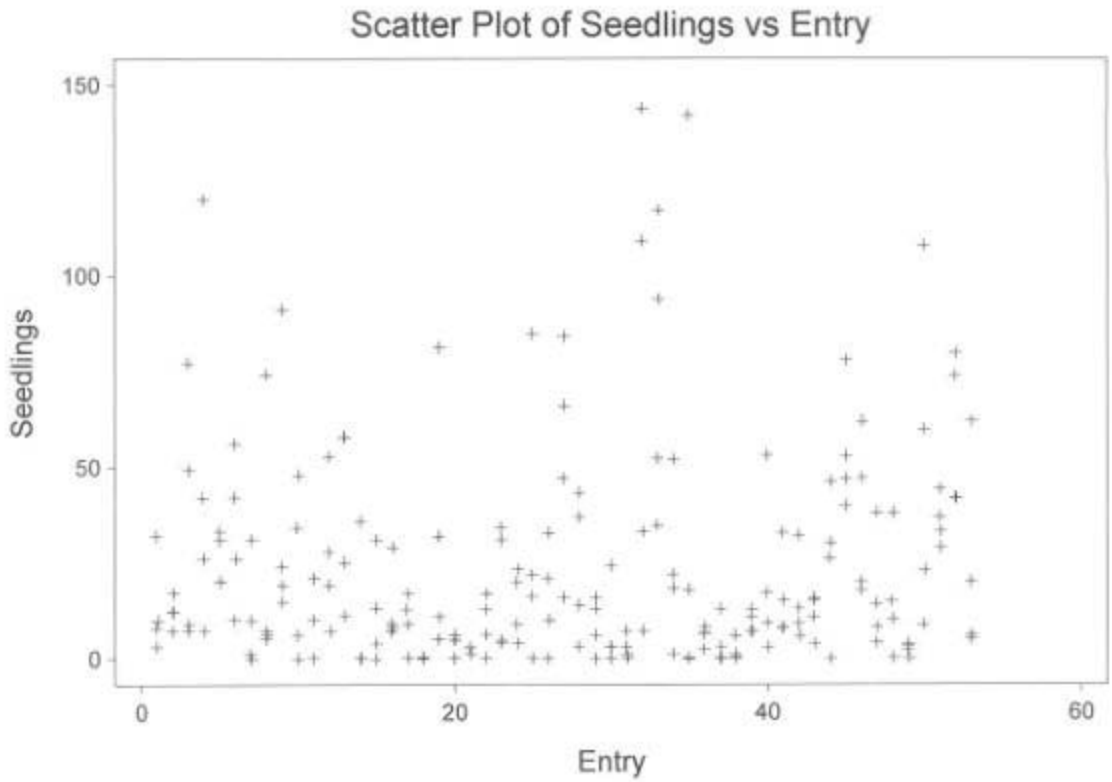

Figure 8: Seedling emergence of entries did not form a normal distribution but related to a leptokurtic distribution with more values near the mean and the tails.

This first October evaluation only measures seedling density and not establishment. The seedlings counted in this evaluation may not persist. The drought-tolerant, C4 grasses such as Viva galleta and Fort Bliss mesa dropseed may rank higher when growth and establishment are evaluated in 2010 and beyond.

Currently, the prairie dogs and other rodents have mainly colonized one of the control main plots. This area was spot treated with a 2% solution of herbicide and was the only area completely clean of all vegetation. The established grasses originally treated with the tractor boom spraying of two quarts per acre have resprouted and are growing vigorously. The rodents may have been attracted to this bare location because both grass seedlings and potential rodent predators were completely exposed. Confirmation of rodent activity on this area included relatively heavy accumulation of dung, and seedlings were damaged from grazing when compared to the other main plots. It is critical that these rodents are controlled before they have an impact on additional plots.

Figure 9: Plots impacted by rodent activity (October 2009)

A second follow-up seeding trial is being considered that will include only a few of the best performing entries and will be replicated more than five times. With an increase in replications (main plot), a more sensitive test to measure the effect of the hydrogel on seedling establishment will be conducted. Additionally, with this increase in replications and fewer entries, seedling response will be more likely to form a normal distribution so parametric statistics may be applied if the other statistical assumptions are met.

References

Azzam R.A.I. 1980. Agricultural polymers, polyacrylamide preparation, application, and prospects. Journal of Communications in Soil Science and Plant Analysis 11: 767-834

Fruta T and R. Autio. 1988. Hydrophilic polymers in potting soil mix. California Agricultural. May-June: 19–21

Attachment 1

Rep 1

Nogal	Wolftail	CSU-10
9024661	Paloma	9024741
Star Lake	9024749	Anatone
9092287	9092281	Discovery
BHP	P-7	P-33
Valvilov	Valvilov II	Tusas
High Plains	9092282	Salado
First Strike	Mankota	Bozoisky II
Pryor	Manifest	Rush
Largo	Jose	Hycrest
Lodorm	Cuchurus	Viva
Hachita	Blue grama A.S.	Sodar
Pastura	Snake River	Thickspike-Utah
9092278	Arriba	San Juan
Recovery	Rosana	Magnar
Salina	902288	Continental
Trailhead	Granta	Mesa dropseed – FB
Richfield	Vaughn	Winterfat – cold desert

136 No Hydrogel

10’ 10’ 20’

Salado	Mesa dropseed – FB	Sodar
Rosana	Snake River	Grants
Recovery	Arriba	9092278
Rush	Manifest	Wolftail F.S.
Nogal	Blue grama A.S.	Hachita
Vaughn	Tusas	Hycrest
9024661	9024749	CSU-10
Paloma	Star Lake	9024741
Pastura	Mankota	Bozoisky II
902288	Salina	Largo
Magnar	Pryor	Jose
Strike	Thickspike – Utah	Lodorm
Winterfat – Cold Desert	Valvilov	Cuchurus
Discovery	9092287	P-7
BHP	P-33	9092281
Anatone	High Plains	9092282
Richfield	San Juan	Viva

136 Hydrogel

60′ 20′

80′

Attachment 2

N

Rep 2

Rush	Manifest	Salado
Nogal	Lodorm	Cuchurus
Mesa dropseed – F.B.	Largo	Jose
9024749	9024741	Star Lake
9024661	Paloma	CSU-10
9092278	Arriba	Recovery
Rosana	San Juan	902288
Salina	Magnar	Continental
Trailhead	Viva	Snake River
BHP	P-7	Hycrest
Discovery	9092287	Anatone
9092282	9092281	P-33
High Plains	Thickspike – Utah	Hachita
Bozoisky 2	Vaughn	Blue grama – A.S.
Mankota	Valvilov	Valvilov II
Grants	Winterfat N.C.D.	Sodar
Tusas	Pastura	Wolftail F.S.
Hycrest II	First Strike	Pryor

136 No Hydrogel

10’ 10’

20

Vaughn	San Juan	9092281
P-33	P-7	Anatone
9092287	Discovery	BHP
Tusas	Pastura	Viva
Snake River	9024741	Paloma
CSU-10	Star Lake	9024749
9024661	Mesa dropseed – Fort Bliss	Rush
Pryor	First Strike	Manifest
Winterfat – Cold Desert	Valvilov	Valvilov II
Sodar	9092282	High Plains
Hycrest	Bozoisky	Mankota
Thickspike – Utah	Salado	Nogal
9092278	Rosana	Recovery
Jose	Wolftail F.S.	Arriba
Largo	Trailhead	Magnar
902288	Salina	Continental
Grants	Hachita	Blue grama A.S.
Hycrest II	Lodorm	Cuchurus

136 Hydrogel

60′ 20′

80′

Veguita Bridge Longstem Transplant Study

Study No. NMPMC-T-0701-RI

The USDA Natural Resources Conservation Service Los Lunas Plant Materials Center (LLPMC) staff planted 60 indigobush (*Amorpha fruticosa*), 367 New Mexico olive (*Forestiera pubescens*), 60 false willow (*Baccharis salicina)*, and 74 wolfberry (*Lycium torreyi*) transplants on three separate 5-acre sites near the Veguita Bridge in Veguita, New Mexico. All plantings were completed in January of 2007. The sites, owned by the Middle Rio Grande Conservancy, are located on the northeast, northwest, and southwest sides of the Veguita Bridge over the

Figure 1. South edge of southwest Veguita Bridge site showing "wall" of uncleared saltcedar and plants with tubes.

Rio Grande adjacent to the community of Veguita (T4N, R2E, S29 and S30, lat 34.33ºN, long -106.46ºW). In addition to increasing the aesthetics of the Rio Grande bosque, the expected benefits of the project include improving wildlife habitat and recreational opportunities and increasing the plant diversity and microflora; thereby creating a much healthier ecosystem than the existing saltcedar monoculture (Fig. 1). Additionally, this project provided the LLPMC an opportunity to test both new plant materials and longstem planting methods. Based on the expected benefits in water conservation, the project received funding from Senator Bingaman's program for the control of non-native phreatophytes and Rio Grande bosque watershed restoration.

Methods

Site preparation

Three to four months before planting, saltcedar (*Tamarix sp*., dominant species), Russian olive (*Elaeagnus angustifolia*), and Siberian elm (*Ulmus pumila*) (all three on the New Mexico "Class C" noxious weed list, National Plant Board 2007) were removed by extraction method using an excavator with articulate thumb. The removed plants were chipped, and these chips were applied for a mulch cover ranging from 2- to 6-inches in depth. Resprouts of all woody noxious species were spot-treated once in the fall by foliar spraying with the herbicide Arsenal (isopropylamine salt of imazapyr) before the January 2007 plantings. Additionally, in June 2007 LLPMC staff sprayed (using a four percent solution mix of 2,4-D and glyphosate) perennial pepperweed (*Lepidium latifolium*, classified in New Mexico as a "Class A" noxious weed).

Planting methods

All four species of the 2- to 3-year-old nursery longstem stock transplants were grown at the LLPMC in Stewie and Sons, Inc. one-gallon tree pots (4" X 4" X 14") to a stem height of up to 6 feet (i.e., total plant height = 8.5 feet). As directed, the transplants were planted to the depth of capillary water, which at the time of planting varied from 4- to 5-feet, while ground water varied from 6- to 7-feet deep. This technique of deeply burying the root crown in contact with the capillary fringe enables establishment of understory transplants without supplementary irrigation (LLPMC 2007). The soil appeared to be sandy. All transplants were planted with a 9-inch by 8-foot augur attached to a front-end loader on a 65-hp farm tractor. The transplants were placed in the 8-foot holes and back-filled with hand shovels. A 20-inch section of schedule 20 PVC thin-wall pipe perforated along the bottom one-third of the pipe was inserted into the holes. The pipe was used as a flag to locate plants, to distinguish plantings from volunteer plants, and to provide irrigation at root crown depth in the event watering was needed. Following an evaluation of the plants for drought stress, LLPMC personnel returned in late August to hand irrigate, delivering approximately 2.5 gallons of water to each plant.

Evaluation

At the time of irrigation and four days post-irrigation, each plant was evaluated by species by LLPMC staff member for survival (live/dead above-ground growth) and every fifth plant was evaluated for the following: length of new growth, height, vigor (color), herbivory, amount of top die-off, and overall health. Most of the plants were measured on the first day; the only water they had received since planting was via sub-irrigation or surface runoff (precipitation). To facilitate survey efforts and eliminate double-counting, transplant tubes were spray-painted using a gold metallic paint. Geospatial coordinates were recorded for all plants exhibiting above-ground die-off and projected on USGS digital orthographic quarter quadrants (SW Veguita) using ESRI ArcGIS 9.1 (ESRI 2005). Data was entered into Microsoft Excel® and analyzed using Statistix 8.1 software (Statistix 2006). The Linear Models statistic was used to run a Factorial ANOVA for all dependent variables with species as a main effect without interaction, blocking on location.

Figure 2. Vigorous wolfberry plantings with one season's growth.

Results

Of the 561 transplants, 534 plants were located. Based on the survival rate for those plants that were located, total survival for the four species reached 96.3 percent (Table 1). Wolfberry had the highest survival rate (98.4 percent, Fig. 2), followed by New Mexico olive (98.0 percent, Fig. 3), false willow (96.1 percent), and indigobush (88.1 percent).

® Microsoft Excel is a registered trademark of Microsoft Corporation in the United States and/or other countries.

Table 1: Results of summary statistics and ANOVA for Veguita Bridge longstem transplant study.

	Amorpha fruticosa	*Baccharis salicina*	*Forestiera pubescens*	*Lycium torreyi*	Unknown
Percent survival [a] (n = 514) Total survival = 96.3	88.1 (n = 52)	96.1 (n = 49)	98.0 (n = 351)	98.4 (n = 62)	0.006
Percent of all plants (n = 534)	11.1 (n = 59)	9.6 (n = 51)	67.4 (n = 358)	11.9 (n = 63)	0.006 (n = 3)
Average height (inches)	47.5 (n = 16)	46.7 (n = 15)	43.7 (n = 59)	23.4 (n = 9)	tube, no plant
New growth (inches)	13.8 (n = 15)	19.1 (n = 15)	10.5 (n = 59)	8.0 (n = 9)	tube, no plant
Vigor (1−3, 3 highest) [b]	2.12 (n = 17)	2.67 (n = 15)	2.02 (n = 60)	2.33 (n = 9)	tube, no plant
Herbivory (0−3, 3 highest) [c]	0.50 (n = 14)	0.00 (n = 15)	0.52 (n = 60)	0.11 (n = 9)	tube, no plant
Die-off (0−3, 3 highest)	0.75 (n = 16)	0.53 (n = 15)	0.52 (n = 60)	0.33	

a $P = 0.008$

b $P = 0.004$

c $P = 0.011$

Geospatial analysis revealed that dead-top transplants appeared to have a patchy distribution, perhaps relating to drought conditions. The majority of dead-top plants in the southwest site occurred either in open areas close to the river or farthest inland. Those found in clusters near the river may have died due to sandy soil texture over clay that limited their access to water.

The majority of species were of average to above average vigor (86.1 percent, n = 101), experienced no woody die-off (60.0 percent) and no herbivory (65.3 percent). Species effect was statistically significant for survival (P = 0.008, lower survival for *Amorpha*), vigor (P = 0.004, higher vigor for *Baccharis*), and herbivory (P = 0.011, *Baccharis* and *Lycium* with no or lowest herbivory).

Figure 3. New Mexico olive

Discussion

The species that were planted for this study are riparian phreatophytes that require irrigation until their root systems can tap into groundwater and establish healthy root systems and robust above-ground growth. For example, New Mexico olive (which is also adapted to non-riparian habitats) is routinely found in Ponderosa pine (*Pinus ponderosa*) forests that receive from 16- to 18-inches of annual rainfall. Annual precipitation for the study region is 9.2 inches per year (Western Regional Climate Center 2007).

Precipitation was 12.1 percent above average from the time of planting to the end of August 2007 and 2.5 percent below average for the year preceding this study. Currently the region is experiencing a period of climate extremes; July 2007 precipitation was 37.6 percent below average, while August precipitation exceeded the average by 33.9 percent. The majority of August rainfall (86 percent) occurred on just one day at the end of the month. Lower

survival rate for *Amorpha fruticosa*, a species adapted for moist situations, may reflect drought stress as a result of a lowered water table and reduced flow in the Rio Grande.

The high survival rate and vigorous growth indicated by results from the Veguita Bridge study are supported by similar, positive results from the previous four years at other restoration sites where LLPMC has planted longstems (LLPMC 2005) and in Australia (Chalmers et al. 2007). Longstem planting methodology provides a successful means to establish plantings in arid sites with shallow water tables and obviates the need for supplemental watering.

References

Chalmers, A., G. Bakewell, and A. Taggart. 2007. Improved growth and survival of deep-planted long-stem tube-stock within a rainforest edge on the Central Coast of New South Wales: Preliminary results. Ecological Management & Restoration 8(2):151–154.

ESRI. 2005. ArcGIS 9.1. Redlands, CA, Environmental Systems Research Institute, Inc.

Los Lunas Plant Materials Center. 2005. Revegetation treatment results for the Middle Rio Grande fuels reduction study. USDA-NRCS Plant Materials Center, Los Lunas, NM.

Los Lunas Plant Materials Center. 2007. Guidelines for planting longstem transplants for riparian restoration in the Southwest: Deep planting—the ground water connection. USDA-NRCS Plant Materials Center, Los Lunas, NM. URL = http://www.nm.nrcs.usda.gov/news/publications/deep-planting.pdf. Accessed 10 October 2007.

National Plant Board. 2007. National Plant Board State Noxious Weed List. Updated June 2007. URL = http://www.nationalplantboard.org/docs/statenwnew.pdf. Accessed on 10 October 2007.

Statistix. 2006. Statistix 8 user guide, version 1.0. Analytical Software, PO Box 12185, Tallahassee FL 32317 USA. Copyright © 2006 by Analytical Software.

Western Regional Climate Center. 2007. Los Lunas 3 SW weather station, 46-year precipitation record, 1958-August 2007. URL = http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?nm5150. Accessed on 18 September 2007.

Reinkin Bridge South Planting Workshops Demonstration Plantings

Study Numbers: NMPMC-T-0803-RI and NMPMC-T-0804-RI

This planting is the result of three riparian workshops which were held in 2008 on January 30, February 28, and March 12. The Los Lunas Plant Materials Center (LLPMC) has developed two, unique planting methods that were demonstrated during these workshops: 1) Deep-planting of long-stem shrubs, and 2) planting willow whips using electric hammer drills. During a 25 year period, the LLPMC has also refined the methodology of planting cottonwood pole and willow pole cuttings, where successful plantings are now more common than unsuccessful plantings. Because of the LLPMC's development of these two technologies, workshops have been in high demand by local and regional conservationists from Arizona, Colorado, and New Mexico, and have been provided by the LLPMC.

Three workshops, averaging approximately 30 participants per session, were located on the west side of the river about one mile south of the Reinkin Road Bridge in Belen, New Mexico. The site was burned by a wildfire in the spring of 2007. Standing dead cottonwood trees, scorched from the fire, were cut down and were beginning to be removed from the site. However, much of the debris was still on the site at time of the plantings. Exotic woody species such as saltcedar, Russian olive, and Siberian elm also were cut down and removed from the site. For control purposes, stumps of the exotic species were treated with herbicide. A small portion (less than three acres) of the newly treated areas was planted by the workshop participants.

The riparian planting methods developed by the LLPMC involve drilling deep holes (up to eight feet) and connecting stem cuttings or the root systems of plants to groundwater. Root crowns of shrubs are buried deeply, which is contrary to traditional thinking for plant health. The LLPMC has been using the long-stem, deep-planting method for about five years, with plant survival averaging above 80 percent with minimal or no follow-up irrigation. These plantings are done in areas that receive less than 10 inches of annual precipitation. Plant growth is averaging 1- to 3-feet per year, depending on species and location.

Methods

The planting sites consisted of three adjacent sites, each about one-acre in size. GPS coordinates for each site was taken (Table 1). Holes were drilled with a 65-hp farm tractor with a front-end mounted auger (8-ft x 9-inches) by the LLPMC staff. Participants planted shrub rootballs to the depth of capillary water (about 3-feet) and cottonwood pole cuttings to the depth past ground water (about 8-feet). The holes were backfilled so there would be either good soil-to-root or soil-to-stem contact. Poultry wire tree guards that were 5-feet in height an 10-inches in diameter were assembled and installed by participants to protect the cottonwood pole cuttings from beaver, while the shrubs were not protected.

Electric rotary 8.5 amp hammer drills with 36-inch x 1-inch bits were used to drill 30-inch holes on the riverbank. Participants placed the willow whips in the holes past the groundwater level and then backfilled the holes.

