Revegetation Studies 2006 – Pecos River Project

September 19, 2006

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N
Lakewood
McMillan Lake
Revegetation
Herbicide
Railroad
USGS

McMILLAN HERBICIDE STUDY

June 3, 2005

Herbicide Treatments

9 - Vanquish + 2,4-D

8 - Plateau DF

4 - 2,4-D Amine 4

7 - Escort XP + 2,4-D + Vanquish

2 - Vista

10 - Vista + Overdrive

6 - Telar + 2,4-D + Vanquish

1 - Escort XP

3 - Overdrive

5 - Telar + Vista

Preliminary Results

- All herbicides effective
- No indication of confirmed resistance
- Possible escapes with Plateau™
- Vista™ ineffective on Russian thistle

August 5, 2005

McMILLAN STUDY SITE

McMillan Soils

Depth (in)	Text	pH	ECe (mmhos cm^{-1})	SAR (meq L^{-1})	OM (%)	NO_3-N (ppm)	P (ppm)	K (ppm)	Ca (meq L^{-1})	Mg (meq L^{-1})	Na (meq L^{-1})
0-3	Clay	7.6	0.7	1.7	2.1	4.4	7.1	583	3.5	1.3	2.6
3-6	Clay	7.5	2.7	1.2	1.9	2.5	4.9	382	24.3	8.5	5.0
6-12	Clay	7.6	3.0	2.9	1.5	3.6	4.6	372	18.3	7.1	10.5

HOBO MicroStation (Onset Computer Corp.)

- Precipitation
- Relative Humidity
- Air Temperature
- Soil Temperature (8”)
- Soil Moisture (8”)

EXPERIMENTAL DESIGN – McMILLAN REVEGETATION STUDY SITE

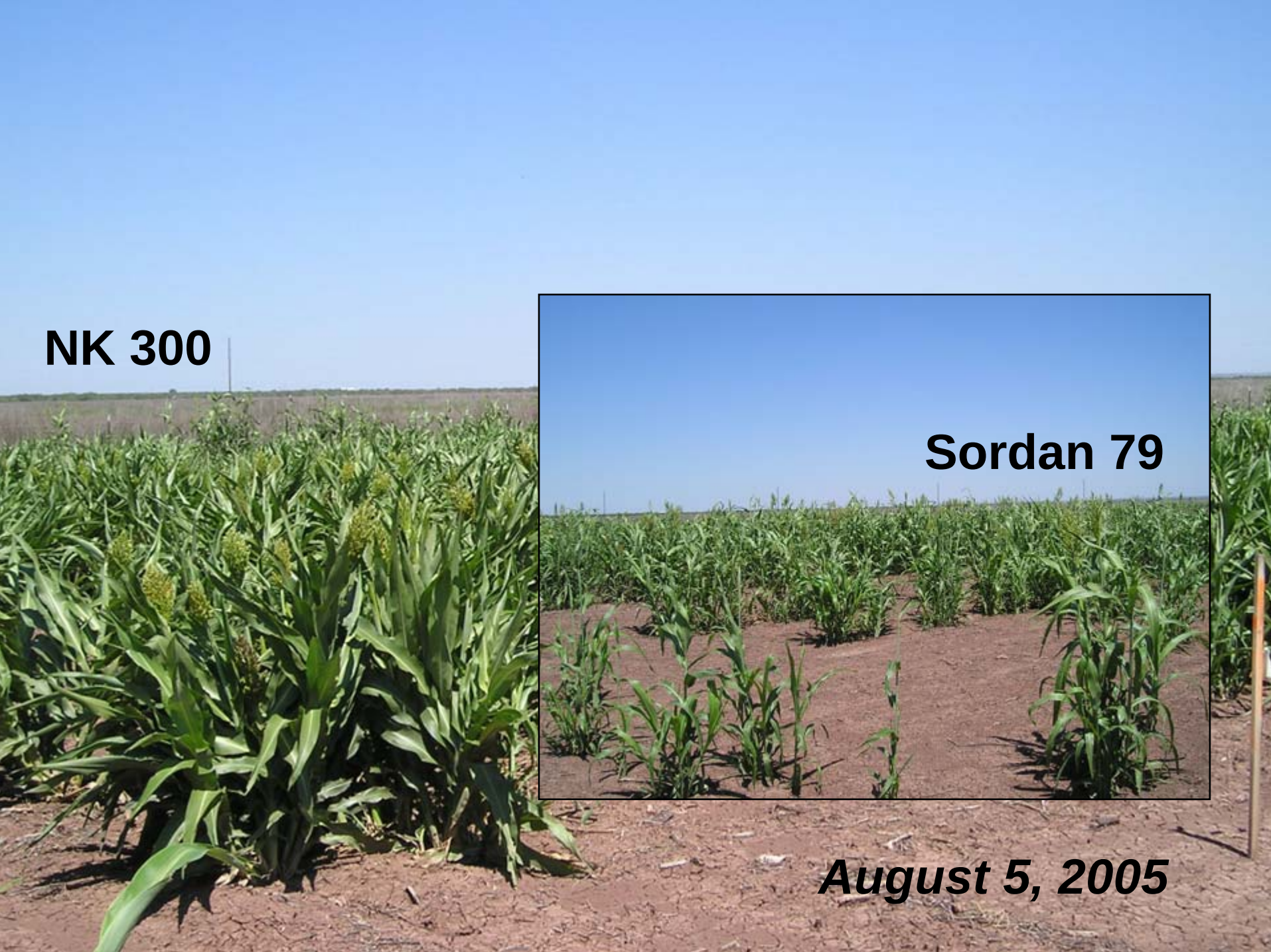
COVER CROP		ACRES
SNC	TILLED; SUDAN NURSE CROP; ALT. ROWS; SPRING	0.9
SCC	TILLED; SUDAN COVER CROP; SUMMER	0.9
FNC	TILLED; FORAGE NURSE CROP; ALT. ROWS; SPRING	0.9
FCC	TILLED; FORAGE COVER CROP; SUMMER	0.9
NCSp	TILLED; NO COVER CROP; SPRING	0.9
NCSm	TILLED; NO COVER CROP; SUMMER	0.9
		5.5

