Revegetation Strategies and Technologies for Restoration of Native Shrub/Grass Plant Communities on Xeric Saltcedar Infestation Sites

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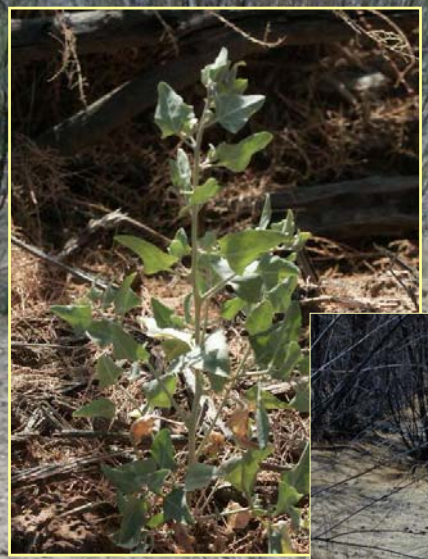
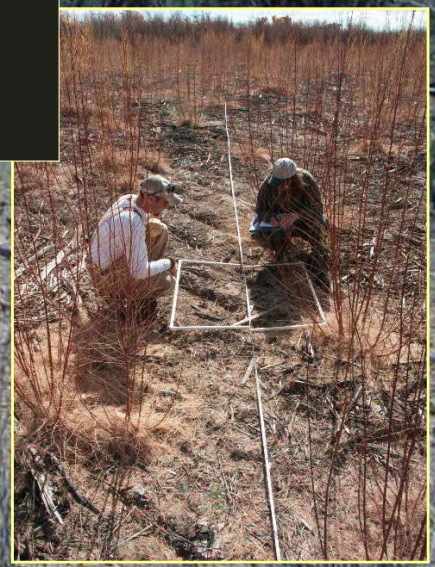


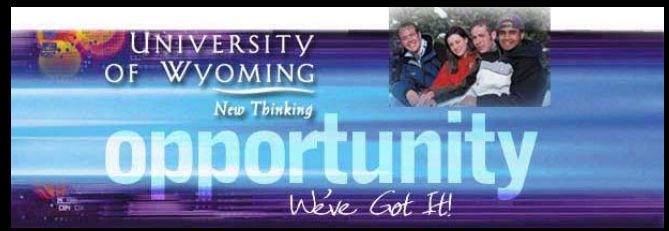


Diorhabda elongata

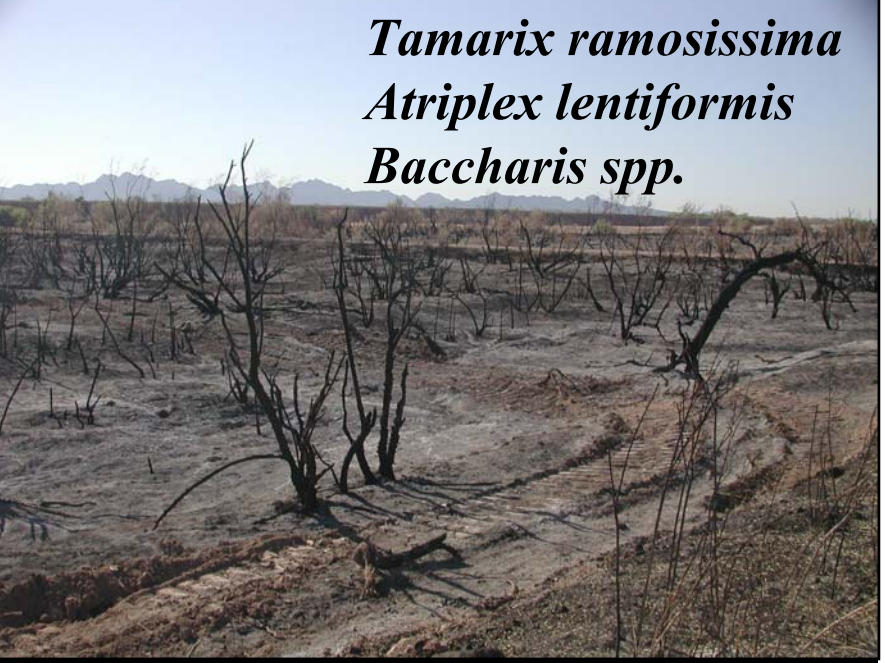
Initiative for Future Agriculture and Food Systems

ARS
APHIS
NRCS (PMC)

Saltcedar Biological Control Consortium



Saltcedar Revegetation Research Sites



Tamarix ramosissima
Atriplex lentiformis
Baccharis spp.