Two groundwater monitoring wells were installed by the participants using an 8.5 hp, tripod mounted auger at each workshop. The well casing was composed of a 10-foot x 2-inch scheduled 40 PVC pipe, perforated at the bottom one-third of the pipe and caped at both ends. The casing was driven to the 9-foot depth with a hand- held posthole pounder.

Shrubs species planted as long-stems were New Mexico olive (*Forestiera pubescens*), indigobush (*Amorpha fruticosa*), false willow (*Baccharis salicina*), wolfberry (*lycium torreyi*) golden current (*Ribes aureum*), skunkbush sumac (*Rhus trilobata*), screwbean mesquite (*Prosopis pubescens*) and giant sacaton (*sporobolus wrightii*). Rio Grande cottonwood (*Populus deltoids*) was planted as a pole cutting. Coyote willow (*Salix*

exigua) was planted as a whip cutting. Each shrub was planted with sub irrigation tube composed of a thin wall 40-inch x 1-inch PVC pipe perforated at the bottom one-third of the pipe. If the plants were to become droughty, they would be irrigated through this pipe. This only happens when the watertable drastically drops well below the root system of plants and they are no longer connected to capillary water.

Results

Cottonwoods failed to establish on any of the three sites (Table 1). Shrubs only established on Site One with a 75% survival rate (Figures 1, 2, and 3).

Table 1: Survival of Plants at the Three Sites

Species	**Site 1**		**Site 1**		**Site 2**	
	Alive	**Dead**	**Alive**	**Dead**	**Alive**	**Dead**
New Mexico Olive	6	3		3		9
Indigobush	1	1				11
False willow	1	0				
Wolfberry	111	0		2		
Golden current	1	0				
Skunkbush sumac						1
Screwbean mesquite				1		2
Giant sacaton			1			
Cottonwood		15		15		
% Survival Shrub	75		0		0	
% Survival cottonwood	0		0		0	

Figure 1: Dead cottonwood pole cuttings at Site 1.

Figure 2: Surviving New Mexico olive shrub (right corner) on Site 1.

Figure 3: Wolfberry (foreground) and *baccharis* (center) marked by a 6-inch white PVC pipe.

Figure 4: Site 1 where the plants survived on the slightly raised, cleared areas.

Figure 5: Cottonwood saplings from vegetative root sprouts.

Figure 6: Black willow saplings from vegetative root sprouts.

Figure 7: Established vine mesquite grass protecting soil surface from erosion.

Figure 8: Stiff-stem bulrush (center) and cattails (foreground) occupy a natural swale.

Discharge, cubic feet per second

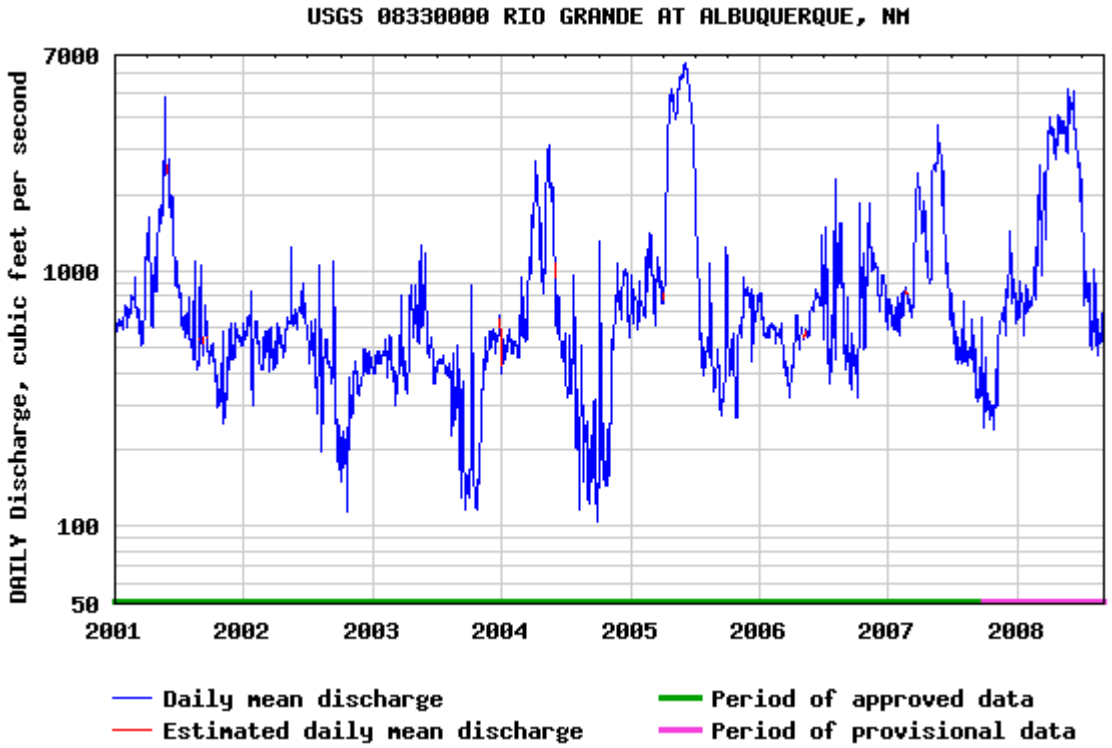

Figure 9: Rio Grande discharge from 2001 - 2008

The poor survival rate of shrubs and trees may be attributed to the higher than normal water table caused by the higher than normal spring runoff in the Rio Grande during the 2008 spring runoff (Figure 9).

At Site 1, where there were surviving plants, is a slightly raised area relative to the planting location (Figure 4). When plant roots become submerged in groundwater for more than 30 days, they often die due to the restriction of root restoration. Even at Site 1, where the plants survived, they seemed to have been stressed because of their lack of growth and some necrosis of leaves. After longstem transplants and cottonwood pole cuttings are established (after the first year) they can withstand much longer periods of this type of inundation. This same poor survival response was observed in the summer of 2005, when the Rio Grande experienced higher than normal spring runoff. Of the 1,000 long-stem shrubs that were planted at the Los Lunas Silvery Minnow Habitat Reconstruction Site in Los Lunas, only about 700 survived. This was an interagency project that involved the LLPMC, the Bureau of Reclamation, the Army Corp of Engineers, and the University of New Mexico. The plants that were lost were mainly located in low areas of standing water for more than a two-month period.

Even though the vegetation planting mainly failed at the site, native riparian vegetation is rapidly reoccupying the entire area (Figures 5 through 8). However, root sprouts of salt cedar and Russian olive are also competing for dominance. The best restoration treatment for this area is the continuation of spot treating with herbicide the non-native pheatophytic species. Because the sites are so wet, the native riparian species are establishing mainly by vegetative reproduction. There does not seem to be any overbank flooding which would provide soil surface

disturbance from deposition and scouring allowing for riparian seedling emergence. However, the native grasses are spreading by rhizomes, and the woody species such as cottonwoods and willows by root sprouting. After a period of eight to ten years when the cleared areas are re-occupied by native vegetation with continued woody exotic species controlled with herbicide, it may be beneficial to plant some various riparian shrub species (i.e. New Mexico olive, golden current, wolfberry, screwbean mesquite) to improve species diversity. Planting long-stem shrub transplants at shallow depths on perched locations should prove successful.

Production of Riparian Plant Materials for the Apache-Sitgreaves National Forests

Study Number:

The Los Lunas Plant Materials Center (LLPMC) was asked to produce riparian plant materials as containerized stock or dormant pole cuttings for the Apache-Sitgreaves National Forests for use in riparian restoration and revegetation activities. This stock was propagated from plant propagules (cuttings or seed) collected within the Forest.

Narrowleaf Cottonwood Dormant Pole Cuttings

Over the past two decades, the LLPMC has installed several narrowleaf production fields. The later pole production fields were installed with cuttings from the original planting installed in the early 1990's. Some of the older fields were removed in the late 1990's and again in 2008 because they were no longer producing numerous, vigorous poles. As of June 1, 2009, there were two fields (32N and 31S) containing eight rows (about 0.5 acre) and approximately 1,000 plants (Figure 1). Two-hundred poles will be of sufficient size to harvest in early 2010.

Figure 1: Narrowleaf cottonwood pole production in Field 31S at the LLPMC (photo taken June 12, 2009)

Arizona Willow Containerized Stock

Approximately 25 Arizona willow stock plants grown from seed have been maintained and have provided micro-cuttings for propagation activities in FY2009. Approximately 200 cutting-propagated tubelings were growing as of June 1, 2009 (Figure 2).

Figure 2: Arizona willow tubelings propagated from micro-cuttings harvested in March 2009 (photo taken June 12, 2009)

Other Willow Species

In 2006, seed of a number of willow species was collected by Carl-Eric Granfelt and was propagated at the LLPMC. The following list describes the species and collection locations:

- Geyer's (*Salix geyeriana*) near McNary, Arizona – 7,300 feet, Porter Spring – 8,500 feet , and West Fork Little Colorado – 9,160 feet
- Pacific (*Salix lucida ssp. lasiandra*) Walnut Creek, Arizona
- strapleaf (*Salix ligulifolia*) Walnut Creek, Arizona
- arroyo (*Salix lasiolepis*) near Flagstaff, Arizona
- bluestem (*Salix irrorata*) Walnut Creek, Arizona
- mountain (*Salix monticola*) West Fork Little Colorado – 9,160 feet

As of June 2009, the number of Apache-Sitgreaves willows in one-gallon treepots at the LLPMC totaled over 1,300 (Figure 3). Approximately 300 willows were propagated from cuttings in March 2009 (Figure 4) and are listed in Table 1.

Figure 3: Mountain willow (background) and Geyer's willow (foreground) in one-gallon treepots (photo taken June 12, 2009)

Figure 4: Apache-Sitgreaves willow tubelings propagated from cuttings harvested in March 2009 (photo taken June 12, 2009)

Table 1: Apache-Sitgreaves National Forests willows at the Los Lunas Plant Materials Center as of June 2009

Common Name	Species	Origin and Elevation	No. of One-Gallon Treepots	No. of Tubelings Propagated in FY 2009
Geyer's	*Salix geyeriana*	McNary – 7,300 feet	150	
Geyer's	*Salix geyeriana*	Porter Spring – 8,500 feet	360	25
Geyer's	*Salix geyeriana*	West Fork Little Colorado – 9,160 ft	90	
Pacific	*Salix lucida ssp. lasiandra*	Walnut Creek	210	60
strapleaf	*Salix ligulifolia*	Walnut Creek		60
arroyo	*Salix lasiolepis*	Flagstaff	440	70
bluestem (or dewystem)	*Salix irrorata*	Walnut Creek	220	
mountain (or park willow)	*Salix monticola*	West Fork Little Colorado – 9,160 ft	220	85
Bebb's	*Salix bebbiana*	Los Burros and Lookout Pasture	480	
Total			**1360**	**300**

Seed Production and Source-Identified Germplasm Release of Upland Grass Species from the Apache-Sitgreaves National Forest

Study Number:

The purpose of this project is to develop new, native plant materials for use in Southwestern site restoration and rehabilitation, especially following wildfire, prescribed fire, and watershed restoration. Grass seed sources are being developed from wildland collections ranging in elevation from 6,100 to 10,500 feet and representing piñon/juniper woodland, ponderosa pine forest, and mixed conifer forest types. The intent is for the Los Lunas Plant Materials Center (LLPMC) to develop source-identified, germplasm releases that will be made available to commercial seed growers in the Southwest. The goal is to eventually produce a sufficient amount of seed for large-scale rehabilitation and restoration projects

Seed Collection, Seed Cleaning, and Plug Seedling Propagation

The Apache-Sitgreaves National Forest developed a list of preferred grass species for release development that span forest types from piñon/juniper to mixed conifer. With input from United States Department of Agriculture Forest Service (USDA-FS) personnel regarding potential collection sites, Mel Wilhelm of 3C Consulting, Vernon, Arizona collected the seed in both 2006 and 2007. The collected seed was sent to the LLPMC for cleaning, producing plug seedlings, and installing the seedlings into production fields.

Tables 1A and 1B present information about:

- Seed collection locations for 2006 and 2007
- LLPMC accession number assignment
- Cleaned seed weight

These seed were used to produce plug seedlings for planting in the seed production fields. Plugs trays with 341 cells (each cell measuring ¾”x ¾” x 2½”) were filled with a sphagnum peat moss/perlite media. The media incorporated micro-pellet, controlled-release fertilizer that provides major and minor nutrients. The seed was sown by diluting it with 1 cup of media and then dispersing it through a large, mesh, soil sieve to achieve uniform seed distribution. The seeded plug trays were placed in the greenhouse on a bench under micro-sprinklers that automatically watered them daily for five minutes. After germination and initial seedling growth, the plug trays were set on mesh flats to allow air pruning of the roots. The trays were watered once per day and were fertilized with a balanced, soluble, nutrient solution several times a week. Several weeks before planting the seedlings into the field, they were placed in the nursery to harden off.

Seed Production Field Planting

When the plug seedlings had developed cohesive root balls, they were installed using a mechanical, vegetable transplanter with two people manually feeding plugs into the planter (see Figure 1). The rows were spaced 38 inches apart and the plugs were placed approximately 12 inches apart in each row. Following the transplanting process, each row was sprayed with water from a water trailer. Once the entire field was planted, it was flood irrigated.

Figure 1: Mechanical, vegetable transplanter used for planting grass plug seedlings.

Table 2-A delineates the field planting information for each species planted in 2007, 2008, and 2009.

2007 Plantings

The only grasses that produced a significant amount of seed in 2007 were the blue grama (5 lbs bulk, 3.6 lbs PLS) and wolftail (28 lbs bulk). A small amount of spike muhly seed with deergrass seed contamination was also harvested and cleaned (36 g bulk) as well as galleta (0.46 lb); these seed lots were too small to submit for seed testing.

2008 Plantings

The 2008 plantings included:

- Transplanting two rows of large deergrass clumps that were present as contaminants in the spike muhly field.
- Plug-planting two new rows of weeping brome.
- Plug-planting three and one-half new rows of Arizona fescue.
- Plug-planting eleven new rows of Thurber fescue.

The seedheads produced in the brome field in the early summer of 2008 did not appear to be mountain brome. Mitchel White of the Apache-Sitgreaves National Forests identified the brome to be weeping brome; so all information pertaining to this accession has been changed accordingly. During the winter of 2008, Mitchel White identified the spike muhly contaminant to be deergrass (*Muhlenbergia rigens*). After receiving the go-ahead from the Forest, we proceeded to transplant deergrass clumps from the spike muhly field into an adjacent plot which will become a deergrass seed production field.

The seed harvest in 2008 yielded the following amounts:

- Blue grama – 0.9 lbs – no seed test performed
- Wolfstail – 28.1 lbs – 72% purity and 53% germination (7% dormant seed)
- Spike muhly – 5.2 lbs – 95% purity and 92% germination (1% dormant seed).

2009 Plantings

The galleta field was completed by installing plug seedlings in June 2009 grown from seed that was collected in 2008. A total of 11.5 new rows were added for a total of 13 rows. Also during the summer of 2009, the weeping brome and Arizona fescue were harvested.

Figures 2 through 10 show the field plantings installed in 2007, 2008 and 2009. The photos were taken in the middle of June 2008 or in early September 2009.

Figure 2: Wolftail (Four Bar Mesa) seed production Field 33N. Seedlings planted on June 14, 2007; photo taken September 2, 2009.

Figure 3: Blue grama seed production Field 33N. Seedlings planted on June 14, 2007; photo taken on September 2, 2009. Left four rows Four Bar Mesa and right four rows Town Draw.

Figure 4: Spike muhly (Sky Hi Road Trailhead) seed production Field 14. Seedlings planted on July 10, 2007; photo taken on September 2, 2009.

Figure 5: Galleta (Town Draw) seed production Field 33N comprising 13 rows. Left 2 rows of seedlings planted on June 14, 2007, the other rows planted in June 2009; photo taken on September 2, 2009

Figure 6: Weeping brome (Beehive Spring) seed production Field 13 Seedlings planted on September 10, 2007. Photo taken on July 15, 2008. Additional plugs planted September 3, 2008.

Figure 7: Weeping brome on September 2, 2009 showing poor stand of plants installed in 2007on the right. The left 2 rows were planted on September 3, 2008.

Figure 8: Arizona fescue (Greens Peak) seed production Field 33N. Seedlings planted on September 10, 2007. Photo taken on June 12, 2009.

Figure 9: Deergrass (Sky Hi Road Trailhead) seed production Field 14. One-year-old plants transplanted on May 12, 2008; photo taken on September 2, 2009.

Figure 10: Thurber fescue (Escudilla Mtn.) seed production Field 23N. Three rows on extreme left planted on 9/25/07. Remaining eleven rows planted on August 12, 2008; photo taken on September 2, 2009.

Future Plans

To date, the future plans for the following species are uncertain:

- Mountain muhly – This species is the only warm-season grass struggling to make vigorous growth. Its performance has been so poor that this production field will be removed in the fall of 2009.
- Thurber fescue – It had good, early, vegetative growth, but when high temperatures started in July, it began to look stressed and has since gone dormant. If Thurber fescue does not produce a significant number of seedheads in the spring of 2010, we also will remove this field.
- Weeping brome – The stand is declining rapidly and probably should be removed.
- Deergrass – We hope to get viable seed off the deergrass field in 2009 to allow us to complete the deergrass field in 2010.
- Arizona fescue – The yield and quality of the Arizona fescue seed will determine whether this cool-season grass can perform adequately in our environment, or whether this field also should be removed.

Table 1-A: 2006 and 2007 seed collection information provided by Mel Wilhelm of 3C Consulting, Vernon, AZ. Collection number, LLPMC accession number, collection date, ranger district, and elevation.

Genus	Species	Wilhelm Collection Number	LLPMC Accession Number	Collection Date	Ranger District	Elevation
2006 Collections						
Festuca	*thurberi*	W-1	9066725	9/29/06	Alpine	10,480
Pleuraphis	*jamesii*	W-2	9066724	10/11/06	Black Mesa	6,100
Bouteloua	*gracilis*	W-3	9066721	10/11/06	Black Mesa	6,100
Bouteloua	*gracilis*	W-4	9066722	10/19/06	Lakeside	6,700
Muhlenbergia	*wrightii*	W-5	9066726	10/19/06	Lakeside	7,100
Bouteloua	*gracilis*	W-6	9066723	10/20/06	Clifton	6,400
Lycurus	*setosus*	W-7	9066720	10/20/06	Clifton	6,400
Muhlenbergia	*montana*	W-8	9066727	10/20/06	Alpine	8,100
Festuca	*arizonica*	W-9	9066728	10/21/06	Springerville	9,500
Bromus	*frondosus*	W-10	9066729	10/21/06	Springerville	9,500
2007 Collections						
Festuca	*thurberi*	W-1	9066725	9/29/07	Alpine	10,480
Festuca	*arizonica*	W-9	9066728	10/27/07	Springerville	9,500
Bromus	*frondosus*	W-10	9066729	10/27/07	Springerville	9,500

Table 1-B: 2006 and 2007 seed collection information provided by Mel Wilhelm of 3C Consulting, Vernon, AZ. Township, range, section and quarter section, location description, associated species, soil type, and weight of cleaned seed.