PLANTING METHOD		
SD	STANDARD GRASS DRILL	2.8
DFD	DEEP-FURROW DRILL	2.8
		5.5

MYCORRHIZAL INOCULATION		
M	MAI	2.8
N	NO MYCORRHIZAL INOCULUM	2.8
		5.5

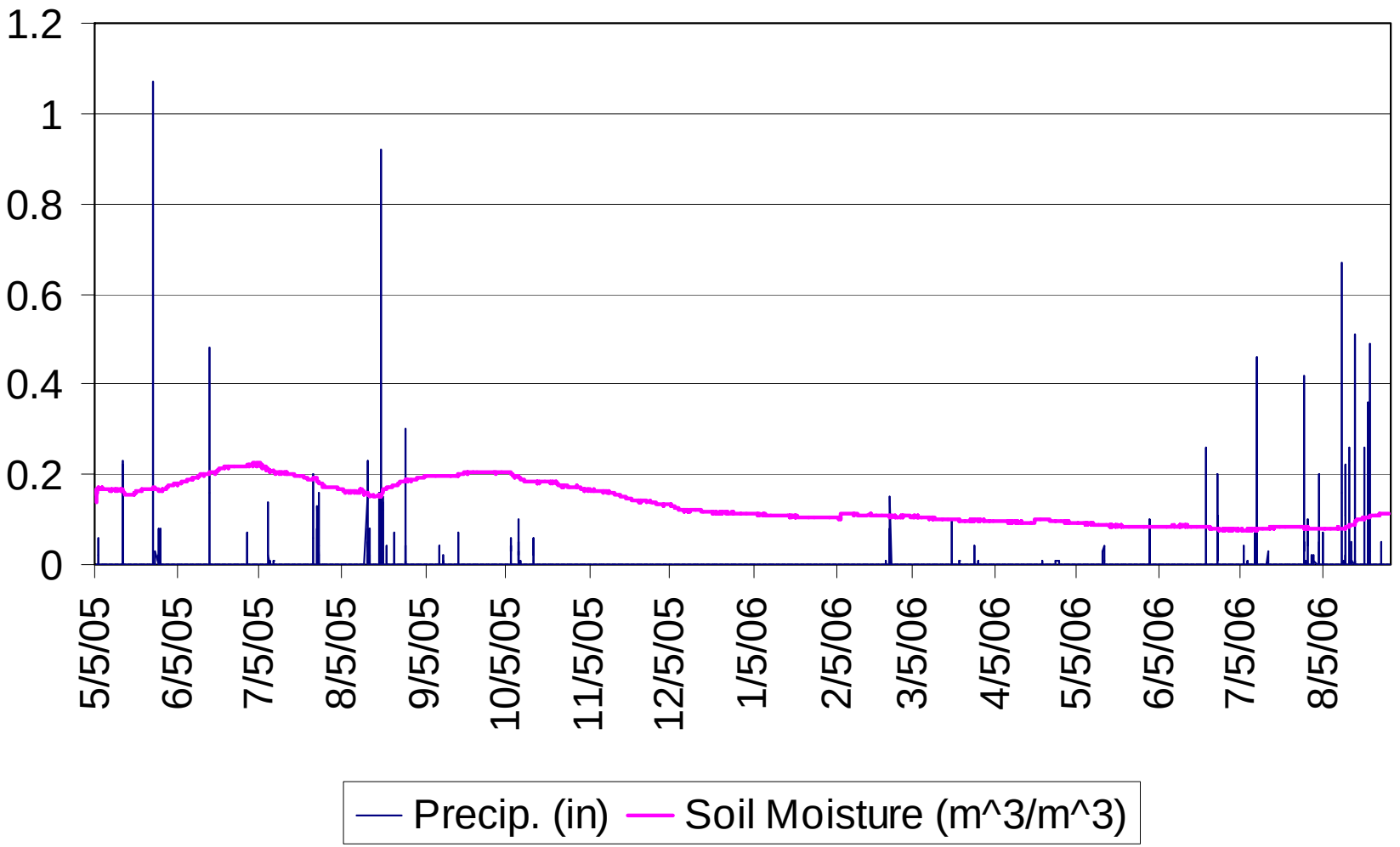
Site Description:	McMillan Lake / Pecos revegetation	
Scientific Name	Common Name	Culivar or Pre-Release
CLAY MIXTURE 1 - STUDY 1 (McMILLAN LAKE BED) - DRILLED		
Distichlis spicata	**Inland saltgrass**	VNS
Bothriochloa barbinodis	**Cane bluestem**	Grant
Panicum virgatum	**Switchgrass**	Blackwell
Sporobolus airoides	**Alkali sacaton**	VNS
Bouteloua gracilis	**Blue grama**	Hachita
Bouteloua curtipendula	**Sideoats grama**	Niner
Pleuraphis jamesii	**Galletagrass**	Viva

June 3, 2005


NK 300
Sordan 79
August 5, 2005


McMillan Revegetation Site – 6/14/06

McMillan - 08/29/06



From 10/15/05 to 06/14/06 the McMillan Site received 0.61 inches of precipitation. From 06/14/06 to 08/29/06 the McMillan Site received 6.72 inches of precipitation; 4.90 inches of this fell between 7/28/06 and 8/28/06.