Genus	Species	TP	RG	Section and Quarter	Location	Assoc. Species	Soil	Cleaned Seed Wt. (g)
2006 Collections								
Festuca	*thurberi*	7N	31E	Sec. 31 SW	Bead Spring Meadow, Escudilla Mtn.	MUMO, FEAR, BRMA,IRMI, Achillea	Red silty loam, eastern aspect	14.6
Pleuraphis	*jamesii*	14N	20E	Sec. 21 NW	Town Draw Area	BOGR, ATCA, SPAI, SPCR	Derived from rim gravels	3.3 caryopsis
Bouteloua	*gracilis*	14N	20E	Sec.20 NE	Town Draw Area	ATCA, GUSA, JUMO	Gravelly silt	38.4
Bouteloua	*gracilis*	9N	23E	Sec. 23 NE	Ranger District Horse Pasture	BLTR, ELEL, PIPO, JUDE	Clay with surface rock	21.0
Muhlenbergia	*wrightii*	9N	23E	Sec. 34 NW	Sky Hi Road Trailhead	IRMI, FEAR, PIPO	Silty clay, upland meadow	15.6
Bouteloua	*gracilis*	1S	29E	Sec. 34 SW	Four Bar Mesa	BOCU, LEDU, PAOB, PIED, JUDE	Granitic soil	11.1
Lycurus	*setosus*	1S	29E	Sec. 34 SW	Four Bar Mesa	BOCU, LEDU, PAOB, PIED, JUDE	Granitic soil	19.7
Muhlenbergia	*montana*	5N	30E	Sec. 6 NW	FR 249 to Big Lake	BLTR, MUWR, ELEL, POTR, PIPO	Volcanic origin, upland meadow	26.9
Festuca	*arizonica*	8N	26E	Sec. 2 SW	East Side of Greens Peak FR 117	BRMA, MUMO, POTR	Volcanic origin, upland meadow	39.7
Bromus	*frondosus*	8N	26E	Sec 25 NE	Beehive Spring FR 117	FEAR, MUMO, POTR	Upland meadow	22.1
2007 Collections								
Festuca	*thurberi*	7N	31E	Sec. 31 SW	Bead Spring Meadow, Escudilla Mtn.	MUMO, FEAR, BRMA,IRMI, Achillea	Red silty loam, eastern aspect	600
Festuca	*arizonica*	8N	26E	Sec. 2 SW	East Side of Greens Peak FR 117	BRMA, MUMO, POTR	Volcanic origin, upland meadow	29.9
Bromus	*frondosus*	8N	26E	Sec 25 NE	Beehive Spring FR 117	FEAR, MUMO, POTR	Upland meadow	14.2

Table 2-A: Apache-Sitgreaves National Forest grass species planted into seed fields at the Los Lunas Plant Materials Center in 2007, 2008, and 2009.

Common Name	Species	Number of Rows	Field Size (acre)	Accession Number	Collection Location	Date of Final Plug Seedling Planting	LLPMC Field
Wolftail	*Lycurus setosus*	12	0.28	9066270	Four Bar Mesa	6/14/07	33N (west end)
Blue Grama	*Bouteloua gracilis*	4	0.09	9066722	Horse Pasture	6/14/07	33N (west group)
Blue Grama	*Bouteloua gracilis*	4	0.09	9066723	Four Bar Mesa	6/14/07	33N (middle group
Blue Grama	*Bouteloua gracilis*	4	0.09	9066721	Town Draw	6/14/07	33N (east group)
Galleta	*Pleuraphis jamesii*	13	0.30	9066724	Town Draw	June 2009	33N
Spike Muhly	*Muhlenbergia wrightii*	15	0.24	9066726	Sky Hi Road Trailhead	7/10/07	14
Mountain Muhly	*Muhlenbergia montana*	9	0.19	9066727	FR 249 to Big Lake	7/17/07	6
Weeping Brome	*Bromus frondosus*	10	0.22	9066729	Beehive Spring	9/3/08	13
Arizona Fescue	*Festuca arizonica*	10.5	0.23	9066728	Greens Peak	9/3/08	33N (east end)
Thurber Fescue	*Festuca thurberi*	14	0.30	9066725	Bead Spring Meadow	8/12/08	23N
Deergrass	*Muhlenbergia rigens*	2	0.03	9066740	Sky Hi Road Trailhead	5/12/08 (Clumps)	14

Plant Materials Development and Production Activities New Mexico USDI-Bureau of Land Management

Study Number:

The agreement between the New Mexico USDI-Bureau of Land Management (BLM**)** and the USDA–Natural Resources Conservation Service (NRCS) Los Lunas Plant Materials Center (LLPMC) was authorized in 2009 to expand the plant materials development and production activity at the LLPMC. This activity involved the maintenance of a desert needlegrass seed production field of a San Juan Basin ecotype that was installed in 2008.

The activities authorized in previous fiscal years and continuing through FY 2009 include:

- Maintenance of a bluebunch wheatgrass seed production field with the objective of releasing a selected germplasm ecotype from the San Juan Basin for use in mule deer habitat improvement and for reseeding after cheatgrass eradication.
- Production and maintenance of four ecotypes of sand bluestem from eastern New Mexico in 30-inch tallpots and 14-inch Deepots for evaluation of outplanting success in lesser prairie chicken habitat.
- Maintenance of two-gallon longstem transplants and a pole production block of Fremont cottonwood propagated from seed collected along the Rio Puerco, Sandoval County.
- Production of 750 plant material units per year of tree and shrub poles or transplants primarily intended for riparian restoration.

Other unfunded activities related to BLM programs included experimental germination trials of pointleaf manzanita collected by BLM personnel at the Kashe-Katuwe Tent Rocks National Monument.

Seed Production of Desert Needlegrass

Seed of desert needlegrass, *Achnatherum speciosum* (Trin. & Rupr.) Barkworth, was collected in the Hogbacks region of the San Juan Basin from 1994 through 1996 and entered as LLPMC accession 9066330. The seed from all collections was mixed, and small transplants were grown in 1997. These transplants were installed in Field 35N at the LLPMC. Seed was collected from the surviving plants (see Figure 1) until 2008. Long-term survival under LLPMC growing conditions was the primary selection criteria.

Figure 1: Mature desert needlegrass (Acc. 9066330) plants in Field 35N at the Los Lunas Plant Materials Center. Photo taken on May 15, 2007.

The seed used to establish the BLM seed production field in 2008 came from the 2006 harvest when the parent plants were approximately nine years old (see Figure 1). When the plug seedlings had developed cohesive root balls, they were installed using a mechanical, vegetable transplanter with two people manually feeding plugs into the planter (see Figure 4). The 10 rows (0.21 acre) of desert needlegrass plugs were planted in Field 23N on August 12, 2008 (see Figure 2).

Figure 2: Desert needlegrass seed production field planted with plug seedlings August 12, 2008. Photo was taken on September 2, 2009.

During FY 2009, the seed production field was irrigated nine times including once in January due to the dry winter. Weed control included mechanical cultivation, hand hoeing, and application of pre-emergent herbicide. The field was also fertilized during FY 2009.

Bluebunch Wheatgrass Seed Production

In 1997, a bluebunch wheatgrass (*Pseudoroegneria spicata* (Pursh) A. Löve) collection (Accession 9066431) was made in the San Juan Basin. These seed were grown as small transplants and installed in Field 35N at the LLPMC. Seed was collected from the surviving plants (see Figure 3) until 2008. Long-term survival under LLPMC growing conditions was the primary selection criteria. The seed used to establish the BLM seed production field in 2008 came from the 2006 harvest when the parent plants were approximately nine years old.

This seed was used to produce plug seedlings for planting in the seed production fields. Plugs trays with 341 cells (each cell measuring ¾”x ¾” x 2½”) were filled with a sphagnum peat moss/perlite media. The media incorporated a micro-pellet, controlled-release fertilizer that provided major and minor nutrients. Because a late-summer planting is advantageous for cool-season, grass-plug plantings, the seed was sown on July 24, 2008.

Figure 3: Mature bluebunch wheatgrass (Acc. 9066431) plants in Field 35N at the Los Lunas Plant Materials Center. Photo taken on June 1, 2007.

The 2006 seed was sown by diluting two volume ounces of seed with one cup of media, and then dispersing it through a large, mesh, soil sieve to achieve uniform seed distribution. The seeded plug trays were placed in the greenhouse on a bench under micro-sprinklers that automatically watered them daily for five minutes. After germination and initial seedling growth, the plug trays were set on mesh flats to allow air pruning of the roots. The trays were watered once per day and were fertilized with a balanced, soluble, nutrient solution several times a week. Several weeks before planting the seedlings into the field, they were placed in the nursery to harden off.

When the plug seedlings had developed cohesive root balls, they were installed using a mechanical, vegetable transplanter with two people manually feeding plugs into the planter (see Figure 4). The 13 rows (0.28 acres) of bluebunch wheatgrass plugs were planted in Field 35N on September 25, 2008 (see Figure 5). The rows were spaced 38-inches apart, and the plugs were placed approximately 12-inches apart in each row.

As the plugs were being installed, each row was sprayed with water from a water trailer. Once the entire field was planted, it was flood irrigated.

Figure 4: Mechanical transplanter used for planting grass plug seedlings.

During FY 2009, the seed production field was irrigated 13 times including once in January due to the dry winter. Weed control included mechanical cultivation, hand hoeing, and application of a pre-emergent herbicide. The field was also fertilized during FY 2009.

Figure 5: Bluebunch wheatgrass seed production field planted with plug seedlings on September 25, 2008. Photo taken on September 2, 2009.

Sand Bluestem Tallpots and Deepots

Because of losses of tallpot sand bluestem plants during the late summer of 2008, additional sand bluestem seed of four BLM accessions (ANHA-SOSNM-930-074-08, -075-08 -076-08, and -077-08) was delivered to the LLPMC. One plug flat of each accession was sown during the late winter of 2009. After germination and initial seedling growth, the plug trays were set on mesh flats to allow air pruning of the roots.

In March 2009, the plugs were transplanted into D60 Deepots (2 ½" in diameter x 14" tall, 60 cubic inch) filled with the nursery canning mix of composted wood chips and bark, pumice and peat moss, and top-dressed with 5 grams of a three-month, controlled-release fertilizer (see Figure 6).

Figure 6: Sand bluestem transplants growing at the Los Lunas Plant Materials Center.

In early March 2009, the 80 most vigorous 2008 plants of each accession in D60's were transplanted into 30-inch tallpots (4" x 4" x 30" tall) to replenish the tallpot inventory resulting from die-off in 2008. On September 1, 2009, 390 tallpots and 400 D60's as well as 98 SuperCell plants were picked up by BLM for outplanting.

Fremont Cottonwood – Collecting Seed, Producing Transplants, and Installing a Pole-Cutting Block

Fremont cottonwood seed was collected by Bret O'Haver from the Rio Puerco near Cuba, New Mexico, and delivered to the LLPMC on June 27, 2005. The seed was cleaned and sown into containers filled with a sphagnum peat moss/perlite media. The container volume was 10 cubic inches.

In the late spring of 2006, about 300 seedlings were transplanted into two-gallon treepots containing a nursery canning mix of composted bark, pumice, and peat moss. After transplanting, the pots were top-dressed with 30 grams of a controlled-release fertilizer and then again in the spring of 2007 and 2008. The pots were watered daily in the summer and once a week in the winter. Figure 7 shows the two-gallon treepots with stem heights up to 6–7 feet as of September 2, 2009. Approximately 160 treepots (100 were rated good or better) were alive in September 2009.

Figure 7: Two-gallon treepot stock of Rio Puerco Fremont cottonwood on September 2, 2009.

During the summer of 2006, the most vigorous 150 of the 10-cubic-inch seedlings were transplanted into a pole production block measuring 300-feet long in Field 31N. Figure 8 shows the pole production block of the Rio Puerco Fremont cottonwood as of September 2, 2009.

Figure 8: Pole production block of Rio Puerco Fremont cottonwood in Field 31N as of September 2, 2009.

During the 2009 growing season, the pole production block was flood irrigated every three weeks, fertilized with nitrogen twice per year, and fertilized with phosphorous once per year. As needed, the pole production block was cultivated, hand weeded, and sprayed for cottonwood leaf beetle.

Some dormant cottonwood pole cuttings (approximately 12-13 feet in length) will be available during the winter of 2009−2010.

Pointleaf Manzanita − Seed Germination Trials

The seed germination of *Arctostaphylos* species is always problematic. The LLPMC proposed to the New Mexico BLM to investigate seed germination treatments to allow the routine production of seedlings of pointleaf manzanita (*Arctostaphylos pungens*) from the Kashe-Katuwe Tent Rocks National Monument.

A number of seed treatments were performed including a control with warm, moist stratification, smoke and char, acid scarification, and burning. Following treatment, the seed was cold stratified (35° to 40°F) for three months and then sown in individual replicated containers for each treatment and seed size. After three months in a warm greenhouse, germination had not occurred in any of the treated seed. The containers were then put back into cold stratification for an additional three month cold treatment. The seed will remain cold stratification until September 2009 when it will be placed in the greenhouse.

Distribution of Plant Materials to the BLM

During FY 2009, the following plant materials were picked up by BLM personnel:

30-inch tallpots	45
Two-gallon treepots	30
Longstem one-gallon treepots	130
Regular one-gallon treepots	45
Poles	135
Whips	100

Cibola National Forest
Production of Riparian Plant Materials for Watershed and Ecosystem Restoration Projects

The purpose of this project is to establish a plant materials source for native riparian trees and shrubs at the USDA-NRCS Los Lunas Plant Materials Center (LLPMC). These plant materials are ecotypes indigenous to areas undergoing watershed and ecosystem restoration within the Cibola National Forest including the Canadian River Salt Cedar Eradication Project and the Tajique Watershed Restoration Project.

The LLPMC is producing containerized plant materials of tree, shrub and wetland species from seed collected by US Forest Service personnel. Some of the seedlings produced were installed in pole production plantations at the LLPMC to provide a long-term source of dormant pole cuttings.

Seedling and Transplant Production

The US Forest Service personnel collected seed from the Canadian River watershed (Perico Creek, Seneca Creek, and Mills Canyon). Table 1 shows the species collected, the origin of the seed, and the collection and transplant dates.

Table 1: Species in Production for Cibola National Forest

Species	Origin	Collection Date	Transplant Dates
cottonwood	Mills Canyon, Perico Creek, Canadian River watershed	June 2005 June 2006	Summer 2006, Summer 2007
Peachleaf willow	Mills Canyon, Seneca Creek, Perico Creek, Canadian River Watershed	June 2005 June 2006 June 2007	Summer 2006, Summer 2007
Coyote willow	Mills Canyon, Perico Creek, Canadian River watershed	June 2005 June 2006 June 2007	Summer 2006, Summer 2007
Fivepetal cliffbush or waxflower	Red Canyon, Manzano Mountains	Fall 2005	Spring 2006
Chokecherry	Mills Canyon, Canadian River watershed	2005	2006, 2007

Cottonwood, Peachleaf Willow, Coyote Willow, and Chokecherry Seedling and Transplant Production

2005 – 2006

Cottonwood, peachleaf willow, and coyote willow seed was shipped to the LLPMC in late June of 2005. These seeds were propagated in 2005, and during the summer of 2006, the seedlings were transplanted into one-gallon treepots (Figures 1 and 2 show their appearance in late summer 2009).

Figure 1: Blocks of Mills Canyon cottonwood (left) and coyote willow (right) in one-gallon treepots propagated from seed collected in 2005. The average stem length is approximately 7-8 feet (photo taken on September 2, 2009).

Figure 2: Block of Mills Canyon peachleaf willow in one-gallon treepots propagated from seed collected in 2005. The average stem length is approximately 6 feet (photo taken on September 2, 2009).

In June 2006, additional cottonwood, peachleaf and coyote willow seed was collected and sent to the LLPMC. Because the coyote and peachleaf willow seed was not viable, we took cuttings in the spring of 2007 from the one-gallon treepots that were started in 2005 in order to increase the numbers of these species.

However, the cottonwood seed from the Mills Canyon area (including a collection labeled “short raceme variety”) was sufficient to propagate approximately 500 seedlings in Super Cell containers (10-cubic-inch).

2007 – 2008

The coyote and peachleaf willow seed we received in the summer of 2007 had very poor viability, but the seed numbers were sufficient to produce a few hundred seedlings of peachleaf willow and perhaps 50 seedlings of coyote willow.

In the summer of 2007, we transplanted approximately 320 cottonwood, 200 coyote willow, and 100 peachleaf willow into one-gallon treepots. We also transplanted about 300 chokecherry that had been started in 2005.

In the spring of 2008, peachleaf willow, coyote willow, and cottonwood cuttings were taken from the Mills Canyon ecotype pole plantations and placed into Super Cell containers.

In the late spring and early summer of 2008, Super Cell 2007 seedlings and 2008 cuttings were transplanted into one-gallon treepots. Altogether approximately 800 Super Cell plants were propagated.

Fivepetal Cliffbush Seedling and Transplant Production

Fivepetal cliffbush or waxflower (*Jamesia americana*) seed was collected in the fall of 2005 from Red Canyon in the Manzano Mountains. The seed was cleaned and cold stratified. In the spring of 2006, we propagated approximately 200 Super Cells. Most of the fivepetal cliffbush seedlings did not survive the winter of 2006-2007. In addition, some mortality was noted in the late spring of 2007 that necessitated moving the remaining plants under shade to try to ameliorate the growing environment for these shade-tolerant, montane shrubs. Very few plants succumbed after they were moved. About 50 plants remained alive at the end of August 2007.

In May 2008, fivepetal cliffbush seedlings were transplanted into Super Cell containers. In 2009, additional fivepetal cliffbush seed was germinated to increase the eventual inventory of one-gallon treepot stock (fivepetal cliffbush seedlings are shown in Figure 3).

Figure 3: Block of *Jamesia americana* (fivepetal cliffbush) in Super Cell (10-cubic-inch) containers propagated from seed in 2009 and slated for transplanting in 2010 into one-gallon treepots (photo taken on September 2, 2009).

FY 2009 Principal Activities

The following principal activities took place during FY 2009:

- Propagating 400 peachleaf willow from cuttings taken from the best performing plants in the LLPMC pole production plantation.
- Propagating 150 cliffbush (waxflower) seedlings from the original seedlot.
- Transplanting 500 cuttings and seedlings into one gallon treepots.
- Maintaining over 2000 one-gallon treepots produced in prior years.

Table 2 lists the estimated Cibola National Forest plant materials inventory (as of September 2009) of chokecherry, willows, and cottonwoods in one-gallon treepots. Fivepetal cliffbush are in one-gallon treepots and Super Cells.

Table 2: 2009 Estimated Plant Materials Inventory for Cibola National Forest

Species	Size	Stem Height (ft)	Number	Species Total Number
Chokecherry	Large	4 – 6	50	
	Medium	2 - 3	50	
	Small	0.5 - 2	100	200
Peachleaf willow	Large	5 - 7	200	
	Medium	2 - 4	300	900
	Small	1 - 2	400	
Coyote willow	Large	5 - 7	300	
	Medium	3 - 5	200	500
Cottonwood	Large	5 - 7	300	
	Medium	3 - 4	340	
	Small	2 - 3	80	720
Fivepetal cliffbush	Medium	2 - 3	30	
	Small	0 - 1	150 Supercells	180
Total				**2,500**

Many cottonwood and willow plants (approximately 1,500) were ready for outplanting by the fall of 2009 based on root ball integrity. Substantial numbers of long-stem stock (approximately 850) with stem lengths greater than six feet are available for most species; these plants have sufficient stem lengths to enable planting in holes four feet or deeper. This planting method will allow the rootball to reach the capillary fringe in areas with deeper water tables.

Installation of Pole Production Plantations

In mid-July 2006, we transplanted Super Cell seedlings into flood irrigated fields for the eventual production of dormant pole cuttings. We installed a total of 14 rows, each 300-foot in length and containing approximately 150 plants per row.