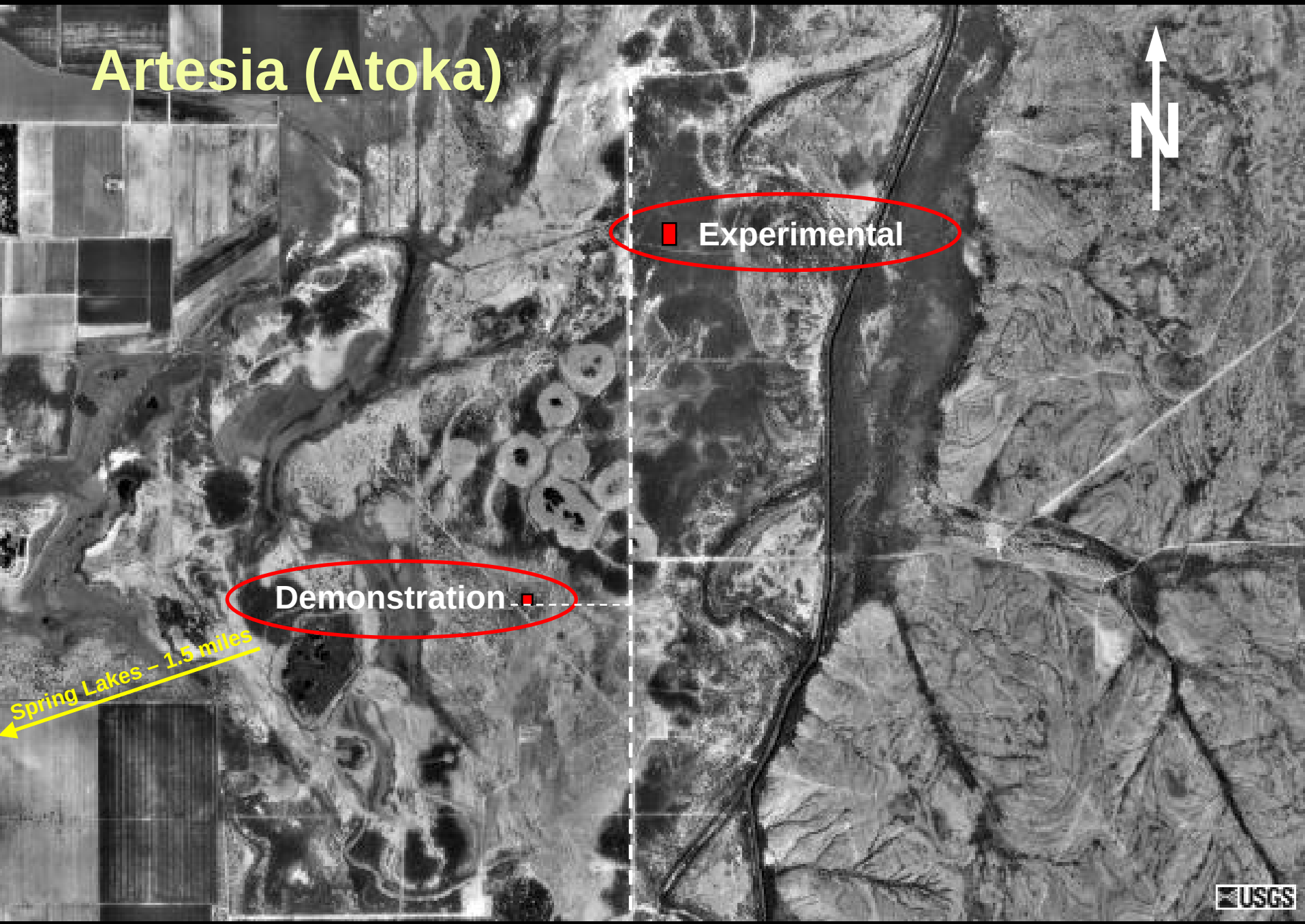

McMillan Revegetation Site – 8/29/06

Preliminary Results

McMillan

Soil texture

Seed predation


Artesia (Atoka)
N
Experimental
Demonstration
Spring Lakes – 1.5 miles
USGS

Demonstration

Single-Species, Single-Row Trials

Artesia “Alkali Scald” Test Species

Common Name	Symbol	Scientific Name
Inland saltgrass	**DISP**	*Distichlis spicata*
Alkali muhly (Scratchgrass)	**MUAS**	*Muhlenbergia asperifolia*
Vine mesquite	**PAOB**	*Panicum obtusum*
Alkali sacaton	**SPAI**	*Sporobolus airoides*
Giant (big) sacaton	**SPWR**	*Sporobolus wrightii*
Salt heliotrope	**HECU**	*Heliotropium curassivicum*
Dwarf glasswort	**SAVI**	*Salicornia virginica*
Alkali goldenbush	**ISAC**	*Isocoma acradenius*
Frankenia	**FRSA**	*Frankenia salina*
Iodinebush; Pickleweed	**ALOC**	*Allenrolfia occidentalis*
Fourwing saltbush	**ATCA**	*Atriplex canescens*
Shadscale	**ATCO**	*Atriplex confertifolia*
Quailbush	**ATLE**	*Atriplex lentiformis*
Seep willow	**BAGL**	*Baccharis glutinosa*
Pale or Anderson wolfberry	**LYAN**	*Lycium andersonii*
Tornillo; screwbean mesquite	**PRPU**	*Prosopis pubescens*
Greasewood	**SAVE**	*Sarcobatus vermiculatus*
White bursage	**AMDU**	*Ambrosia dumosa*
Desert seepweed; iodineweed	**SUMO**	*Suaeda moquinii*

October 3, 2005


Alkali Scald Site
August 29, 2006

ARTESIA (ATOKA)

Artesia Soils

Depth (in)	Text	pH	ECe (mmhos cm^{-1})	SAR (meq L^{-1})	OM (%)	NO_3-N (ppm)	P (ppm)	K (ppm)	Ca (meq L^{-1})	Mg (meq L^{-1})	Na (meq L^{-1})
0-3	Clay	7.9	1.1	5.5	2.1	3.6	4.3	472	2.5	0.6	7.0
3-6	Clay	7.9	2.0	7.8	1.7	2.7	3.1	360	4.2	1.4	13.0
6-12	Clay	7.7	7.0	10.4	1.7	3.0	2.8	352	21.0	8.8	40.2