The field was prepared using the following steps:

1. Discing.
2. Laser-leveling.
3. Ripping with a single shank ripper to breakup any hardpan in the planting row.

4. Installing 3-foot wide ground cover fabric to serve as a weed barrier.
5. Irrigating one day before planting.
6. Auguring planting holes at least 12 inches deep.
7. Applying 5 grams of 17-6-12 controlled release fertilizer in each hole.
8. Inserting the seedling, backfilling with sufficient soil to fill all voids, and irrigating again.

The pole and whip production plantations include:

- Peachleaf willow (Seneca Creek seed source) two rows of 150 plants per row.
- Peachleaf willow (Perico Creek seed source) four rows of 150 plants per row.
- Cottonwood (Perico Creek seed source) seven rows of 150 plants per row.
- Coyote willow (Perico Creek seed source) one row of 100 plants.

FY 2009 Pole Production Plantation Activities

The plantation fields were cultivated, hand weeded, sprayed for cottonwood leaf beetle, fertilized, and flood irrigated every three weeks during the 2009 growing season. The plantation fields for coyote willow, cottonwood, and peachleaf willow are shown in Figures 4, 5, and 6.

Approximately 400 to 500 dormant cottonwood poles (approximately 12- to 18-feet in length) will be available during the winter of 2009-2010. Dormant whip cuttings (5- to 8-feet in length) of peachleaf willow (100 to 200 whips) and coyote willow (100 to 200 whips) will also be available during the winter of 2009–2010.

Figure 4: Coyote willow field planting for dormant whip cutting production (photo taken on September 2, 2009) in Field 6 at the LLPMC.

Figure 5: Cottonwood pole production for Mills Canyon in Field 33S at the LLPMC (September 2, 2009). Some cottonwood stems are approaching 18 feet. Note shovel handle for scale.

Figure 6: Peachleaf willow pole production for Mills Canyon in Field 33S at the LLPMC (September 2, 2009). Note the shovel handle for scale.

Headquarters, United States Army Garrison Fort Bliss, Texas Seed Production and Source-Identified Germplasm Release of Mesa Dropseed and Spike Dropseed from Fort Bliss

Interagency Agreement: FB#W6CLAA-08024-MOA 111R

In managing military training lands, enhancing these assets for current training missions, and conserving them for future training, Fort Bliss has a need to preserve the native plant resources and revegetate these assets for training requirements. Fort Bliss requires that restoration of native plants will be accomplished using germplasm from populations as closely related genetically and ecologically as possible to the existing populations on the military training lands. This is being accomplished through the Army's Integrated Training Area Management (ITAM) program, and through the Land Rehabilitation and Maintenance (LRAM) portion of the ITAM program.

The intent of this project is for the USDA-NRCS Los Lunas Plant Materials Center (LLPMC) to develop source-identified, germplasm releases that will be made available to commercial seed growers in the Southwest. The goal is to eventually produce a sufficient amount of seed for large-scale rehabilitation and restoration projects.

Seed Collection, Seed Cleaning, and Plug Seedling Propagation

The Fort Bliss LRAM staff developed a list of preferred grass species for revegetation purposes on Fort Bliss with an initial emphasis on mesa dropseed (*Sporobolus flexuosus* (Thurb. ex Vasey) Rydb.) and spike dropseed (*Sporobolus contractus* Hitchc.). LRAM personnel collected seed of both species at Fort Bliss during the middle of October 2007. The collected seed was sent to the LLPMC for cleaning, producing plug seedlings, and installing the seedlings into seed production fields.

October 24, 2007 – We cleaned the spike dropseed which yielded 25 grams of cleaned seed.

November 1, 2007 – We cleaned the mesa dropseed which yielded 152 grams of cleaned seed.

We filled plugs trays with a sphagnum peat moss/perlite media. Each plug tray contained 341 cells with each cell measuring ¾"x ¾" x 2½". The media incorporated micro-pellet, controlled-release fertilizer to provide major and minor nutrients. To achieve uniform seed distribution, the seed was sown by diluting it with one cup of media and then dispersing it through a large, mesh, soil sieve.

- Spike dropseed – On April 22, 2007, 20 plug trays (6,800 plugs) of Fort Bliss spike dropseed were sown at a rate of 1 cc of seed per flat.
- Mesa dropseed – May 27, 2008, 45 plug trays (15,000 plugs) of Fort Bliss mesa dropseed were sown at a rate of 3 cc of seed per flat.

The seeded plug trays were placed on a greenhouse bench under micro-sprinklers that automatically watered them daily for five minutes. After germination and initial seedling growth, the plug trays were set on mesh flats to allow air pruning of the roots. The trays were watered once per day and were fertilized with a balanced, soluble, nutrient solution several times a week. Several weeks before transplanting the seedlings into the seed production field, they were placed in the nursery to harden off.

Planting the Seed Production Fields

When the plug seedlings had developed cohesive root balls, they were planted using a mechanical, vegetable transplanter with two people manually feeding plugs into the transplanter (see Figure 1). The rows were spaced 38 inches apart, and the plugs were placed approximately 12 inches apart in each row. As the plugs were being planted, they were watered using a water trailer that sprayed each row. Once the entire field was planted, it was flood irrigated.

Figure 1: Mechanical, vegetable transplanter used to plant grass plug seedlings.

Table 1 describes the details of the plug seedling plantings.

Table 1: Planting the Seedling Plugs at the LLPMC

Species	Planting Date	Field Number	Number of Rows (Field Length)	Total acreage
Spike dropseed	6/20/2008	35N	14 (300 ft.)	0.30 acre
Mesa dropseed	7/8/2008 8/7/2008	25S 34S	43 (265 ft.) 6 (300 ft.)	0.95 acre

Seed Field Maintenance 2008

From June to October 2008, the production seed fields were flood irrigated approximately every three to five weeks. They were also irrigated once during the winter. Weeds present between the rows were removed monthly with a tractor-mounted cultivator with sweeps. Within the rows, weeds were removed by hand hoeing every several weeks. Periodically, the field borders were sprayed with herbicide.

Seed Harvest 2008

Because the plug seedlings were planted in the middle of the growing season, flower development, pollination, and seed maturation were considerably delayed compared with the phenology of an older field.

- **Spike dropseed** – The spike dropseed field was harvested using a forage harvester on November 4, 2008. The uncleaned, harvested material weighed 135 pounds. After cleaning, the bulk seed weight was 14.1 pounds. The New Mexico State Seed Lab determined 95% viable seeds using a tetrazolium staining test.

- **Mesa dropseed** – The mesa dropseed field was harvested using our combine on November 4, 2008. The uncleaned, harvested material weighed 135 pounds. After cleaning, the bulk seed weighed 59.5 pounds. The New Mexico State Seed Lab determined 93% viable seeds using a tetrazolium staining test. Photos of the fields as of late September 2008 are presented in Figures 2 and 3.

Figure 2: Spike dropseed (0.30 acre) planted on June 20, 2008 in Field 35N at the Los Lunas Plant Materials Center (photo taken September 26, 2008).

Figure 3: Mesa dropseed (0.83 acre) planted on July 8, 2008 in Field 25S at the Los Lunas Plant Materials Center (photo taken on September 22, 2008)

Seed Field Maintenance 2009

From January to September 2008, the production seed fields were flood irrigated 5 to 6 times. Weeds present between the rows were removed monthly with a tractor-mounted cultivator with sweeps. Within the rows, weeds were removed by hand hoeing every several weeks. The fields were fertilized in the spring with NPK. Periodically, the field borders were sprayed with herbicide.

Seed Harvest 2009

The spike dropseed field was harvested on August 18, 2009, and the mesa dropseed field was harvested on August 17, 2009. In September, both fields were sending out a second set of seedheads which may mature before frost and allow a second harvest.

Development of Legume *Dalea* for the Gila National Forest for Use in Burn Rehab Seed Mixtures in Southwestern Pinyon/Juniper Communities

The purpose of this project is to test different species of *Dalea* that could establish naturally after burns. The goal is to use these species as burn-rehab species in pinyon/juniper communities in the Southwest, and this will require that they have potential for commercial seed production.

The USDA-NRCS Los Lunas Plant Materials Center (LLPMC) is:

- Evaluating the candidate species for agronomic characteristics that would make them promising for commercial-scale production.
- Producing sufficient quantities of seed for testing as a component in burn-rehab seed mixtures.
- Assessing the palatability and forage value of the species to determine their potential use for wildlife habitats.

The objective is to develop legume releases that will be requested by land managers and can be produced economically by commercial growers. The two species currently being tested are *Dalea albiflora* and *Dalea leporina.*

***Dalea albiflora*−Seed Field**

Ralph Pope and Bruce Anderson from the Gila National Forest collected *Dalea albiflora* seed (whiteflower prairie clover) on October 11, 2006 near the T-Bar-T well on the Bullard Peak burn in the Burro Mountains (T18S R16W NW1/4 Sec. 17). The amount of cleaned seed was one tablespoon (15 cc). After cleaning the *Dalea albiflora* seed, the seed was scarified in a MAT-OSU pneumatic scarifier using sandpaper for two minutes and an air pressure of 20 psi.

March 7, 2007 – Nine flats, each containing 341 plug cells, were sown with approximately 1.5 cc of seed per flat. The plug seedlings then were transplanted into Ray Leach Super Cells (10-cubic-inch) between early- and mid-April. As of late August 2007, the final seedling count was 1,200 with about 1,000 large enough for field planting. On August 27, 2007 seven 300-foot rows were planted with an in-row spacing of two feet in Field 31N at the LLPMC.

October 26, 2007 – We hand-harvested the seedheads from Field 31N, and after drying the seedheads weighed 180 grams. After cleaning, the seed yield was 48 grams with approximately 450 seed per gram. One teaspoon of seed weighs 4.2 grams and has approximately 1,900 to 2,000 seed.

May 28, 2008 − In May 2008, the *Dalea albiflora* seed was scarified in one teaspoon batches in a MAT-OSU pneumatic scarifier using sandpaper for two minutes and an air pressure of 20 psi.

We seeded one row on the east side and one row on the west side of the existing planting in Field 31N. A plot seeder dispersed one tablespoon of seed (approximately 16 grams) per 290-foot row. These rows were irrigated using a water trailer on a daily basis for two weeks until emergence, and then twice a week for a month.

Figure 1 shows the planting as of September 2008. It became apparent in the spring of 2008 that this *Dalea* had begun to spread by root sprouts, a feature not acknowledged in several floras.

Figure 1: *Dalea albiflora* seed production field (Field 31N) in early September 2008.

Figure 2 shows *Dalea albiflora* in bloom in late September 2008.

Figure 2: *Dalea albiflora* plant in flower late September 2008

FY 2009 Activities

The *Dalea albiflora* field was irrigated eight times between January and December 2009, tractor cultivated several times, and hand hoed five times during the growing season.

Dalea leporina−Collecting, Cleaning, and Testing Seed

Ralph Pope collected *Dalea leporina* seed on October 7, 2005 from the edge of the ball fields behind the US Forest Service Office in Silver City, New Mexico. The seed was cleaned by the LLPMC and yielded:

- 41.8 grams of seed greater than 1/18-inch sieve.
- 3.6 grams smaller than 1/18-inch and larger than 1/25-inch.

Many seeds were damaged by an infestation of miniature weevil, and as result, the cleaned seed was treated with Sevin powder to kill any weevils that might emerge from the seed.

June 14, 2006 – We planted *Dalea leporina* plug seedlings in two rows in Field 35N at the LLPMC. The field was flood irrigated twice a week for the first three weeks, and weekly thereafter except during periods of high rainfall.

August 23, 2006 – We conducted a final stand count. The west row had 65 plant units and the east row had 116 plant units; in many instances, more than one plant was in a unit.

October 25, 2006 – The lower stems were severed, and the entire plant was collected using a small-plot forage harvester. The harvested plants were placed into cloth bags and air-dried until January 2007 when seed cleaning began. The total amount of air-dried plant material was 140 pounds. The plants were hammer-milled twice using a ⅜-inch screen. The milled material was cleaned using a fanning mill with a final screen size of 10/64-inch (round-hole diameter). The total, cleaned weight of the seed was 31.9 pounds.

Results from NMDA State Seed Laboratory indicated 99.39% pure seed with 0.57% inert matter and 0.04% weed seed (amaranth). Their germination test was conducted for 21 days at alternating temperatures of 20°C night and 30°C day and completed on June 21, 2007. In that time period, 24% of the seed had germinated with 72% classified as hard seed.

Dalea leporina−Seed Production Field Established by Direct Seeding

On April 19, 2007, we direct-seeded a quarter-acre field of *Dalea leporina* in LLPMC Field 7 (see Figure 3).

Figure 3: 2009 *Dalea leporina* crop Field 7 (seed production field of approximately ¼–acre) on 9/2/09. Note shovel handle for scale.

Each 300-foot row was sown with 30 grams (2 tablespoons) of seed (approximately 10,000 seed). According to our greenhouse germination tests, about 40% were readily germinable; therefore 4,000 germinable seed were sown per row (or about 13 germinable seed per foot). According to NMDA State Seed Laboratory, a germination

percentage of 24% equates the germinable seed as 2,400 per row or eight per foot. The field was flood irrigated twice per week until emergence two weeks later, and then once per week until late June. In July and August 2007, the field was irrigated every 10 to 14 days. Seed harvested in 2007 was tested at the NMDA State Seed Laboratory and had 99.97% purity, 62% germination, and 30% hard seed.

On October 30, 2008, we used our combine to harvest seed from Field 7. We harvested 781 pounds of uncleaned seed and chaff. The cleaned seed weighed 377 pounds. During the winter of 2008-2009, we did not cultivate, disc, or plow Field 7. We irrigated the field in April to see if a sufficient quantity of seed remained on the ground to allow self-sowing. A good stand of seedlings resulted from the late April irrigation. This 2009 crop was managed in a similar fashion as the 2007 and 2008 crop.

Future Plans

Dalea albiflora – The poor performance of *Dalea albiflora* in 2009 precludes its consideration as a viable commercial species. The plants appeared stressed from spring through the entire growing season. A few plants had some vigor, but the agronomic characteristics of this species in our environment are insufficient to consider devoting any additional time to its development. Seed will be collected off the few vigorous plants this fall. These plants will be dug out of the field and potted up to allow preservation of the root system in case their good performance was a result of Rhizobium inoculation.

Dalea leporina **–** Because of the initial success with direct sowing, the expectation is that the cost to commercially produce *Dalea leporina* would be quite reasonable. The high forage quality of this species as shown in earlier progress reports indicates potential wildlife benefits if it can be established as a part of post-fire rehab. Considering the seed yield and ease of establishment of the *Dalea leporina* 2007 and 2008 crops, it should be possible to begin the paperwork to release this species as a selected germplasm release with USDA-NRCS as the primary releasing agency and the US Forest Service and New Mexico State University as secondary releasing agencies for commercial production.

Evaluation of Giant Sacaton for Use in Field Windstrip Plantings

Study Number: NMPMC-P-9801-CP

Background information on the Los Lunas Plant Materials Center's (LLPMC's) evaluation of the native grass species giant sacaton (*Sporobolus wrightii*) can be found in *LLPMC Annual Technical Reports* from 1981 to present and in study number NMPMC-9601-CP. This study details the LLPMC's efforts to develop a selected accession of giant sacaton for a possible plant materials release. The study also details the efforts of producing giant sacaton seed and transplants from advanced plantings grown at the LLPMC.

In 2009, the LLPMC evaluated giant sacaton plantings in Deming, Lordsburg, Jal, and Hobbs, New Mexico and at The Gap, Arizona. A new giant sacaton windstrip planting was installed on farmland near Lordsburg, New Mexico.

NRCS Field Offices in our service area continue to be very interested in using the giant sacaton species for windstrip plantings to control or prevent existing soil erosion on various types of land uses. Distribution and planting of this native species continues to promote the utility of this species for use as a windstrip and further defines its range of adaptability.

Inactive Windstrip Plantings

The following plantings are no longer being evaluated on an annual basis. For background and evaluation information about these plantings, please see the previous *LLPMC Annual Technical Reports*:

- Columbus, New Mexico – Rancho La Frontera
- Tucumcari, New Mexico – Tucumcari Outdoor Classroom
- Isleta, New Mexico – Bernard Lujan
- McIntosh, New Mexico – Schwebach Farm
- Deming, New Mexico – Keeler Farm
- Lovington, New Mexico – Lovington USDA Service Center
- Tatum, New Mexico – Tatum Memorial Cemetery and the Tatum Town Park
- Clayton, New Mexico – Ken Dellinger

2009 Evaluations

Windstrip Planting – Jal, New Mexico

On April 14, 2006, the LLPMC delivered 100 giant sacaton plants to the NRCS Lovington Field Office and the Sureste Resource Conservation and Development Office for a giant sacaton trial windstrip planting in Jal, New Mexico. The windstrip was planted as part of a landscaping project along Third Street in Jal.

Evaluation of this planting was performed on September 22, 2009 for survival and growth rates. The plants appeared to be healthy and vigorous, and had averaged 46 inches in height and 39 inches in width. All of the plants had produced seedheads with an average seed stalk height of 65 inches. Seed stalk production appeared to be less than other sacaton plantings, but several stalks were still observed on each plant. The soil in which this planting was installed appears to have a high salt content because of the white residue on the soil surface. This

may have caused some growth problems. The plants were installed alternately with pine trees along the east side of Third Street. The planting showed a 100 percent survival rate.

The planting site is located in USDA Plant Hardiness Zone 7 (see Attachment 1) at an elevation of 3,700 feet.

An evaluation will be performed in 2010.

Windstrip Planting – Deming, New Mexico

In 2006, approximately 750 giant sacaton transplants were installed adjacent to Highway 180 on the Eddie Diaz property 14 miles northwest of Deming, New Mexico. The trial planting was installed on this site to evaluate its potential in relieving dust problems caused by high winds blowing across Highway 180. This site was once a livestock feedlot and has seen little regeneration of native vegetation since the removal of the livestock.

The giant sacaton windstrip planting does not receive any supplemental irrigation and will have to survive on natural precipitation. The plants were installed along man-made furrows which were constructed to capture water during rainfall events. The plants are spaced at two-foot intervals and as a result, this could hinder the establishment and survival of the planting. The LLPMC recommended five-foot spacing. The limited rainfall in the area coupled with high temperatures should provide vital data on the establishment of giant sacaton windstrips that do not have access to supplemental moisture.

On September 21, 2009, this planting was evaluated for growth and survival rates. All of the plants were alive but in poor condition. The plants had averaged 15 inches in height and 10 inches in width. Approximately 80 percent of the plants had produced seedheads, and average height of the seedhead stalks was 25 inches. The planting did not appear to have received much rainfall in 2009, and the plants had produced only a small amount of forage.

The main concern at this site is the spacing of the plants which may reduce the amount of growth in the planting. The LLPMC recommends that the spacing be changed by removing plants to at least four feet between each plant. The survival of the planting may be in jeopardy if the area continues to receive less than normal rainfall in 2010.

The planting site is located in USDA Plant Hardiness Zone 8 (see Attachment 1) at an elevation of 4,250 feet.

An evaluation will be performed in 2010.

Figure 1: Eddie Diaz Giant Sacaton Windstrip, Deming, New Mexico, September 2009

Windstrip Planting – Milan, New Mexico

Highway 122

See previous *LLPMC Annual Technical Reports* for information on this giant sacaton planting located in Milan, New Mexico.

The planting site is located in USDA Plant Hardiness Zone 6 (see Attachment 1) at an elevation of 6,520 feet.

An evaluation will be performed in 2010.

Windstrip Planting – Espanola, New Mexico

On August 8, 2006, a giant sacaton trial windstrip planting was installed at the Rio Arriba County Rural Event Center just northwest of Espanola on Highway 554. Personnel from the NMSU Rio Arriba County Extension Office, Rio Arriba County, NRCS Espanola Field Office and LLPMC planted 100 giant sacaton transplants into two rows using six-foot spacing. The planting is located along the west side of the Event Center's access road and acts as a visual screen for a property owner next to the Event Center. The planting was installed to provide wind erosion protection along the Event Center. The windstrip will help the LLPMC to evaluate the adaptability of giant sacaton as a windstrip or windbreak species in this area of New Mexico. The planting has a drip irrigation system for supplemental watering.

The planting site is located in USDA Plant Hardiness Zone 6 (see Attachment 1) at an elevation of 5,900 feet.

An evaluation will be performed in 2010.

Windstrip Planting – The Gap, Arizona

In July of 2006, Felix Nez of the Dilkon, Arizona NRCS Field Office contacted the LLPMC for assistance as to the possible use of giant sacaton as wind protection for cropland on the Jesse Willie Farm near The Gap, Arizona. Mr. Willie's farm is located just north of The Gap on Highway 89. He grows dryland vegetable crops and because of the light texture soil in the area, has a severe problem with erosion on his property. Wind erosion during high wind events damages his crops and is eroding the soil at a high rate.

At the request of the Little Colorado River Soil and Water Conservation District, the LLPMC was able to provide 230 giant sacaton plants to Mr. Willie's farm. On August 22, 2006, the giant sacaton transplants were delivered by the LLPMC and installed by Mr. Willie, personnel from the NRCS Dilkon Field Office, The Gap Sub-Office and the LLPMC. The giant sacaton windstrip was installed to help us evaluate its potential in this area of Arizona to reduce wind erosion and possibly water erosion on the dryland farms near The Gap. The windstrip was hand-watered as needed during 2006 and part of 2007 and after that, the windstrip depended upon natural precipitation. This trial planting should provide data on the ability of giant sacaton to be used for windstrips in this area without the use of supplemental irrigation after the first year of establishment.

On October 6, 2009 the windstrip planting was evaluated for growth and survival rates. No plants were lost in 2009. The plants averaged 46 inches in height and 32 inches in width and had produced seedheads with an average height of 70 inches. The plants were healthy and vigorous and produced seed in 2009. The plants did not receive any supplemental water in 2009.

The planting site is located in USDA Plant Hardiness Zone 6 (see Attachment 1) at an elevation of 5,890 feet.

An evaluation will be performed in 2010.

Figure 2: Jesse Willie Farm Giant Sacaton Windstrip, The Gap, Arizona, October 2009

Water Erosion Planting – Hobbs, New Mexico

The Waste Management, Inc. Hobbs Landfill and Transfer Station site was experiencing damage to its slopes as a result of water erosion. The landfill had been closed, and Waste Management, Inc. was in the process of restoring the native vegetation. The landfill had been seeded with a native grass species, and the slopes had been further protected with waddles where the water erosion had occurred. In 2006, the NRCS Lovington Field Office requested assistance from the LLPMC to help revegetate the water-eroded landfill site.

On July 25, 2007, the LLPMC delivered 1,100 giant sacaton transplants to the landfill site. The plants were hand-transplanted by NRCS personnel, Waste Management employees, and several volunteers from local youth organizations. After the installation, the plants were hand-watered. Hand watering continued to be the method of irrigation until the end of the 2007 growing season.

To help increase the protection of the slopes, the giant sacaton transplants were used in conjunction with the waddles to slow the flow of excess water down the slopes. The waddles were placed perpendicular along the slopes of the landfill, and the giant sacaton plants were installed on the upslope side of the waddles.

On September 22, 2009, the planting was evaluated for growth and survival rates. Plant survival was approximately 85 percent. The area appeared to have received a good amount of moisture, and the giant sacaton transplants looked the same as they did during the 2008 evaluation. The foliage averaged 20 inches in height and 14 inches in width. Approximately 20 percent of the plants had produced seed stalks which had produced seed. The giant sacaton foliage vigor was rated only as fair, and growth of the majority of the giant sacaton was fair. The planting relies on natural precipitation. The native grass species previously seeded on the landfill site by Waste Management, Inc. were in excellent condition at the time of evaluation and are providing excellent soil erosion prevention to the landfill area.

The planting site is located in USDA Plant Hardiness Zone 7 (see Attachment 1) at an elevation of 3,600 feet.

An evaluation will be performed in 2010.

Figure 3: Waste Management Inc. Landfill Giant Sacaton Planting, Hobbs, NM, September 2009

Windstrip Plantings –Taos, New Mexico

Tony Benson Ranch

This giant sacaton trial windstrip planting is located west of Taos, New Mexico on the Tony Benson Ranch in Section 4 Township 26N and Range 11E. On July 10, 2008, 300 giant sacaton transplants grown by the LLPMC were installed in a fenced-in plot at the Benson Ranch. The transplants were installed by LLPMC personnel, Taos Field Office personnel, and the foreman of the Benson Ranch. The transplants have been irrigated using a hand-watering system. Mr. Benson would like to use the giant sacaton windstrip for protection around his buildings and other areas on the ranch. The fenced-in area will keep the plants safe from animals. This trial planting of giant sacaton is a continuation of evaluating the adaptability of giant sacaton in different locations in the LLPMC service area.

The planting site is located in USDA Plant Hardiness Zone 5 (see Attachment 1) at an elevation of 7,200 feet.

An evaluation will be performed in 2010.

Steve Trujillo Farm

This giant sacaton trial planting is located on the Steve Trujillo farm in Taos, New Mexico. On July 9, 2008, 150 giant sacaton transplants were installed into an old, abandoned garden plot consisting of native grass and weeds. The planting was installed along a line northwest to southwest in the southeast corner of the field. Mr. Trujillo intends to evaluate the usefulness of giant sacaton for wind protection and as a possible irrigated pasture grass. The planting has received supplemental water from the existing acequia located west of the field.

The planting site is located in USDA Plant Hardiness Zone 5 (see Attachment 1) at an elevation of 6,800 feet.

An evaluation will be performed in 2010.

Taos County Extension Office

This giant sacaton trial planting was installed next to the Taos County Extension Office located in the Juan I. Gonzales building at the Taos County Fairgrounds. On July 9, 2008, thirty-six giant sacaton transplants grown at the LLPMC were planted into an existing, fenced-in, demonstration planting area just east of the office building. The area previously was used by the Taos County Extension Office for planting and drip irrigation trials. The

giant sacaton was irrigated using the existing drip irrigation system. The purpose of this planting is to evaluate the adaptability of giant sacaton at this location.

The planting site is located in USDA Plant Hardiness Zone 5 (see Attachment 1) at an elevation of 6,900 feet.

An evaluation will be performed in 2010.

Bill Anderson

This trial planting was not evaluated in 2009, and it is not known if the plants survived the 2008-2009 winter seasons. Mr. Anderson had installed the giant sacaton transplants into a holding area until he could place them into a windstrip site along his roadway entrance. The plants were being watered by hand from his domestic well. The purpose of the planting is to evaluate the adaptability of giant sacaton at this location.

The planting site is located in USDA Plant Hardiness Zone 5 (see Attachment 1) at an elevation of 8,100 feet.

An evaluation will be performed in 2010.

New Windstrip Planting – Lordsburg, New Mexico

This new giant sacaton windstrip is located on the Joshua Sanchez Farm near Lordsburg, New Mexico. The windstrip was installed to protect Mr. Sanchez's irrigated farmland during the high-wind, soil-erosive period at this site. The Hidalgo Soil and Water Conservation District and the NRCS Lordsburg Field Office participated in this project.

On May 27-28, 2009, 1,900 giant sacaton transplants grown by the LLPMC were delivered and planted on the Sanchez farm. The windstrip was planted in two staggered rows along the west and south boundaries of Mr. Sanchez's cropland to help protect his land and farm roads from blowing soil coming from rangeland adjacent to his farm. The windstrip was planted using two different row spacing measurements: five-feet and six-feet between plants. Our evaluation will determine if there will be any effect on the height or width of the giant sacaton foliage because of the different row spacing measurements.

The giant sacaton planting receives supplemental water from an existing irrigation system used to irrigate the farm. To promote optimum growth of the giant sacaton plants, a drip irrigation system was installed to water the windstrip.

On September 21, 2009, the giant sacaton windstrip planting was evaluated for survival and growth rates. There was a substantial difference in the amount of growth of the transplants:

- West side of the windstrip: The windstrip along the west side of the farm had a limited amount of growth with an average height of 20 inches and an average width of 10 inches and with an approximate survival rate of 95 percent. The seedhead height averaged 40 inches and approximately 30 percent of the plants had produced seed stalks.
- South side of the windstrip: The windstrip along the southern boundary was varied in its amount of growth. The *east half of the southern boundary* averaged 25 inches in height and 16 inches in width with a survival rate of 90 percent. Seedhead height averaged 36 inches, but only 20 percent of the plants had produced seed stalks. The *west half of the southern boundary* averaged 40 inches in height and 30 inches in width and the plants looked healthy and vigorous. This portion of the planting had approximately a 95 percent survival rate. Seedhead height averaged 52 inches, and all of the plants had numerous seed stalks with seed production evident.

It was noted that the west windstrip has Bermuda grass present which could be contributing to the limited growth of the sacaton. If adequate moisture is applied, the giant sacaton will probably be able to overcome the presence of the Bermuda.

The poor amount of growth and seed production in the *east half* of the southern windstrip is probably due to a limited amount of irrigation from the drip system since the planting was installed. The *west half* of the southern

boundary had received an adequate amount of supplemental irrigation which resulted in excellent growth of the giant sacaton plants.

The planting is located in USDA Plant Hardiness Zone 7 (see Attachment 1) at an elevation of 4,275 feet.

An evaluation will be performed in 2010.

Figure 3: Joshua Sanchez Farm, Lordsburg, New Mexico, West Side of the Windstrip Planting, September 2009

Figure 4: Joshua Sanchez Farm, Lordsburg, New Mexico, West Half of the Southern Windstrip, September 2009

Attachment 1 – USDA Plant Hardiness Zones

The USDA Plant Hardiness Zone definitions for this report are:

Zone 5	To –20°F
Zone 6	To –10°F
Zone 7	To 0°F
Zone 8	To 10°F

For an entire list of plant hardiness zones, see *USDA Miscellaneous Publication No. 1475, January 1990*.

‘Tropic’ Sunn Hemp Adaptability Trial

Study Number: NMPMC-T-0901-BF

Background

Sunn hemp (*Crotalaria juncea*) has been touted as a remarkable green manure and cover crop since the 1930’s, 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 the development of cheap fertilizers caused many farmers to abandon the use of this crop. The current rise of energy costs have brought leguminous cover crops back to the forefront for sustainable agriculture production and have led to an increase in efforts to produce sunn hemp for this agricultural practice.

This Los Lunas Plant Materials Center (LLPMC) study is part of a national effort to evaluate the areas of the country where sunn hemp has the potential for use as a green manure and cover crop. Sunn hemp does not produce seed above 28 degrees latitude, and therefore has little chance for it to become weedy. Sunn hemp is a tropical or sub-tropical plant that acts like a summer annual when grown in most of the continental United States. This hemp is adapted to a wide range of soils and has shown superior performance when planted in sandy soils. As a cover crop, sunn hemp can produce 5000-6000 pounds of biomass per acre in southern climates within 60-90 days and can produce 120-140 pounds of nitrogen in that same amount of time.

In 2009, the LLPMC along with most of the 27 other plant material centers participated in the national sunn hemp adaptability study project. On June 24, 2009, the LLPMC established a sunn hemp planting using the methodology predetermined by the National Coordinator, E. Ramona Garner, Plant Materials Specialist at the East National Technology Support Center.

‘Tropic’ Sunn Hemp Planting

The following items describe the details of the 2009 LLPMC Sunn Hemp Adaptability Trial:

- Seeding date – June 24, 2009
- Seeding rate – 50 lbs/acre
- Seeding equipment – Kincaid plot drill
- Row width – 12 inches
- Emergence of seeding – June 28, 2009.
- Complete stand of planting – June 30, 2009
- First flowering of planting observed on August 27, 2009.
- First frost – October 2, 2009 – 29° F*
- First killing frost – October 30, 2009 – 22° F**

The seed was inoculated with a cow-pea type of bacteria (*Bradyrhizobium* sp.) using an adhesive sticker to achieve optimum coating of the seed with the inoculant. The planting was irrigated at regular intervals throughout the growing season for maximum forage production.

* Frost was approximately two weeks earlier than normal average of first frost at Los Lunas.
** Average height of planting was 92 inches.

Field 10 – 2009 Treatment and Harvest

Field 10 maintenance for the planting consisted of the following actions:

Action	2009 Date
Irrigation – 3 inches of water	6/24, 6/29, 7/2, 7/8, 7/17, 7/29, 8/5, 8/20, 9/4
Insecticide application	7/15
Clipping of forage plots and average plant height:	
13 inches	7/27
59 inches	8/27
93 inches	9/30
92 inches	11/27

Forage Production Evaluation

Prior to the emergence of the hemp seedlings, 12 forage clipping plots were established in the planting as set forth in the national guidelines of this study:

- Three clipping plots per harvest date with each plot measuring $2m^2$.
- Each plot contained three $0.5m^2$ replicated subplots for a total of 36 subplots.
- Forage clippings were harvested from the replicated subplots.
- Three harvests were completed every 30 days after the initial planting date.
- Weights of each replication were taken of the green forage following harvest.
- A grab-sample of each replication was taken and allowed to air-dry. The air-dried samples were then weighed to allow a percentage calculation of wet- versus dry-forage to determine the forage yield for the sunn hemp block.
- Three additional randomly selected $0.5m^2$ subplots received a final clipping after the killing frost on October 30, 2009 per instructions by the study coordinator.

Results

All of the data collected at the LLPMC was sent to E. Ramona Garner at ENTC for inclusion in a national project report. The national report will include results from all of the PMC's who participated in this project and should be available in 2010

The following photographs show the sunn hemp adaptability trial forage harvest at the LLPMC:

Figure 1: Field 10 'Tropic' Sunn Hemp Forage Plot Seedling Establishment Shown on June 30, 2009

Figure 2: Field 10 'Tropic' Sunn Hemp Forage Plots Shown on July 27, 2009

Figure 3: Field 10 'Tropic' Sunn Hemp Forage Plots Shown on August 27, 2009

Figure 4: Field 10 'Tropic' Sunn Hemp Forage Plots Shown on September 30, 2009

Figure 5: Field 10 'Tropic' Sunn Hemp Forage Plots Shown on November 17, 2009

Bottlebrush Squirreltail – Intercenter Strain Trial

Study Number: NMPMC-T-0902-RA

Background

This trial is a regional, comparative evaluation of bottlebrush squirreltail for improving the ecological status, production, and soil protection of rangeland. Commercially available plant releases of bottlebrush squirreltail that show promise for rehabilitating rangeland sites are being evaluated in replicated studies at participating plant material centers in the western United States.

Bottlebrush squirreltail (*Elymus elymoides*) is a short-lived, drought-tolerant, cool-season, native bunchgrass that is short to medium sized and has a fair forage value in winter and spring for grazing animals. During the warmer summer period the forage value decreases, and once the bristly awns of the seed are present, grazing becomes limited to most herbivores. These awns also can cause difficulty in seed handling during planting and at harvest. The species tends to increase as range conditions deteriorate.

Bottlebrush squirreltail is adapted to a wide variety of soils including saline soils in the 8 to 18-inch precipitation zone. This and other attributes of the species hopefully will enable it to establish a foothold in rangelands dominated by annual cheatgrass or medusahead. The Agricultural Research Service (ARS) and the Natural Resources Conservation Service (NRCS) have released six squirreltail accessions:

- Sand Hollow selected germplasm (*E. multisetus*) in 1996 – Sand Hollow is best adapted to sandy foothill rangelands receiving 12-inches or more in annual precipitation in the lower Snake River plains. **Note: Sand Hollow is no longer commercially available**.
- Toe Jam selected germplasm (*E. elymoides* ssp. *californicus*) in 2003 – Toe Jam is best adapted to loam to sandy loam soils in the Great Basin and lower to middle Snake River plains receiving 3-14 inches of precipitation.
- Fish Creek selected germplasm (*E. elymoides* ssp. *elymoides*) in 2003 – Fish Creek is best adapted to sandy loam to silt loam to clay loam soils in the middle to upper Snake River plains.
- Tusas germplasm (*E. elymoides* ssp. *brevifolius*) was released in 2001 by NRCS and New Mexico State University at the Los Lunas Plant Materials Center. It was released for use in the southwestern United States.
- Pueblo germplasm and Wapiti germplasm (*E. elymoides* ssp. *brevifolius*) were released in 2005 by the Upper Colorado Plant Center and ARS.

Note: The Pueblo germplasm seed is not available.

- An experimental accession (9092275) shows promise for a potential release. It is being grown at the Upper Colorado Plant Center in Meeker, Colorado.

These accessions have not been fully tested and their full range of adaptation is unkown.

2009 Seeding Trial

In 2009, seed of five accessions of bottlebrush squirreltail (Fish Creek, Toe Jam, Tusas, Wapiti, and 9092275) were received at the Los Lunas PMC from the Idaho PMC. The five accessions were planted into a replicated block in Field 18 at the LLPMC. The seeding was accomplished using a Kincaid plot drill with a seeding rate of 7 lbs/acre of pure live seed for *each* accession. Three replicated plots consisting of four, 20-foot rows on 12-inch row spacing per accession were seeded on July 20, 2009. The plots were irrigated on July 29 following the seeding.

None of bottlebrush squirreltail accessions had germinated in 2009. Evaluations of the plots will start in February 2010.

Field 18 – 2009 Treatment and Harvest

Weed control was performed throughout the growing season to keep the field clean and promote vigorous growth of the planting.

Action	**2009 Date**
Seeded	7/20
Irrigation 3” application	7/29, 8/7, 8/20, 9/9, 10/5

Field 18 will be irrigated and fertilized in 2010 for optimum growth of the planting.

Blue Grama Variety Trial

Study Number: NMPMC-T-0401-RA

Background

High-elevation grazing competition between elk and livestock has become a concern for landowner Carl Smith. Elk have been grazing on his forage pasture during the spring which decreases the available forage for livestock during the summer-grazing season. The elk herd in the area eats the cool-season grass forage prior to the introduction of livestock in the summer months. Without the cool-season species forage and because of the low production rates of warm-season, indigenous forage grass species, the livestock end up with an insufficient amount of feed during the summer grazing period.

In an attempt to solve this problem, the NRCS Field Office in Espanola, New Mexico and the Los Lunas Plant Materials Center (LLPMC) installed a trial planting of improved varieties of blue grama on the Carl Smith Ranch. Blue grama is a component of the warm-season range species indigenous to the ranch. The native blue grama at this location exhibits low forage production and does not adequately contribute to the total forage production of this rangeland. Improved varieties of blue grama could provide a greater forage potential at this high-elevation site (8,200 feet).

The LLPMC installed four varieties of blue grama on Mr. Smith's ranch on July 27, 2004:

- Hachita – Improved blue grama variety developed by the LLPMC
- Lovington – Improved blue grama variety developed by the LLPMC
- Alma – Improved blue grama variety developed by the LLPMC
- Bad River Ecotype – Bad River Ecotype is an ecotype release from the Bismarck Plant Materials Center in North Dakota. By including the Bad River Ecotype in the trial planting, it allows the opportunity to evaluate an accession from a northern climate.