EXPERIMENTAL DESIGN – ARTESIA REVEGETATION STUDY SITE

KOCHIA RESIDUE MANIPULATION / SEEDING METHOD		ACRES
BR	MOW / BROADCAST SEED / ROLLER CHOP	1.0
BI	MOW / BROADCAST SEED / IMPRINT	1.0
ND	MOW / NO-TILL GRASS DRILL	1.0
TD	MOW / DISK / TRILLION DRILL	1.0
NS	MOW / NO SEED	1.0
		5.2

HERBICIDE TREATMENT		
VT	VISTA + TELAR	1.7
VO	VISTA + OVERDRIVE	1.7
NH	NO HERBICIDE	1.7
		5.2

MYCORRHIZAL INOCULATION		
M	RTI	2.6
N	NO MYC. INOCULUM	2.6
		5.2

Site Description:	Artesia Site / Pecos revegetation	
Scientific Name	Common Name	Culivar or Pre-Release
CLAY MIXTURE 2 - (Artesia Site) **DRILLED & BROADCAST**		
Distichlis spicata	**Inland saltgrass**	VNS
Elymus elyloides	**Bottlebrush squirreltail**	Tusas
Panicum virgatum	**Switchgrass**	Blackwell
Sporobolus airoides	**Alkali sacaton**	VNS
Bouteloua gracilis	**Blue grama**	Hachita
Bouteloua curtipendula	**Sideoats grama**	Niner
Pleuraphis jamesii	**Galletagrass**	Viva

Preliminary Results

Artesia

August 30, 2005


August 30, 2005

August 30, 2005

Blue grama (*Bouteloua gracilis*)

Sideoats grama (*Bouteloua curtipendula*)

Blue grama

Sideoats grama

n = 1,350

BOUTELOUA spp.

CANOPY COVER (%)

30
25
20
15
10
5
0

c
b
b
c
a
a
b
a
a
a

BRDCST IMP
BRDCST RC
RNG DRILL
TRILLION
NO SEED
NO HERB
V + O
V + T
MYCO INOC
NO MYCO

LSD = 2.1
LSD = 1.6
LSD = 1.3

n = 540

BOUTELOUA spp.

DEPRESSION GERM (%)

40
30
20
10
0

b
a
a
b
b
a
a

BRDCST IMP
BRDCST RC
NO HERB
V + O
V + T
MYCO INOC
NO MYCO

LSD = 4.0
LSD = 4.9
LSD = 4.0

n = 1,350

KOCHIA SCOPARIA

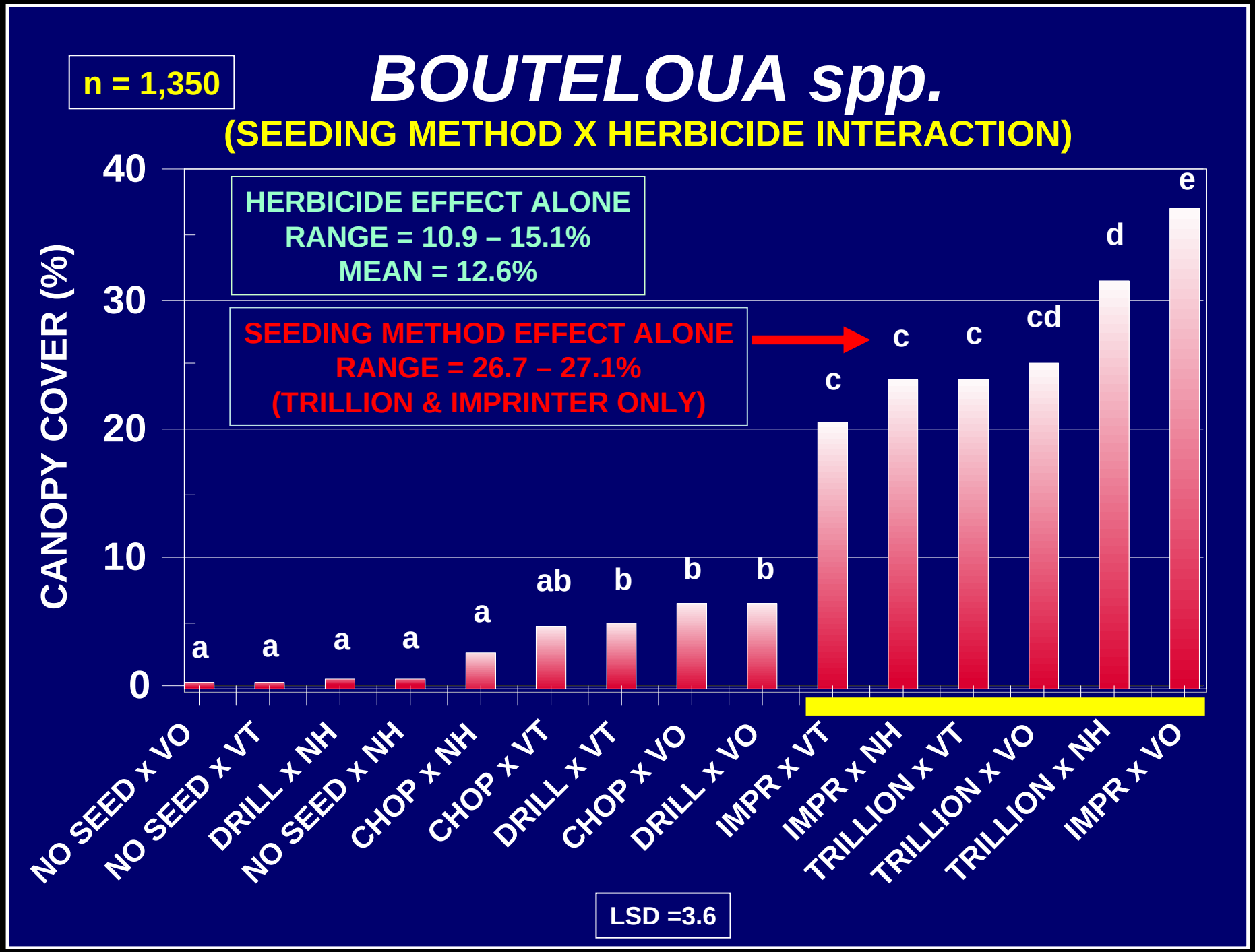
CANOPY COVER (%)

20
15
10
5
0

b b c a c b a a a a

BRDCST IMP
BRDCST RC
RNG DRILL
TRILLION
NO SEED
NO HERB
V + O
V + T
MYCO INOC
NO MYCO

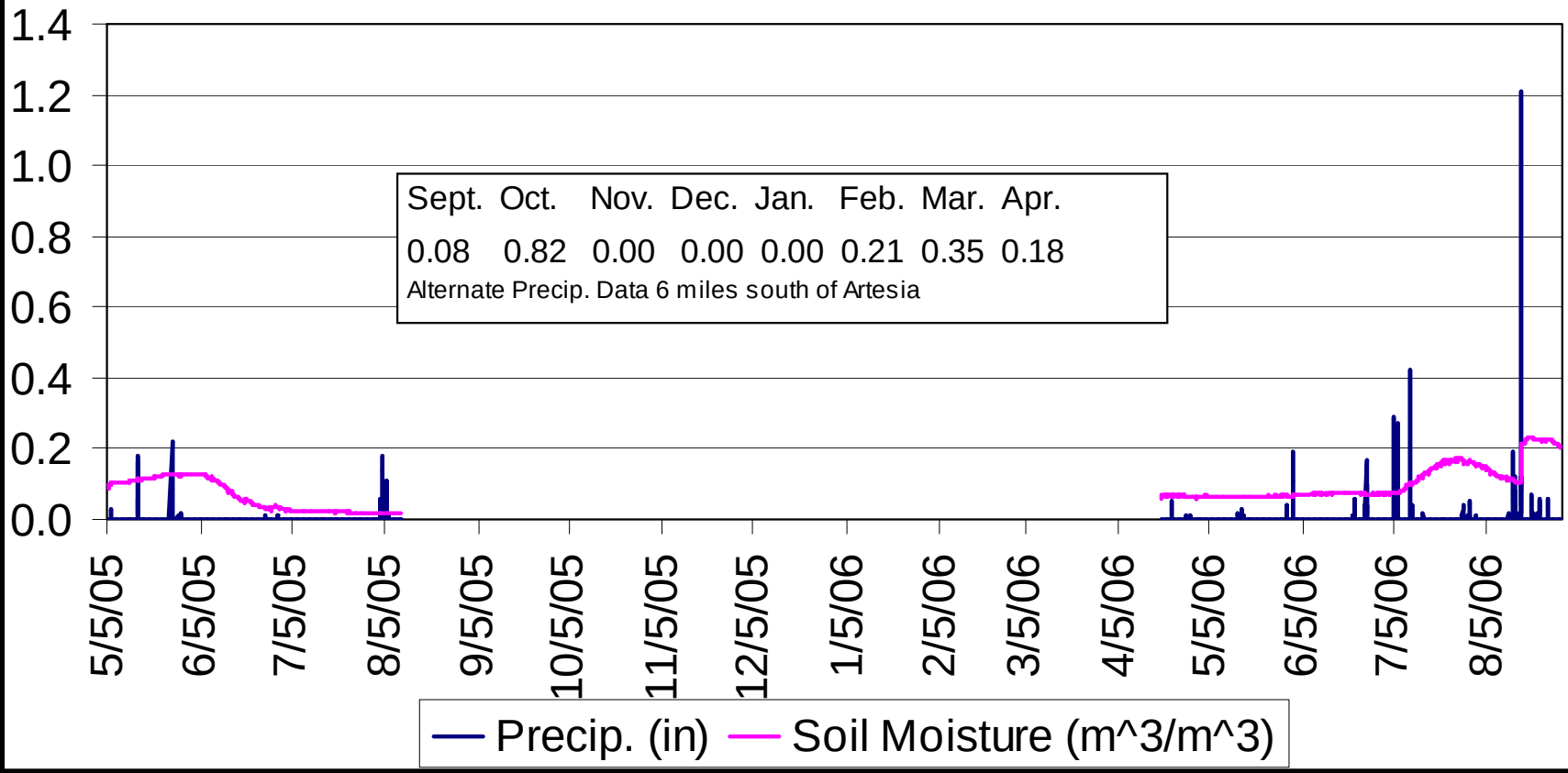
LSD =1.4
LSD = 1.1
LSD = 0.9


n = 1,350
BOUTELOUA spp.
(SEEDING METHOD X HERBICIDE INTERACTION)
HERBICIDE EFFECT ALONE
RANGE = 10.9 – 15.1%
MEAN = 12.6%
SEEDING METHOD EFFECT ALONE
RANGE = 26.7 – 27.1%
(TRILLION & IMPRINTER ONLY)
CANOPY COVER (%)
40
30
20
10
0
a
a
a
a
a
ab
b
b
b
c
c
c
cd
d
e
NO SEED x VO
NO SEED x VT
DRILL x NH
NO SEED x NH
CHOP x NH
CHOP x VT
DRILL x VT
CHOP x VO
DRILL x VO
IMPR x VT
IMPR x NH
TRILLION x VT
TRILLION x VO
TRILLION x NH
IMPR x VO
LSD =3.6


Artesia Revegetation Site – 6/14/06


Artesia Revegetation Site – 6/14/06

Artesia 08/29/06



From 10/15/05 to 06/14/06 the Artesia Site received 1.19 inches of precipitation. From 06/14/06 to 08/29/06 the Artesia Site received 4.61 inches of precipitation; 2.70 inches of this fell between 07/28/06 and 08/29/06.