This trial planting covered .10 acres in 16 replicated plots. The seed was installed using a plot drill, and the trial planting was observed on October 1, 2004. None of the blue grama seed had germinated. This planting may have been installed too late in the season for germination to occur at this elevation. This planting was removed by Mr. Smith in the spring of 2005 to prepare the area for a new trial planting.

On June 6, 2005, the same four varieties of blue grama were installed by the staff from the Espanola Field Office and the Los Lunas Plant Materials Center. The seeding was installed using the same procedures as in 2004 except for the earlier planting date in hopes to provide a longer growing season for any seed that may germinate. This earlier planting date compensates for the shorter growing period at this elevation.

2005 Evaluation

The June 2005 seeding was observed on September 28, 2005. The replicated plots of the four varieties of blue grama had seedling emergence, and the plots as a whole had a germination rate from 10 to 50 percent. All seedlings looked healthy and vigorous and were approximately two inches in height. No disturbance by wildlife or livestock was observed in any of the plots, and at this time, the plots had not been fenced for protection; damage by livestock and wildlife is of a concern. The landowner was aware of this need and stated he will fence the area as soon as possible.

2006 Evaluation

The June 2005 blue grama trial planting was observed for survival and growth on September 20, 2006. The plots did not look very healthy, and most of the seeded rows appeared to be dead. The plots were observed by randomly placing a one-meter, square metal frame in each plot. The seeded area did not appear to have received good moisture, and most of the surrounding rangeland looked to be only in fair condition. The results of the observation are shown in Table 1.

2007 Evaluation

On October 5, 2007, the June 2005 blue grama plots were observed for survival and growth. The seeded plots had not changed much since the September 2006 evaluation. Growth of the surviving plants averaged about 3-inches in height for all of the plots, and the survival rate was the same as it was 2006. Blue grama seedheads were not visible on any of the plants. It is hard to judge the amount of precipitation for this site, but all adjacent native vegetation appears to be in good shape. It should be noted the native blue grama in the areas next to the plots did produce seed, but the foliage averaged only about 4 to 5 inches in height. If any additional studies are done at this site, the LLPMC recommends installing a rain gauge to help determine the amount of moisture occurring, especially during the growing season.

It should be noted that sage and bottlebrush were the dominant species found within the trial site at the time of evaluation.

The following table shows the results for both 2006 and 2007 observational evaluations.

Blue Grama Variety Trial 2006 and 2007 Evaluation

Blue Grama Variety	Species	Average Percent Survival Rate 2006-2007	Height (in) 2006	Height (in) 2007
Alma	*Bouteloua gracilis*	1.0	1.5	2.0
Bad River Ecotype	*Bouteloua gracilis*	10.25	2.0	3.5
Hachita	*Bouteloua gracilis*	1.5	3.0	2.5
Lovington	*Bouteloua gracilis*	1.0	1.5	2.0

The blue grama plots did not appear to be vigorous, and most of the surviving plants were only in fair condition. The blue grama plots were fenced in late 2006 and at the time of observation, there did not appear to be any animal grazing damage.

The survival rate as of 2007 shows the Bad River ecotype to be significantly better than the other three varieties. However, even the Bad River ecotype plants have not exhibited much growth and may have a hard time surviving until the next growing season.

2008 Evaluation

No evaluations were performed in 2008.

2009 Evaluation

No evaluations were performed in 2009. An evaluation will be scheduled for 2010.

Alkali Muhly Herbicide Trials

Study Number: NMPMC-T-0704-RI

Background

In 2006, the Los Lunas Plant Materials Center released Westwater Germplasm alkali muhly (*Muhlenbergia asperifolia*); commonly known as scratchgrass. Alkali muhly is a warm-season, native, perennial sod grass, which may be prostrate or erect and can spread vegetatively by slender rhizomes. Westwater germplasm was collected in 1993 at an elevation of 5,200 feet from a damp arroyo bottom near the Westwater Spring in San Juan County, New Mexico. Alkali muhly is a common riparian grass found throughout the United States except for in the Southeast. Because it is strongly rhizomatous and grows in moist-to-wet, sandy-to-clay and neutral to alkali soils, alkali muhly is an excellent soil stabilizer.

Since its collection in 1993, the LLPMC has been evaluating the potential of alkali muhly for forage and seed production. Conducting these evaluations has required the LLPMC to install field plantings of alkali muhly at the LLPMC, and to pass field certification program standards and regulations, the field plantings must be kept free from weeds. To control the weed species, the LLPMC employs three methods of control: herbicide applications, hand weeding, and mechanical cultivation.

To control weeds, especially perennials such as bindweed and nightshade, the LLPMC relies on the Phenoxy-Carboxylic (2,4-D) group of herbicides. These types of herbicides are selective systemic plant growth regulators that are rapidly absorbed by the plants. They are and used to control or kill most broadleaf plants, and typically they are not harmful to grasses unless used at an unacceptable rate. The LLPMC applied 2,4-D herbicide to alkali muhly to control broadleaf weeds which had become established in the field planting, and it was applied using the recommended timing and application rates for the weed species being controlled.

This herbicide application had the anticipated effect on the weeds in the planting; however, the unintended effect became evident in less than 30 days. The alkali muhly plants that had been sprayed were noticeably injured by the chemical. The plants were yellowing and growth was noticeably diminished. The application of a 2,4-D type chemical to alkali muhly stopped top growth and the plants appeared to be dead. The planting where no chemical had been applied was not injured and continued to have healthy and vigorous plant growth. The field was checked periodically for the remainder of the growing season, and it was observed the chemically treated areas did resume growth, presumably by root regeneration. However, it also was noted that no seed stalk production was found on the treated areas at the end of the growing season.

With the release of Westwater germplasm in 2006, the LLPMC made the alkali muhly seed available to the commercial seed industry in order to facilitate the production of larger quantities of the seed by commercial growers. They could then provide seed to customers seeking to use alkali muhly for revegetation efforts. Being able to use herbicides allows seed producers to alleviate the need for hand removal of weeds, and therefore can dramatically decrease the cost of producing weed-free seed.

The LLPMC is well aware of the needs of the commercial seed industry to produce large quantities of high-quality seed by the most economical means possible. The use of applying chemicals by commercial growers in this process is highly probable, and the LLPMC is well-aware of the problems of not being able to use certain chemicals to produce a weed-free seed crop.

2007 Herbicide Trial

With the knowledge of the possibility of injury to the alkali muhly by Phenoxy-Carboxylic (2,4-D) chemical type applications, the LLPMC has maintained its production fields only by hand-hoeing or mechanical cultivation. In 2007, the LLPMC decided to study this chemical-control production problem and started an herbicide trial on a small, established field of alkali muhly. The chosen field had been in production since 1999, and until 2007, the

weeding has been done by hand-hoeing or mechanical cultivation. The field had been previously harvested for seed, and the field had received optimum growing conditions for the production of healthy and vigorous plants.

This herbicide trial consisted of a simple, replicated observational evaluation by applying three herbicides to this field. The herbicide trial was designed to evaluate types of herbicides that may be used on alkali muhly for the control of broadleaf weed species. The LLPMC used the *Greenbook Crop Protection Reference, 2005, 21st Edition* as a source reference for herbicides that are available for use on grass seed production fields other than the phenoxy-carboxylic class of chemicals. Herbicides were selected that control or kill broadleaf weeds, especially the perennials bindweed and nightshade.

Photographs were taken at random times during the study to aid in recording the results. The 2007 evaluation and results can be found in the *2007 LLPMC Annual Technical Report*.

2008 Herbicide Trial

In 2008, a second herbicide trial was conducted using four herbicides on the same field of alkali muhly that was planted in 1999 and in 2007, had three herbicides applied. This 2008 herbicide trial used two replications of four herbicides: Distinct, Banvel, Paramount, and 2,4-D, which were recommended for use on perennial grass species to help produce weed-free growing conditions during seed production. There was also a non-treated control plot.

The following table lists the herbicides used, the rates of application, and date of the applications:

2008 Herbicide Treatment and Application Dates

Product Name and Manufacturer	Rate per acre[1]	Date of Application
Distinct, sodium salt of dicamba, BASF[2]	4 ounces	June 26, 2008
Banvel, dimethylamine salt of dicamba Micro Flo Company LLC[2]	2 pints	June 26, 2008
2,4-D Amine 4, dimethylamine Salt of 2,4-Dichlorophenoxyacetic acid Winfield Solutions, LLC[2]	3 pints	June 26, 2008 August 20, 2008
Paramount, quinclorac, BASF[2]	4 ounces	September 15, 2008

The visual observations of the 2008 herbicide trial are described in the following table:

2008 Herbicide Trials on Alkali Muhly – Visual Observations

Type of Herbicide	Date/Observation
Non-Treated Control Plot	**June 26, 2008** - The control plots contained alkali muhly with approximately 5 inches of forage growth. The alkali muhly plants were healthy and vigorous. No alkali muhly seed production was found in either plot. Bindweed and nightshade in the plots had begun to produce flowers and plants were growing vigorously. There were also several other grass and broadleaf weed species growing in the control plots. **July 24, 2008** - The alkali muhly had started to produce seed stalks and forage production appeared to be very vigorous and healthy. Forage in the control plots was approximately 9 inches in height. Broadleaf weed species in the plots was also vigorous and flower production was noted on the two most prevalent species, bindweed and nightshade. Other broadleaf and grass species were also present in the control plots and appeared to have very good forage

[1] The herbicides were mixed with water in a tractor-mounted boom sprayer applying 33 gallons of water per acre.

[2] The LLPMC does not endorse any brand or company name of the chemicals involved in this trial study.

2008 Herbicide Trials on Alkali Muhly – Visual Observations

Type of Herbicide	Date/Observation
	production. **Note:** After evaluating the plots on July 24, 2008, it was determined necessary to remove seed stalks of the weed species in the control plots to prevent their seed production. On August 7, 2008 the replicated control plots were mowed using a tractor-mounted rotary mower. The mowing removed some of the alkali muhly seed inflorescences, but not any forage production. The mowing was required to keep weed species regeneration to a minimum. **August 20, 2008** – The alkali muhly in the control plots had good seed stalk production and the plants appeared healthy; forage was approximately 10 inches in height. The plots were mowed on August 7th to prevent any existing weed species from producing seed. All of the weed species in the control plots were vigorously growing, and flowering had been proficient prior to the mowing. The mowing did little damage to the alkali muhly plants, and only a small amount of seed heads was lost during the mowing process **September 15, 2008** – The alkali muhly has good seed production and its forage had matured. The weed species were actively growing, and if not for the mowing done on August 7, 2008 would have been able to produce a good amount of seed. **October 23, 2008** – The alkali muhly seed was maturing and production appeared to be fair-to-good. The weeds had received a frost prior to the evaluation date, and forage growth had been greatly reduced or had stopped completely on all species. **Control Plot – August 20, 2008**
Distinct Plot	**June 26, 2008** – The alkali muhly had forage approximately 4 inches in height and appeared healthy and vigorous. No seed stalk production was seen in the plots. There were flowers blooming on the bindweed and nightshade plants and all had very good forage growth. **July 24, 2008** – The herbicide application on June 26, 2008 had affected the alkali muhly plants. The alkali muhly forage was a light green with some plants exhibiting yellowing to the stems and leaves. The effect of the herbicide on the alkali muhly forage in the Distinct plots was noticeable, especially when compared to the control plots. The height in the Distinct plots

2008 Herbicide Trials on Alkali Muhly – Visual Observations

Type of Herbicide	Date/Observation
	was approximately 5 inches, close to the height found in the June evaluation. A few plants were producing seed stalks, but they were small in size when compared to the control plots. The bindweed and nightshade in the plots were showing the effects of the herbicide application. The two weed species had forage that was twisted and starting to shrivel along with some discoloration. Flowering had been greatly diminished in the two weed species, and a majority of the plants were not showing any signs of producing seed. **August 20, 2008** – The alkali muhly was approximately 5 inches in height, and only a very small amount of seed stalk production had occurred. The herbicide application had impacted the alkali muhly forage, and forage production was greatly reduced. The alkali muhly plants appeared to have been treated with a plant growth regulator; they appeared almost the same as they did at the July 24th evaluation. The bindweed had begun to grow again and some flowering on the plants was observed. The nightshade had not produced any new foliage, but the existing plants were still alive and had begun to set flowers. **September 15, 2008** – The alkali muhly had not returned the vigorous green growth that can be seen in the control plots, and seed stalk production was significantly reduced when compared to the untreated control area. Forage height had not increased since the August 20, 2008 observations. The bindweed and nightshade were actively growing and seem to have the potential to produce seed. **October 23, 2008** – The alkali muhly was maturing and had produced only a small amount of seed heads. Seed production had been hampered by the use of the herbicide, and forage production had been stopped by the herbicide application. After the June 26th herbicide application, the bindweed and nightshade had been controlled, but it did not kill the plants and they will have to be addressed next season. The weeds had received a frost prior to the evaluation, and forage growth had been greatly reduced or had stopped completely on all species. **Distinct Plot – August 20, 2008**
Banvel Plot	**June 26, 2008** – The alkali muhly had forage approximately 4 inches in height and the plants appeared to be healthy and vigorous. The bindweed in the plots had good forage growth with a

2008 Herbicide Trials on Alkali Muhly – Visual Observations

Type of Herbicide	Date/Observation
	very small amount of flowers present. No other weed species was observed in the Banvel plots. **July 24, 2008** – The alkali muhly plants appeared to have some damage from the June 26th application. The vegetation on the plants appeared to have a lighter green color when compared to the control plots, and seed stalk formation also appeared diminished. Plants of the alkali muhly were approximately 6 inches in height, but forage production was noticeably less when compared to the control plots. Very few seed stalks were seen on the alkali muhly plants, and they appeared to be of small size when compared to the alkali muhly plants in the control plots. The nightshade and bindweed had good control after herbicide application, but regrowth of the bindweed was noticeable in the plots. The bindweed regrowth did not have any flowers on the plants. Nightshade regrowth was not seen in the plots, and no other weed species was found in these plots. **August 20, 2008** – The alkali muhly was approximately 9 inches in height and forage production looked healthy. A few seed stalks were found, but when compared to the control plots, seed production appeared to have been dramatically delayed as a result of the herbicide application. The bindweed plants were still alive in the plots, but not much forage growth had occurred since the July 24th evaluation. The bindweed was not flowering, and seed production may not take place. No nightshade plants were found in these plots. **September 15, 2008** – The amount of alkali muhly seed stalk production appeared to be about three-quarters compared to the amount found in the control plots, but seed development may have been delayed by the herbicide application. The alkali muhly forage had not changed since the August observations. Bindweed and nightshade were actively growing in the plots, and some flowering was observed; seed production of these weedy species seems likely this year. **October 23, 2008** – The alkali muhly does not look much different since the September observation, and when compared to the control plots, seed maturity appears to have been delayed by the herbicide application. Prior to this evaluation, the plots had received a frost and mature seed could not be found on the seed heads. Forage production appears to be half the amount of the untreated control plots. The weed species forage production was reduced or stopped completely because of the frost, and flowering was not seen on any plants. The Banvel application appeared to have stopped the production of seed on the bindweed and nightshade. The plants survived and will have to be addressed next season.

2008 Herbicide Trials on Alkali Muhly – Visual Observations

Type of Herbicide	Date/Observation
	 Banvel Plot – August 20, 2008
2,4-D Plot	**June 26, 2008** – The alkali muhly showed good forage vigor and the plants were approximately 5 inches in height. The bindweed and nightshade in the plots appeared to have good, vigorous forage, and flowering of both species was present. No other weed species was found in the 2,4-D plots. **July 24, 2008** – The alkali muhly did exhibit some effects of the June 26th herbicide application. The alkali muhly had less forage production and were a lighter shade of green than in the control plots. The muhly averaged approximately 8 inches in height and the plants had approximately the same amount of seed stalks found in the control plots. Seed stalk height in the 2,4-D plots however, was noticeably less when compared to the control plots. The bindweed did appear to have some control from the herbicide application in June, but those plants that had survived appeared to be recovering and a small amount of flowering was already taking place. **August 20, 2008** – The alkali muhly forage averaged 8 inches in height and appeared smaller compared to the control plots, but the plants were vigorous in appearance. Seed heads were numerous in the plots and average approximately 14 inches in height. The bindweed and nightshade in the plots do show some forage damage from the June 26th application of the herbicide, but new growth of both species is prevalent. The bindweed plants in the plots have very few flowers and seed production should be greatly reduced. **September 15, 2008** – A second application of 2,4-D was applied on August 20, 2008; this had a severe effect on the alkali muhly plants. The forage of the muhly has lost most of its green color and growth of the plants has stopped. Seed heads on the muhly plants has turned to a straw color and no seed was found in any of the florets. The second application of the herbicide was needed to prevent the production of weed seed in the plots. It is obvious the timing of this application has stopped the production of both the weed and the alkali muhly seed. The weeds in the 2,4-D plots show good control of forage growth and no seed production will take place this year. **October 23, 2008** – Prior to the August herbicide application, the alkali muhly had produced a

2008 Herbicide Trials on Alkali Muhly – Visual Observations

Type of Herbicide	Date/Observation
	good amount of forage and seed heads. After the second herbicide application in August, forage and seed production had ceased, and seed was not found on any of the alkali muhly plants. The weed species were controlled by the two herbicide applications, but we found new growth on the bindweed; the plants will have to be addressed next season. **2,4-D Plot – August 20, 2008**
Paramount Plot	**September 15, 2008** – Paramount herbicide was applied on September 15, 2008. The alkali muhly plants looked healthy and vigorous and have produced a large amount of seed heads. Forage height of the alkali muhly averaged 10 inches and is equivalent to the control plots. Seed head height of the muhly plants averaged 15 inches, and seed production appeared good for this year. The bindweed and nightshade plants are also vigorous and flowering is abundant. **October 23, 2008** – The plots did not have any herbicide applied until September 15, 2008, and forage production of the alkali muhly was equal to the untreated control plots. Seed production also appeared to be equal to that found in the control plots. The plots had received a frost prior to evaluation, and the weed species had turned brown and appeared to be dead or dying. The bindweed and nightshade had flowered prior to the herbicide application, but there were not any flowering structures on the plants at the time of this evaluation. This is the second season to receive an application of Paramount, and it appears that the amount of bindweed and nightshade had been reduced. The amount of weed growth will be evaluated in the spring of 2009, and we will determine the amount (percentage) of reduction of the weed species compared to the control plots.

2008 Herbicide Trials on Alkali Muhly – Visual Observations

Type of Herbicide	Date/Observation
	Paramount Plot – August 20, 2008

2009 Herbicide Trial

The 2009 herbicide trial involved a visual observational evaluation of the alkali muhly field that was sprayed with the four herbicides in 2008. The field was examined on June 18, 2009 as to the extent of the existing weed growth in the plots. The plots had received a pre-emergent herbicide application on April 6, 2009 to prevent any new weed seedlings from germinating in the field. No herbicide control of the existing weeds in the field was applied prior to the June 18th evaluation.

The visual observations of the 2009 herbicide trial are described in the following table:

2009 Herbicide Trials on Alkali Muhly – Visual Observations

Type of Herbicide	Date/Observation
Non-Treated Control Plot	**June 18, 2009** – Weeds in the control plot were healthy and had good growth. The bindweed and nightshade were both in bloom and had produced an abundant amount of forage. No new weed seedlings were seen in the plots. Weed seed production from the existing species is expected. The alkali muhly in the control plot was healthy and producing a good amount of forage.

2009 Herbicide Trials on Alkali Muhly – Visual Observations

Type of Herbicide	Date/Observation
	Non-Treated Control Plot – June 2009
Distinct[3] **Herbicide Plots**	**June 18, 2009 –** Control of bindweed and nightshade from the 4 oz. per acre Distinct herbicide spraying in 2008 was fair to poor. Bindweed control from the 2009 application of the herbicide was poor with an abundant amount of blooms and forage production on the existing plants. Nightshade control from the 2009 application was fair with limited forage and blooms present compared to the control plot. The alkali muhly in the plots had about the same amount of forage as found in the control plots and the plants appeared healthy.

[3] The Natural Resources Conservation Service and the LLPMC do not endorse any brand or company name of the chemicals involved in this trial study.

2009 Herbicide Trials on Alkali Muhly – Visual Observations

Type of Herbicide	Date/Observation
	 Distinct Plot – June 2009
Paramount[3] Herbicide Plots	**June 18, 2009 –** The control of bindweed and nightshade in the 7 oz. per acre Paramount treated plots looked to be very good. The bindweed had not expanded in the plots since 2008 and blooms on the existing plants were limited. The nightshade had decreased in the plots since 2008 and the plants were dramatically reduced both in size and in flower production. The alkali muhly in the Paramount plots was healthy and vigorous and had good forage production. **Paramount Plot – June 2009**
Banvel[3] Herbicide Plots	**June 18, 2009 –** The Banvel plots had an application two pints per acre in 2008. The bindweed control in the plots was only fair with no reduction in size of the infestation since 2008. The bindweed had good forage production and flowering was abundant.

2009 Herbicide Trials on Alkali Muhly – Visual Observations

Type of Herbicide	Date/Observation
	Nightshade has been kept out of the plots by the application of the Banvel and preemergence herbicides. The alkali muhly in the Banvel plots was healthy, vigorous and producing a good amount of forage. **Banvel Plot – June 2009**
2,4-D[3] Herbicide Plots	**June 18, 2009 –** The 2008, 3 pint per acre application of 2,4-D had diminished the size of the bindweed infestation in the plots and only a small amount of forage was found for 2009. The bindweed had few flowering blooms and the plants forage was off color compared to those in the control plot. The 2,4-D application in 2008 did appear to be definitely affecting the bindweed growth in 2009. The population of the nightshade plants in the plots was less than in 2008 and the plants were smaller and less vigorous in growth compared to those found in the control plots. The nightshade plants also appeared to be still affected by the 2008 application of 2,4-D. The alkali muhly in the plots also exhibited a smaller amount of forage production and were a lighter shade of green in comparison to the muhly in the control plots.

2009 Herbicide Trials on Alkali Muhly – Visual Observations

Type of Herbicide	Date/Observation
	2-4,D Plots – June 2009

Alkali Muhly Herbicide Trial Summary Results

The results of this study did not make it clear as to what type of herbicide may be best suited to keep weed infestations out of seed production plantings of alkali muhly. The use of a pre-emergent herbicide is recommended, especially if weeds can be kept out of the seeding until this type of herbicide can be applied safely. All of the herbicides used in this study diminished the seed production of the alkali muhly. The 2,4-D was rated as causing the most damage to the alkali muhly, not only in seed production, but also by causing poor plant health. The Banvel, Paramount and Distinct herbicides were less damaging to the grass, but all had reduced the economic potential of the planting by causing a significant reduction in seed production.

The results of this study can only be used in a general type of recommendation for use of herbicides on seed production plantings of alkali muhly. A formal, statistical study should be performed to provide a complete and accurate list of herbicides that should be used on this grass species.

Giant Sacaton (*Sporobolus wrightii*) Windbreak Trial

Study Numbers: NMPMC-P-8401-CP and NMPMC-S-0901-CP

Background

Giant sacaton (*Sporobolus wrightii*) is a native, robust, perennial warm-season bunchgrass found throughout the southwestern United States, usually occurring on low alluvial flats and flood plains. It is useful forage for livestock and wildlife. Under irrigation, giant sacaton may exceed heights of 3 meters. The mature plants range in height from 1–4 meters. Based upon its density and height, it has the potential for use as a windbreak plant for irrigated cropland.

NMPMC-S-8401-CP – Initial Seed Collection and Propagation

Giant sacaton seed was collected from 37 locations throughout New Mexico and used to establish non-replicated, accession rows that consisted of 520 plants in a field at the Los Lunas Plant Materials Center. Based on a visual evaluation of vigor and height, ten superior plants were selected. Each selected superior plant came from a separate accession to maintain a diverse population. From these ten, one super selection was made. A hybrid, cross-planting was established as an attempt to improve the height of the progeny.

In 1992, clonal shoots of each selected plant were planted into a hybrid, seed-production block with the super plant as the male pollinator. In 1995, seed was hand-harvested from each female parent. In 1996, this seed was used to establish an evaluation planting that contained both parents and progeny. The progeny were derived from seed, and the parents were vegetatively propagated. Both sets of plants were grown in 6-inch square pots for eight months in an attempt to equalize carbohydrate reserves in the seed derived plants and the clones. The planting design was an 8-replicated, split-plot, randomized block design. Each replication consisted of 20 plants spaced on 10-ft. centers. A plot consisted of a parent and the progeny plant. By the end of the third growing season, the leaf blades of most plants had approached 3 meters in height.

In August 2002, the planting was evaluated for leaf height, basal width, and appearance. A separate, paired, T-test statistical analysis was performed on each replication comparing the height of each parent to its progeny. The progeny and parent plants were not significantly different in height (alpha .05). However, there appears to be a difference in leaf blade width, color, and uprightness between the parents and progeny plants. The cloned parent plants remain identical to their source where the progeny plants seem to have random variation.

The August 2002 clonal giant sacaton planting was removed in 2009. See previous *LLPMC Annual Technical Reports* for information on study NMPMC-P-8401-CP.

NMPMC-S-0901-CP – Seed Increase of Giant Sacaton Accession No. 9066790

In 2009, giant sacaton seed from the original parental selections was used to start transplants in the LLPMC greenhouse. The transplants were used to plant seed increase plantings of the giant sacaton into fields at the LLPMC. These increase plantings will continue the process towards producing a conservation plant release of giant sacaton by the LLPMC. The increase field plantings are on 38 row centers and use three different in row planting intervals; one foot, two feet and three feet. The three in row intervals will be harvested and cleaned separately to look for any significant affects they may have on seed production. These plantings will increase seed of this accession of giant sacaton for continued testing as a potential plant materials release.

2009 Treatment and Harvest

The 2009 field maintenance for the parent plantings consisted of the following activities:

Field Number	Action	2009 Date
Field 13 Parent Lines	Weed control was performed throughout the growing season. The field will be fertilized and irrigated for optimum of growth of planting in 2010.	
	Herbicide	3/11
	Mow	May
Field 26N Parent Lines	Weed control was performed throughout the growing season. The field will be fertilized and irrigated for optimum growth of planting in 2010.	
	Irrigation 3” Application	3/5, 616
	Herbicide	3/5
	Mow	May
Fields 8 and 14 - 9066790 Giant sacaton seed increase	Weed control was performed throughout the growing season. The fields will be fertilized and irrigated for optimum growth of planting in 2010.	
	Transplant Field 8 - 1 foot plant spacing Field 8 - 2 foot plant spacing Field 14 - 3 foot plant spacing	 8/6 8/13 8/27
	Irrigation 3” Application Field 8 Field 14	8/6, 8/10, 8/13, 8/17, 8/20, 9/4, 9/14, 10/5 8/27, 9/1, 9/4, 9/14, 10/5

Active Field Production Studies for 2009 at the Los Lunas Plant Materials Center

Propagation of Autumn Amber (*Rhus trilobata* Nutt. var. quinata (Greene) Jeps)

Study Number: NMPMC-P-9803-UR

Field 26S – 2009 Treatment and Harvest

Weed control was performed throughout the growing season to keep the field clean and promote vigorous growth of the planting.

Evaluation of propagation techniques will be performed in 2010 as required.

Action Field 26S	2009 Date
Irrigation 3” application	3/5, 6/26, 8/10

Field 26S will be fertilized and irrigated for optimum growth of planting in 2010.

Hope Desert Willow Stock Plant Production (*Chilopsis linearis* (Cav.) Sweet)

Study Number: NMPMC-P-0102-UR

Field 26S –Treatment and Harvest Information

Weed control was performed throughout the growing season to keep the field clean and promote vigorous growth of the planting.

Seed was not harvested in 2009 from this planting.

Action Field 26S	2009 Date
Irrigation 3” application	3/2, 4/3, 5/1, 5/31, 6/16, 7/10, 8/5, 9/14
Fertilizer 40 pounds Nitrogen	4/2

Field 26S will be irrigated and fertilized in 2010 for optimum growth of planting.

Regal Desert Willow Stock Plant Production

Study Number: NMPMC-P-0101-UR

Field 26S –Treatment and Harvest Information

Weed control was performed throughout the growing season to keep the field clean and promote vigorous growth of the planting.

No seed was harvested in 2009.

Action Field 26S	2009 Date
Irrigation 3" application	3/2, 4/3, 5/1, 5/21, 6/16, 7/10, 8/5, 9/14
Fertilizer 40 pounds Nitrogen	 4/2

Field 26S will be irrigated and fertilized in 2010 for optimum growth of planting.

Species from Four Corners Region

Study Number: NMPMC-P-9505-CR

Field 35N – Treatment and Harvest Information

Weed control was performed throughout the growing season to keep the fields clean and promote vigorous growth of the plantings.

The plantings of different shrub species collected in the Four Corners region of New Mexico continue to be grown for possible plant material release in the future. The desert needlegrass and bluebunch wheatgrass collections that were part of these original collections have been placed into seed increase plantings at the LLPMC and are being evaluated in the plant release process. Evaluations will be completed as needed on the remaining collections of this study as needed.

Action – Field 35N	2009Date
Shrub collections Irrigations 3" water application	 5/8, 7/2

Field 35-N will be irrigated and fertilized in 2010 for optimum growth.

Mexican Whitesage (*Artemsisia ludoviciana* Nutt. ssp.)

Study Number: NMPMC-9801-WL

Field 26N – Treatment and Harvest Information

Weed control was performed throughout the growing season to keep the field clean and promote vigorous growth of the planting.

No seed was harvested in 2009. Seed harvest will be attempted in 2010.

This Mexican Whitesage (White sagebrush) collection is being evaluated for its potential as a conservation plant release.

No evaluations were performed in 2009.

Action Field 26N	2009 Date
Irrigation (3" application)	3/5, 6/17

Field 26N will be irrigated and fertilized in 2010 for optimum growth of planting.

Single Leaf Ash and Fragrant Ash

Study Number: NMPMC-P-9804-UR

Field 26S –Treatment and Harvest Information

Weed control was performed throughout the growing season to keep the field clean and promote vigorous growth of the planting.

Evaluation of these accessions of ash will continue in 2010 for possible conservation plant materials release.

Action Field 26S	2009 Date
Irrigation 3" application	3/2, 4/3, 5/1, 5/21, 6/16, 7/10, 8/5, 9/14
Fertilizer	
40 lbs. Nitrogen	7/2
40 lbs. Phosphorous	4/2

Field 26S will be irrigated and fertilized in 2010 for optimum growth of the planting.

Advanced Planting of Needleandthread Grass

Study Number: NMPMC-S-9503-RA

Field 12 –Treatment and Harvest Information

These accessions of needleandthread grass are being evaluated for a possible variety release by the LLPMC. No evaluations were completed in 2009.

Weed control was performed throughout the growing season to keep the field clean and promote vigorous growth of the planting.

Action – Field 12	2009 Date
Irrigation 3" application	1/16, 3/4, 4/28, 6/22, 8/4
Fertilizer	
120 pounds Nitrogen	2/25, 4/2, 7/2
80 pounds Phosphorous	2/25, 4/10
Herbicide	7/10

Field 12 will be irrigated and fertilized in 2010 for optimum growth of planting.

Initial Evaluation Planting of Blowout Grass

Study Number: NMPMC-P-8501-RA

Field 20N –Treatment and Harvest Information

These accessions of blowout grass are being evaluated for a possible conservation plant release by the LLPMC. No evaluations were made in 2009.

Weed control was performed throughout the growing season to keep the field clean and promote vigorous growth of the planting.

No seed was harvested from this planting in 2009.

Action – Field 20N	2009 Date
Irrigation 3” application	1/23, 3/25, 6/4, 6/23, 7/20
Fertilizer	
40 pounds Nitrogen	4/2
40 pounds Phosphorous	2/25
Herbicide	3/6, 5/15

Field 20N will be irrigated and fertilized in 2010 for optimum growth of planting.

Observational Planting with Kingsville TX

Study Number: NMPMC-P-0601-RA

Field 10 –Treatment and Harvest Information

Four accessions of windmill grass are being evaluated for adaptability at the LLPMC. The planting is also evaluating seed and forage production in Los Lunas. The planting was established in 2006 using transplants grown from seed sent to the LLPMC from the STPMC. The planting is a replicated plot design, established in Field 10 at the LLPMC. Evaluations were completed in 2009.

In 2007 two accessions were received by the LLPMC for inclusion in the STPMC observational planting. Kinney two flower trichloris and Dilley slender grama seed sent from STPMC was used to start transplants in the LLPMC greenhouse. These transplants were used to establish a spaced rod row planting of each accession into field 10 of the LLPMC on September 6, 2007. The planting is evaluating adaptability for these two releases at Los Lunas. Evaluations were completed in 2009.

Weed control was performed throughout the growing season to keep the field clean and promote vigorous growth of the planting.

Action – Field 10	2009 Date
Irrigation 3” application	1/21, 3/24, 5/8, 6/12, 6/24, 7/2, 7/8, 7/17, 7/29, 8/20, 9/4
Fertilizer	
40 pounds Nitrogen	7/2
40 pounds Phosphorous	2/25
Herbicide	3/11, 3/20

Field 10 will be irrigated and fertilized in 2010 for optimum growth of planting.

Little Bluestem Polycross Increase Block and Advance Evaluation

Study Number: NMPMC-P-0604-RA

Little bluestem is a native, warm-season, bunch grass and is recognized as an important species for revegetation seeding in its area of adaptation. The LLPMC has released the variety ‘Pastura’ little bluestem, and it has been used extensively in revegetation efforts throughout the LLPMC service area. There are several little bluestem varieties that have been developed by the Natural Resources Conservation Service Plant Materials Program in the past and currently are available through commercial seed sources.

1990-1991 – In 1990, a re-collection of little bluestem accessions from the LLPMC service area was done to attempt finding an improved selection of little bluestem; one that might out-perform ‘Pastura.’ In 1991, these accessions were grown in a greenhouse at the LLPMC and then transplanted to an initial evaluation planting.

After extensive evaluation of this collection, five accessions were identified that appeared to have improved attributes.

2006 – On March 8, 2006, culms of these five accessions were dug from the parent plants and placed into containers to produce new transplant material. On August 2, 2006, some of these transplants were then planted into Field 28S into a replicated polycross block. Several of the transplants did not survive the initial container planting, and therefore new plants had to be grown in 2007 to complete the polycross block.

2007 –On May 1, 2007, additional culms were taken of the five accessions, placed into transplant containers, and on August 22, 2007, the new transplants were planted into the polycross block in Field 28S. Unfortunately all of the transplants did not survive until the August planting date, and as a result, we had to produce additional transplants in 2008 to complete the polycross planting.

2008 – On April 25, 2008 more culms of the five accessions of little bluestem were dug from the initial evaluation planting in Field 6 and placed in transplant containers. On August 7, 2008 these transplants were then planted into the crossing block in Field 28S. All of the transplants of 2008 survived and completed the planting of the little bluestem polycross block. Seed harvest from the little bluestem will allow for new evaluations to be started on this polycross material. These evaluations along with those of the initial evaluation planting should provide the data necessary to complete the plant material release process.

See previous LLPMC *Annual Technical Reports* to examine data on the evaluation process of the little bluestem.

Field 28S –Treatment and Harvest Information

Weed control was performed throughout the growing season to keep the field clean and promote vigorous growth of the planting.

Action – Field 28S	**2009 Date**
Irrigation 3” application	2/17, 5/8, 6/22, 7/29, 8/11
Fertilizer	
40 pounds Nitrogen	7/2
40 pounds Phosphorous	7/2
Herbicide	
2,4-D	5/15
Pre-emergent	3/6
Harvest seed	
Flail-vac	9/8

Field 28S will be irrigated and fertilized in 2010 for optimum growth of the planting.

Figure 1: F28S – Little bluestem crossing block – December 2008

Tobosagrass Polycross Increase Block

Study Number: NMPMC-P-0602-RA

Tobosagrass (*Pleuraphis mutica* Buckley) is an important, warm-season bunch grass that grows in the LLPMC's service area. There has been a need to develop an improved selection of tobosagrass, and to provide this selection to commercial seed source. Since the initial evaluation collections were done in the late 1970s, the LLPMC has been in the process of selecting a plant material release of this species. This species of bunch grass is in high-demand for seeding efforts in the low rainfall, southern desert areas of the LLPMC service area.

2006 – In 2006, culms were taken from six accessions in the initial evaluation planting in Field 6 at the LLPMC, which were identified as having the potential for a plant material release. The vegetative material was used to start transplants for inclusion in a polycross block to be established in Field 28S at the LLPMC.

The transplants of the six accessions were planted into Field 28S on August 2, 2006. Several of the transplants from the six accessions had died prior to the August planting, and this required new plants to be harvested in 2007 to complete the polycross block.

2007 – On May 1, 2007, culms were taken again from the initial evaluation planting in Field 6 and potted in containers to grow transplants for the polycross block in Field 28S. On August 22, 2007, the transplants were planted in the polycross block in Field 28S. Several transplants had died prior to this planting, and as a result, new culms had to be dug and transplanted in 2008 to complete the polycross block.

2008 – On April 25, 2008 culms were taken from the initial evaluation planting in Field 6 were harvested once again in order to complete the polycross block in Field 28S, and were planted on August 7, 2008. All of the transplants had survived and the tobosagrass polycross block was complete. .

In 2008 plant samples of the six accessions were taken from the tobosa crossing block. These plant samples were individually packaged into plastic bags and on November 3, 2008, they were sent to Dr. Kelly Allred at New Mexico State University in Las Cruces, New Mexico. Dr. Allred is a plant identification specialist for the university and the LLPMC has requested the samples be examined to determine if they all are indeed tobosagrass.

Seed harvest from the tobosagrass took place in 2009. The seed harvested from the crossing block will allow for new evaluations to be started on this polycross material. These evaluations, along with that of the initial evaluation block, will provide the data needed to complete the plant material release process.

See previous *LLPMC Annual Technical Reports* for information on the accessions in the initial evaluation planting of tobosagrass at the LLPMC.

Field 28S Treatment and Harvest

Weed control was performed throughout the growing season to keep the field clean and promote vigorous growth of the planting:

Action – Field 28S	**2009 Date**
Irrigation 3" application	2/17, 5/8, 6/22, 7/29, 8/11
Fertilizer	
40 pounds Nitrogen	7/2
40 pounds Phosphorous	7/2
Herbicide	
Pre-emergent	3/6
2,4-D5/15	5/15
Pesticide Application	7/9
Harvest Seed	
Flail-Vac	8/6

Field 28S will be irrigated and fertilized in 2010 for optimum growth of the planting.

Observational Planting with Kansas PMC

Study Number: NMPMC-P-0701-RA

Field 10 –Treatment and Harvest Information

Three accessions of blue grama, 421282, 421283, 9050485 are being evaluated for adaptability at the LLPMC. The planting is also evaluating seed and forage production in Los Lunas. The planting was established in 2007 using transplants grown from seed sent to the LLPMC by the KSPMC. The planting is a replicated plot design and was planted into Field 10 of the LLPMC on 9/06/2007. Evaluations were completed in 2009.