Artesia Revegetation Site – 8/29/06


Artesia Revegetation Site – 8/29/06

Artesia Revegetation Site

- Sprayed for broadleaf weed control 9/15/06 by airplane
- A combination of Speedzone (3.6 pt/ac, similar to Overdrive)
  - **Carfentrazone-ethyl 0.62%**
  - **2,4-D, 2-ethlhexyl ester 28.57%**
  - **Mecoprop-p acid 5.88%**
  - **Dicamba acid 1.71%)**
- Vista (1.33 pt/ac)
- MSO (4 pt/ac).

SUMMARY

RESULTS

- ***Bouteloua*** **spp. (blue grama, *B. gracilis*; sideoats grama, *B. curtipendula*) were the dominant grasses, with small amounts of switchgrass (*Panicum virgatum*) and alkali sacaton (*Sporobolus airoides*) also emerging. The two grama species were selected and pooled for data collection in 2005 because of their dominance, and to expedite sampling.**

- **Pre-chilling of the seed (stratification or vernalization) prompted rapid germination, suggesting its utility for further applications.**

- **Extreme drought following successful germination and emergence of several species in August 2005 significantly reduced vigor and survival, especially for non-*Bouteloua* species. Most grasses were unable to successfully develop secondary (adventitious) root systems during this drought phase, resulting in reduced survival and vigor regardless of treatment. The gramas, however, have been very resilient. Dormancy mechanisms in other seeded species, coupled with drought effects, may have delayed their first-year germination.**

SUMMARY

RESULTS

- **Broadcast seeding with imprinter and the Trillion broadcast drill were much superior seeding methods in *Bouteloua* spp. establishment (mean of 26.9% canopy cover vs. 3.0% for other methods). This positive effect may be the result of soil-firming compaction, clod reduction, and increased seed-to-soil contact afforded by the Trillion ring rollers (cultipackers) and imprinter design. The use of broadcast seeding followed by imprinting holds further promise in terms of cost savings, requiring only a single pass over a given acreage without the need for prior, preparatory tillage.**

- **While [Vista™ + Overdrive™] and [Vista™ + Telar™] were equally effective in controlling kochia (mean of 1.3% kochia canopy cover vs. 15.3% for no herbicide), canopy cover of the *Bouteloua* spp. derived significant benefit from [Vista™ + Overdrive™] application. This latter interaction may be due to better control of other broadleaf weeds (e.g., Russian thistle, lamb's quarters, pigweed, mallow, nightshade, ground cherry, etc.), augmenting targeted kochia control. Timing of application may have also affected this interaction, as Telar™ was applied late in relation to label recommendations.**

SUMMARY
RESULTS

- **The Trillion drill also exhibited a positive interaction with kochia suppression independent of herbicide treatment, although this effect may be augmented by the weed control impacts of prior, preparatory tillage.**

- **Surprisingly, there were no differences in *Bouteloua* establishment or kochia control between mycorrhizal inoculation and no inoculation. Such inoculation does not appear warranted on soils in the Artesia locale, possibly because of sufficient, inherent mycorrhizal populations associated with remnant patches of alkali sacaton, inland saltgrass (*Distichlis spicata*), and other native species in the general area.**

SUMMARY

RESULTS

- **Germination of *Bouteloua* occurring in depressions (% occurrence) created by imprinting and roller chopping following broadcast seeding averaged 23%, suggesting that these mechanical measures may have limited utility for *Bouteloua* spp. on these soils if applied solely to enhance moisture capture and retention. Imprinting was superior to roller chopping in this regard, however, in correspondence to positive effects of the imprinter noted above. Germination in depressions was greatly enhanced across both seeding methods under herbicide treatment (up to 30% occurrence), suggesting that higher levels of weed control may positively affect the efficacy of this mechanical practice. This will continue to be monitored for other species exhibiting later germination.**

- **There was a significant interaction between seeding method and herbicide application, derived primarily from the enhancement of *Bouteloua* spp. canopy cover beyond single effects of herbicide or seeding method alone for Trillion and broadcast / imprinter applications. Efficacy of [Vista™ + Overdrive™] treatment in particular appears to be enhanced under these two seeding methods.**

SUMMARY

MAJOR POINTS

- ***Bouteloua*** **species established well, given the extreme drought conditions following seeding. Seed stratification is highly recommended for future applications.**

- **Both herbicide treatments for kochia control were effective, particularly the [Vista™ + Overdrive™] treatment which enhanced grass establishment independent of degree of kochia control.**

- **The Trillion drill and broadcast seeding followed by imprinter treatment were superior in establishing a native grass stand. Use of broadcast seeding with an imprinter offers a lower cost alternative because prior, preparatory seedbed tillage is not required.**

- **Mycorrhizal inoculation treatment appears to be ineffective on Pecos River riparian soils in the Artesia locale.**

SUMMARY
FUTURE APPLICATIONS

- **Further monitoring and data collection will be conducted in fall of 2006-07 at Artesia to determine:**
  - **Germination and emergence of other species.**
  - **Establishment and long-term viability of seeded plant community.**
  - **Feasibility of inter-seeding native shrubs and forbs on selected plots exhibiting higher degrees of self-sustaining weed control and grass establishment / productivity.**

- **Re-establishment of the McMillan lakebed study, incorporating a new experimental design and treatments, including:**
  - **Different array of seeding methods, utilizing information derived from the Artesia study.**
  - **Incorporation of polyacrylamide polymer as a seeding treatment**
    - **Row banding**
    - **Seed coatings**