Weed control was performed throughout the growing season to keep the field clean and promote vigorous growth of the planting.

Action – Field 10	**2009 Date**
Irrigation 3" application	1/21, 3/24, 5/8, 6/12, 6/24, 7/2, 7/8, 7/17, 7/29, 8/20, 9/4
Fertilizer	
40 lbs. Nitrogen	7/2
40 lbs. Phosphorous	2/25
Herbicide	
2,4-D	3/20
Pre-emergence	3/11

Field 10 will be irrigated and fertilized in 2010 for optimum growth of planting.

Observational Planting with James E. 'Bud' Smith PMC, Knox City, TX

Study Number: NMPMC-P-0802-RA

Field 10 –Treatment and Harvest Information

In 2008, seed from three accessions of native species, Arizona cottontop, Prairie acacia, and little bluestem were sent from the James E. Bud Smith Plant Materials Center to the Los Lunas Plant Materials Center, to establish an observational planting. The accessions are being evaluated for possible plant materials cultivar releases. The planting will be used to evaluate adaptability and performance of the three species in the climate found at the LLPMC. The seed sent received by the LLPMC was used to start transplants of the three accessions. These transplants were then used to establish rod rows of each accession in Field 10 at the LLPMC on August 6, 2008.

The planting will be evaluated by the LLPMC for adaptability and plant performance for the next three years.

Weed control was performed throughout the growing season to keep the field clean and promote vigorous growth of the planting.

Action – Field 10	2009 Date
Irrigation 3" application	1/21, 3/24, 5/8, 6/12, 6/24, 7/2, 7/8, 7/17, 7/29, 8/20, 9/4
Fertilizer	
40 lbs. Nitrogen	7/2
40 lbs. Phosphorous	2/25
Herbicide	
2,4-D	3/20
Pre-emergence	3/11

Field 10 will be irrigated and fertilized in 2010 for optimum growth of planting.

Alkali Sacaton - Tucson PMC - ICST

Study Number: NMPMC-P-0801-RA

Field 18 –Treatment and Harvest Information

In 2008, seed of alkali sacaton from three plant material releases, Salado, Saltalk and Vegas, along with one collection from California, were sent by the Tucson Plant Materials Center to the Los Lunas Plant Materials Center to establish an intercenter strain trial. The seed was planted into replicated plots on 8/13/08 in field 18 at the LLPMC. Each accession will be evaluated for its performance here at the LLPMC.

The planting was evaluated in 2009.

Weed control was performed throughout the growing season to keep the field clean and promote vigorous growth of the planting.

Action – Field 18	2009 Date
Irrigation 3" application	1/15, 3/23, 4/21, 6/1, 6/19, 7/29, 8/7, 8/20, 9/9, 10/5
Herbicide	
2,4-D	5/5, 7/10

Field 18 will be irrigated and fertilized in 2010 for optimum growth of planting.

Mesa Dropseed Initial Evaluation Planting

Study Number: NMPMC-P-0702-RA

Field 31S –Treatment and Harvest Information

In 2006, 18 collections of the warm season native bunchgrass, mesa dropseed, (Sporobolus flexuosus), were made in the LLPMC service area for inclusion into an initial evaluation study. These collections will start the evaluation process to produce a conservation plant release of mesa dropseed.

In 2007, seed from each of these collections was used to start transplants in the LLPMC greenhouse. The transplants were planted into replicated plots in field 31S at the LLPMC on 8/21/2008. The replicated initial evaluation planting will be evaluated annually to provide data for a possible conservation plant material release from the LLPMC of mesa dropseed.

The mesa dropseed IEP was evaluated in 2009.

Weed control was performed throughout the growing season to keep the field clean and promote vigorous growth of the planting.

Action – Field 31S	2009 Date
Irrigation 3" application	3/30, 4/28, 6/4, 6/19, 7/15, 8/10, 9/9
Fertilizer 40 lb. Phosphorous	2/25

Field 31S will be irrigated and fertilized in 2010 for optimum growth of planting

Bottlebrush Squirreltail – Idaho PMC – ICST

Study Number: NMPMC-P-0902-RA

Field 18 –Treatment and Harvest Information

On July 20, 2009, five accessions of bottlebrush squirreltail, *Elymus elymoides* were seeded into a replicated plot planting in field 18 at the LLPMC. The five accessions were 9092275, Toe Jam, Wapiti, Tusas and Fish Creek. The seeding was completed using a Kincaid plot drill using a 38 inch row width and 20 foot row length. This planting is a comparative study of the five accessions at the LLPMC and will be evaluated annually for survival, growth and production.

Weed control was performed throughout the growing season to keep the field clean and promote vigorous growth of the planting.

Action – Field 18	2009 Date
Seeding	7/20/2009
Irrigation 3" application	7/29, 8/7, 8/20, 9/9, 10/5

Field 18 will be irrigated and fertilized in 2010 for optimum growth of planting.

2009 LLPMC Annual Seed Production Report

Project Number/Name	Field #	Acres	Planting Date	Fertilizer Applications	Irrigation Dates (3" Application)	Harvest Date	Harvest (Cleaned Wt. lbs.)
NMPMC-P-0602-WO Gila NF Foxtail prairieclover seed production	7	0.30	2007 2008	40 lbs. Phosphorous	3/30, 4/15, 5/1, 5/21, 6/16, 7/2, 7/29, 8/5, 9/3	10/26/2009	218.22
NMPMC-S-0901-CP 9066790 SPWR Seed Increase	8 14	0.85 0.40	8/2009		8/6, 8/10, 8/13, 8/17, 8/20, 9/4, 9/14, 10/5 8/27, 9/1, 9/4, 9/14, 10/5	No harvest	
NMPMC-S-0402-WO Pipe Spring National Monument Indian ricegrass seed production	8	0.25	2004	80 lbs. Nitrogen 80 lbs. Phosphorous	1/15, ¾, 4/3, 5/1, 7/2, 8/7	5/27, 6/1, 6/8/2009	41.08
NMPMC-S-0302-RA **Salado** Alkali Sacaton Foundation seed field	11 19	1.0 0.72	2003 2003	40 lbs. Nitrogen 40 lbs. Phosphorous 40 lbs. Nitrogen 40 lbs. Phosphorous	4/15, 6/11, 7/15 5/6, 6/9, 7/15, 8/4	No harvest	
NMPMC-S-0402-RI **Westwater germplasm** Alkali muhly Foundation seed field	11	1.0	2004	40 lbs. Nitrogen 40 lbs. Phosphorous	4/17, 6/11, 7/13, 8/4	9/23/2009	18.2
NMPMC-S-9902-RA **Largo** Tall wheatgrass Foundation seed field	12	0.45	5/3/1999	120 lbs. Nitrogen 40 lbs. Phosphorous	1/15, 3/4, 4/13, 5/8, 6/9, 7/15, 8/6	8/28/2009	113.34
NMPMC-S-0403-RA Carlsbad Caverns NP Blue grama seed production	13	0.50	7/6/2005	40 lbs. Nitrogen 40 lbs. Phosphorous	3/18, 6/4, 7/8, 8/10	10/15/2009	3.54
NMPMC-S-0603-RA **Tusas** Bottlebrush squirreltail foundation seed field	14	1.0	2006	120 lbs. Nitrogen 40 lbs. Posphorous	1/16, 4/3, 5/8, 5/20, 7/13, 8/17	6/12/2009	81.54
NMPMC-S-0703-PA **Grenville** Switchgrass seed production	14	0.14	2007	40 lbs. Phosphorous	3/25, 4/28, 6/4, 6/26, 7/15, 9/11	9/8/2009	1.12
NMPMC-S-0503-RI Composite Vine mesquite seed increase field	14	1.0	2005	40 lbs. Nitrogen 40 lbs. Phosphorous	4/28, 6/18, 7/29	10/16/2009	29.30
NMPMC-S-7801-RA	16	2.0	1963	40 lbs. Nitrogen	4/23, 6/22, 8/6	10/26/2009	13.88

Project Number/Name	Field #	Acres	Planting Date	Fertilizer Applications	Irrigation Dates (3" Application)	Harvest Date	Harvest (Cleaned Wt. lbs.)
Hachita Blue grama Foundation seed field				70 lbs. Phosphorous			
NMPMC-S-0701-OT Boulder County CO Big bluestem seed production	16	0.33	2007	40 lbs. Nitrogen 40 lbs. Phosphorous	3/25, 6/1, 6/26, 7/29	9/4/2009	37.26
NMPMC-S-0801-PA **Jose** Rush wheatgrass foundation seed production	18	1.0	2008	40 lbs. Nitrogen 40 lbs. Phosphorous	3/30, 4/2, 6/8, 7/29	9/4, 9/14/2009	230.28
NMPMC-S-0402-RA **Vaughn** Sideoats grama Foundation seed field	19	1.20	7/22-28/2004	40 lbs. Nitrogen 40 lbs. Phosphorous	4/4, 6/19, 7/31	8/20/2009	103.90
NMPMC-S-0401-RA **Pastura** Little bluestem Foundation seed field	19	0.86	2004	40 lbs. Nitrogen 40 lbs. Phosphorous	3/25, 6/9, 7/13, 8/4	9/16/2009	35.88
NMPMC-S-0301-RA **Viva** Galleta Foundation Seed field	19	2.4	2003	40 lbs. Nitrogen 70 lbs. Phosphorous	4/21, 6/8, 7/13	No harvest	
NMPMC-S-0004-WO Grand Canyon NP Muttongrass seed production	20N 28S 21S	0.50 1.00 0.28	4/20/2006 2006 2008	120 lbs. Nitrogen 80 lbs. Phosphorous 160 lbs. Nitrogen 80 lbs. Phosphorous 40 lbs. Nitrogen 40 lbs. Phosphorous	1/14, 2/27, 3/30, 4/13, 4/30, 5/21, 6/19, 7/15, 8/11 1/16, 2/27, 3/30, 4/13, 4/30, 5/21, 6/22, 7/10, 8/11, 9/3 1/14, 2/17, 3/2, 3/18, 3/30, 4/16, 4/28, 5/14, 6/4, 6/17, 7/13, 7/29, 8/10, 9/9, 10/5, 10/14	5/8/2009 5/8/2009 No harvest	72.88
NMPMC-S-0003-RA Grand Canyon NP Blue grama seed production	20N 28S	0.50 0.50	2000 2006	40 lbs. Nitrogen 40 lbs. Phosphorous 40 lbs. Nitrogen 40 lbs. Phosphorous	1/23, 3/25, 6/4, 6/23, 7/16 1/23, 3/25, 6/4, 6/23, 7/17	9/6/2009 9/6/2009	10.16
NMPMC-S-0901-WO Grand Canyon NP Spike muhly seed production	20S	0.70	2009		9/3, 9/8, 9/23, 10/5, 10/14/2009	No harvest	
NMPMC-S-0403-RA Carlsbad Caverns NP Bristlegrass seed	20S	.50	2006	40 lbs. Nitrogen 40 lbs. Phosphorous	3/18, 6/5, 7/16, 9/14	8/11/2009	77.88

Project Number/Name	Field #	Acres	Planting Date	Fertilizer Applications	Irrigation Dates (3" Application)	Harvest Date	Harvest (Cleaned Wt. lbs.)
production	28S	0.17	2007	40 lbs. Nitrogen 40 lbs. Phosphorous	3/18, 6/4, 6/23, 7/8, 9/3	8/11/2009	
NMPMC-S-0602-CR Grand Canyon NP Bottlebrush squirreltail seed production	20N 28S	0.50	2006 2006		1/15, 2/27, 3/30 1/15, 3/18	No harvest	
NMPMC-S-9701-RA **Nogal** Black grama Foundation seed field	21N	1.3	1997	40 lbs. Nitrogen 40 lbs. Phosphorous	3/17, 6/17, 7/29, 8/19, 9/9	11/16/2009	28.68
NMPMC-S-0904-RA Grand Canyon NP Blue grama seed production	21S	0.60	2009		8/4, 8/7, 8/10, 8/13, 8/17, 8/20, 9/3, 9/11, 9/23, 10/5, 10/14	No harvest	
NMPMC-S-0802-RA Desert needlegrass seed production	23N	0.25	2008	80 lbs. Nitrogen 80 lbs. Phosphorous	1/14, 3/3, 4/3, 4/28, 5/20, 6/19, 7/16, 8/10	6/12, 6/23/2009	0.90
NMPMC-S-0403-RA Carlsbad Caverns National Park Sideoats grama seed production	23N	0.50	6/8/2005 6/29/2006	40 lbs. Nitrogen 40 lbs. Phosphrous	3/18, 6/4, 6/22, 7/13, 8/10	8/19/2009	19.96
NMPMC-S-0403-RA Carlsbad Caverns NP Sprangletop seed production	24N	0.50	2006	40 lbs. Nitrogen 40 lbs. Phosphorous	3/11, 6/3, 6/17, 7/8, 7/30, 8/11, 9/2	10/16/2009	33.32
NMPMC-S-0501-RA **Llano** Indiangrass foundation seed field	24N	0.25	9/8/2005	80 lbs. Nitrogen 40 lbs. Phosphorous	3/12, 6/3, 6/23, 7/10, 7/30, 9/2	10/1/2009	25.00
NMPMC-S-0403-RA Carlsbad Caverns National Park Three-awn seed production	24S	0.50	6/2/2005 6/22/2006	40 lbs. Nitrogen 40 lbs. Phosphorous	3/12, 5/20, 6/16, 7/10, 8/10	8/4, 8/13, 9/14, 10/1/2009	8.20
NMPMC-S-9401-RA **Paloma** Indian ricegrass foundation seed field	25N	0.89	2000	80 lbs Nitrogen 80 lbs. Phosphorous	1/14, ¾, 4/9, 5/6, 7/2, 8/19	5/28, 6/1, 6/8/2009	69.08
NMPMC-S-0701-CR Grand Canyon Sideoats grama seed production	25N 34S`	0.50	2007	40 lbs. Nitrogen 40 lbs. Phosphorous 40 lbs. Nitrogen 40 lbs. Phosphorous	3/11, 5/21, 6/16, 7/2, 8/4, 9/2 3/11, 5/20, 6/16, 7/2, 8/4	8/19/2009 8/19/2009	44.52
NMPMC-S-0301-WO Zion NP Sand bluestem seed production	25S	0.50	2003	40 lbs. Nitrogen 40 lbs. Phosphorous	3/5, 6/3, 7/2, 8/6	8/20/2009	44.52

Project Number/Name	Field #	Acres	Planting Date	Fertilizer Applications	Irrigation Dates (3" Application)	Harvest Date	Harvest (Cleaned Wt. lbs.)
	27N		8/23/2005	80 lbs. Nitrogen 40 lbs. Phosphorous	3/5, 5/8, 5/21, 6/16, 7/8, 7/29, 9/13	8/20/2009	
NMPMC-S-0801-CR US Army Fort Bliss Mesa dropseed seed production	25S 34S	0.90 0.13	2008	40 lbs. Nitrogen 40 lbs. Phosphorous 40 lbs. Nitrogen 40lbs. Phosphorous	3/6, 5/21, 6/16, 7/8, 8/20, 9/2 3/11, 4/28, 5/20, 6/16, 7/2, 8/5, 9/2	8/12, 11/4/2009 8/13, 11/4/2009	241.96
NMPMC-S-0301-WO Zion NP Bottlebrush squirreltail seed production	26N 19 20S 34S	0.25 0.20 0.40 0.44	2007 2008 2009 2009	80 lbs. Nitrogen 80 lbs. Phosphorous 120 lbs Nitrogen 70 lbs. Phosphorous	1/14, 3/2, 4/2, 4/15, 5/1, 6/9, 7/9, 7/29, 9/3 1/14, 3/2, 4/3, 4/17, 5/6, 6/18, 7/15 10/14, 10/22, 11/5, 12/29 10/15, 10/21, 11/5, 12/29	5/20, 5/28, 6/4, 6/9/2009 5/20, 5/28, 6/4, 6/9/2009 No harvest No harvest	98.62
NMPMC-P- 0602-WO Gila NF Whiteflower prairieclover seed production	31N	0.25	2007		1/23, 3/18, 4/13, 4/28, 6/4, 6/17, 7/13, 8/5	No harvest	
NMPMC-S-0801-RA 9066431 Bluebunch wheatgrass seed production	35N	0.30	2008	80 lbs. Nitrogen 80 lbs. Phosphorous	1/14, 3/3, 4/3, 4/16, 5/1, 5/14, 6/16, 6/26, 7/15, 8/4, 8/20, 9/3	No harvest	
NMPMC-S-0802-CR US Army Fort Bliss Spike dropseed seed production	35N	0.30	2008	80 lbs. Nitrogen 40 lbs. Phosphorous	1/14, 5/20, 6/16, 7/16, 9/14	8/14/2009	41.06
NMPMC-S-0301-WO Zion NP Indian ricegrass seed production	35N	0.50	2004 2005	80 lbs. Nitrogen 80 lbs. Phosphorous	1/15, 3/4, 4/9, 5/8, 7/2	6/8, 6/18/2009	50.94
NMPMC-T-0603-WO USFS Apache Sitgreave Seed Production							
Bristly Wolftail	33N		2007	80 lbs. Nitrogen 40 lbs. Phosphorous	3/13, 5/20, 6/16, 7/31, 8/4	10/14/2009	4.64 0.86
Blue Grama	33N		2007	120 lbs. Nitrogen 40 lbs. Phosphorous	3/3, 5/20, 6/16, 7/31, 8/4	9/24/2009	3.58

Project Number/Name	Field #	Acres	Planting Date	Fertilizer Applications	Irrigation Dates (3" Application)	Harvest Date	Harvest (Cleaned Wt. lbs.)
Galleta	33N		2007 2009	80 lbs. Nitrogen 40 lbs. Phosphorous	3/13, 5/20, 6/3, 6/5, 6/11, 6/15, 6/19, 6/26, 6/30, 7/8, 7/13, 7/20, 8/5, 8/19	No harvest	
Arizona fescue	33N		2007 2008	80 lbs. Nitrogen 80 lbs. Phosphorous	1/14, 3/2, 4/3, 4/15, 4/28, 5/14, 6/3, 6/15, 6/19, 6/30, 7/13, 8/7, 8/20, 9/2	7/6/2009	1.54
Thurber fescue	23N		2007 2008	80 lbs. Nitrogen 80 lbs. Phosphorous 4 lbs. Iron	1/14, 3/2, 4/2, 4/16, 5/11, 5/20, 6/4, 6/22, 7/8, 8/7, 9/14 1/14, 2/27, 3/23, 4/3, 5/1, 5/21, 6/16, 7/2, 7/20, 8/17	No harvest	
Mountain muhly	6		2007	80 lbs. Nitrogen 80 lbs. Phosphorous 4 lbs. Iron	3/23, 6/4, 6/26, 7/15, 8/10, 9/3	No harvest	
Spike muhly	14		2007	40 lbs. Nitrogen 40 lbs. Phosphorous 4 lbs. Iron	1/14, 3/3, 4/3, 4/28, 5/15, 6/16, 7/8, 8/7, 9/11	10/29/2009	5.60
Weeping brome	13		2007 2008	80 lbs. Nitrogen 80 lbs. Phosphorous 4 lbs. Iron	3/23, 6/4, 6/26, 7/15, 8/10, 9/3	7/6/2009	7.40
Deergrass	14		2008	40 lbs. Nitrogen 40 lbs. Phosphorous		12/1/2009	0.86