- **Possible re-establishment of Artesia alkali scald site**

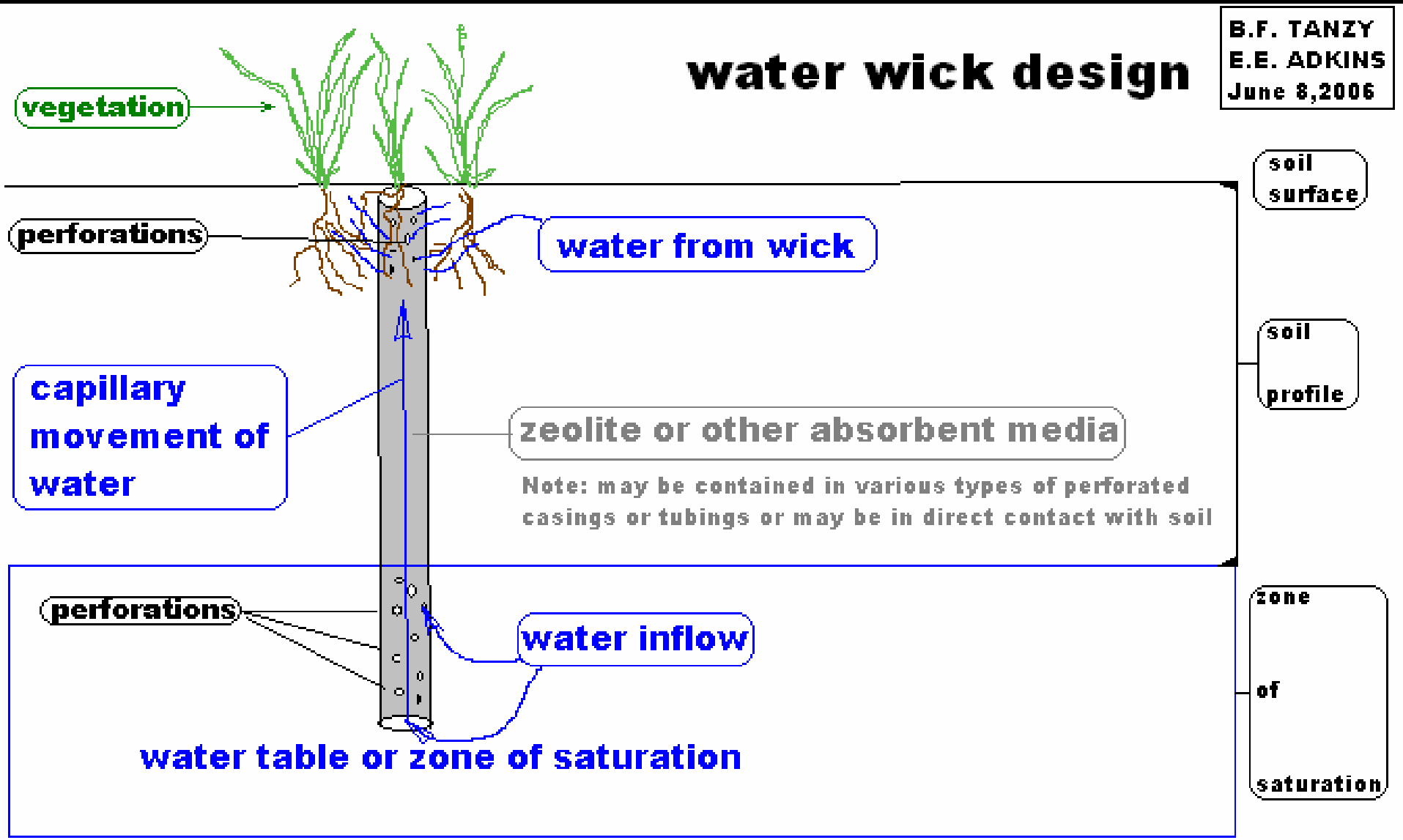

Arsenal Dissipation Study
9/10/06


Arsenal applied by Helicopter 9/8/06
Initial Soil Samples collected 9/10/06


Control Site
9/10/06

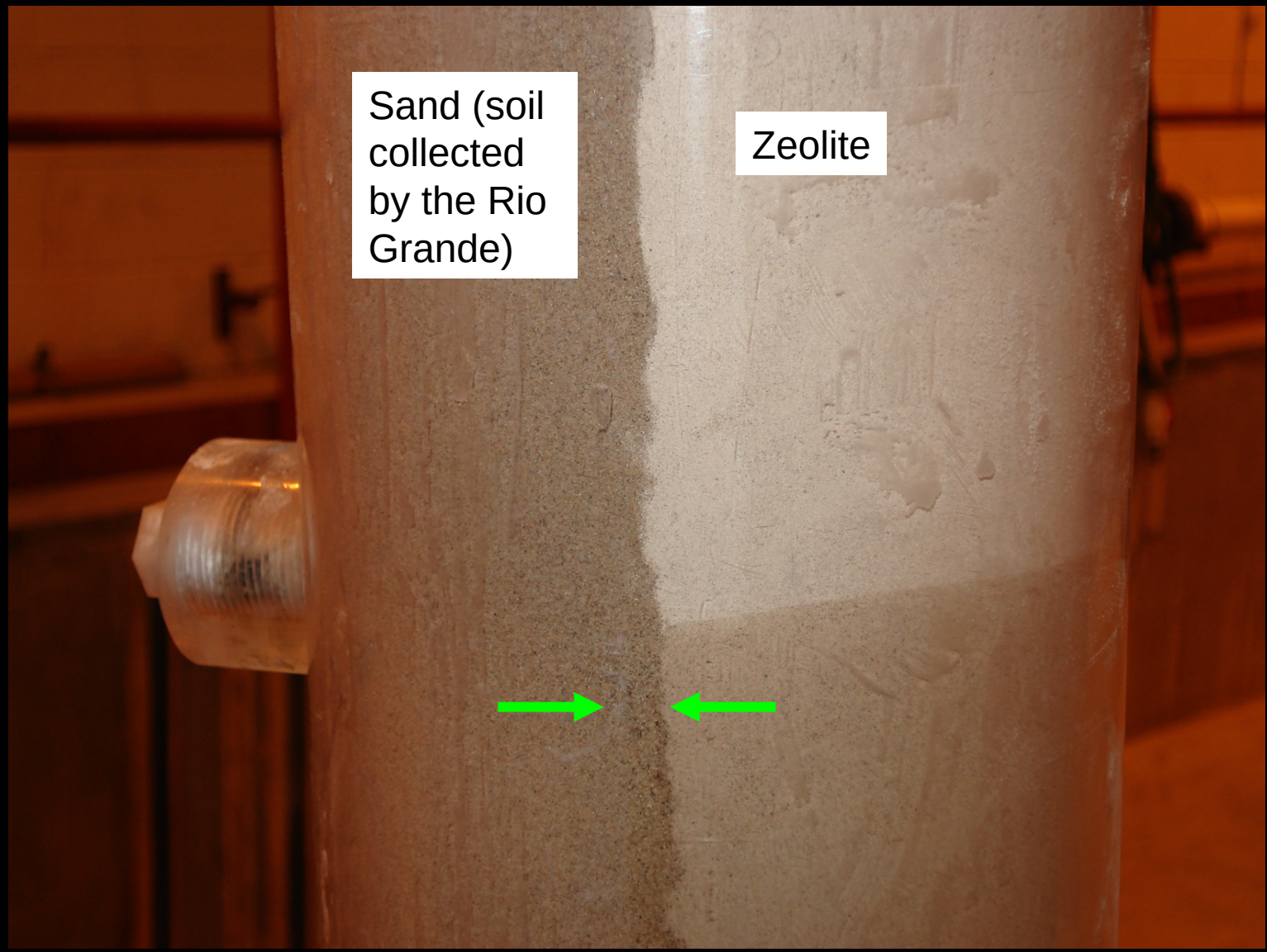

Control Site
9/10/06

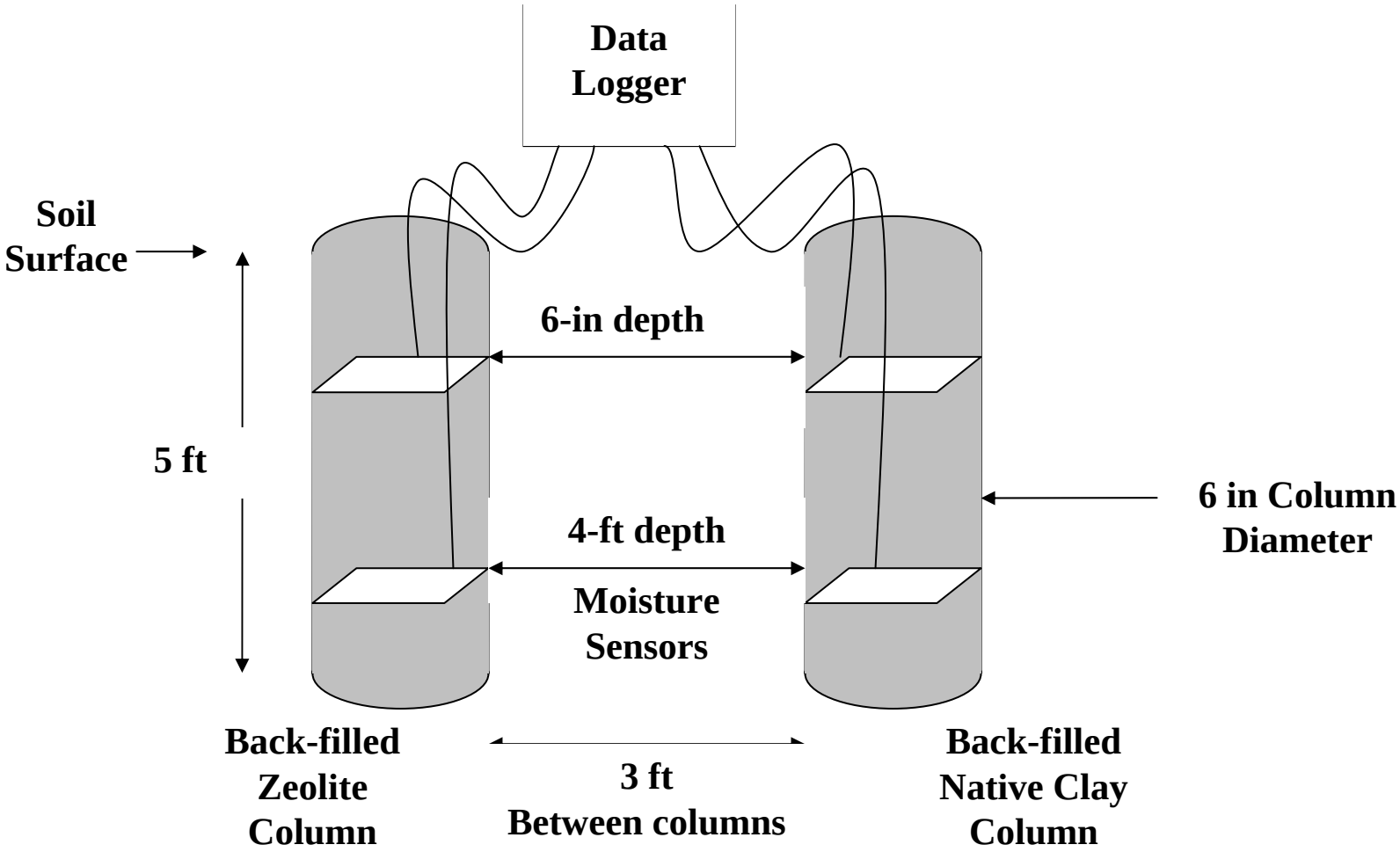
Zeolite Water Wick Study



Eric Lopez showing the height of capillary rise in zeolite portion of the 4-inch split sample of zeolite and sand- 2.89 ft (11 days) above water table

A closer look – minimal horizontal movement




Data
Logger
Soil
Surface
6-in depth
5 ft
4-ft depth
Moisture
Sensors
6 in Column
Diameter
Back-filled
Zeolite
Column
3 ft
Between columns
Back-filled
Native Clay
Column

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

Bureau of Reclamation

Managing Water In The American West