Cibola burn site

(~45 miles N. of Yuma, AZ)

3.5 miles

Palo Verde, CA

COLORADO RIVER

Cibola

5.5 miles

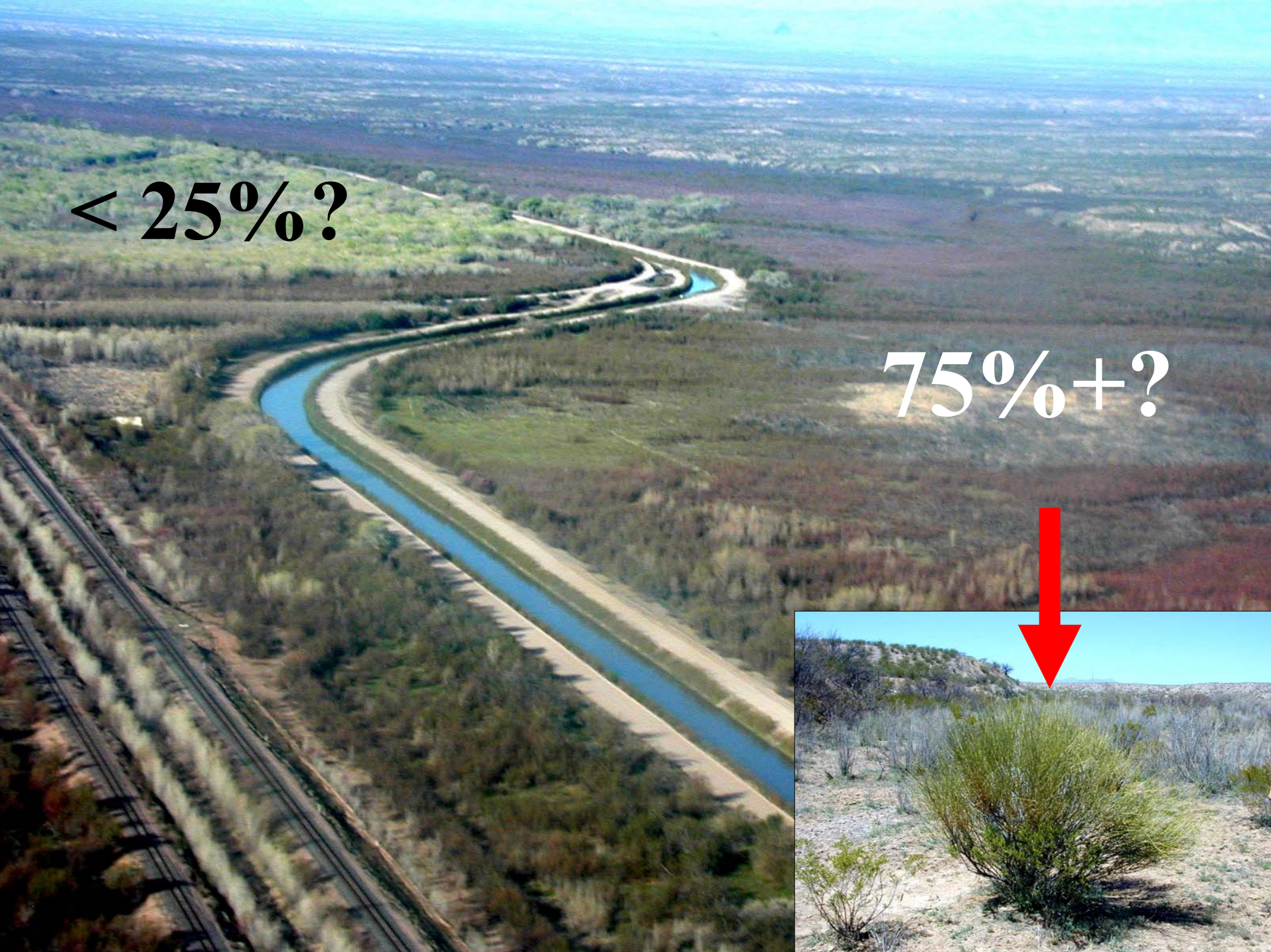
Cibola National Wildlife Refuge

Latitude 33.3902° N; Longitude 114.7078° W;
UTM Zone 11, NAD 27, 713212E, 3696701N;
SW ¼ Section 25 and NW ¼ Section .36, T. 1 N., R. 24 W.

Lower Rio Grande:

- Big Bend National Park (NPS)
- Big Bend Ranch State Park (TP&W)
- Santa Elena Canyon Protected Area, Mexico
- Maderas del Carmen Protected Area, Mexico

Tamarix ramosissima
Arundo donax
Prosopis spp.
Acacia spp.


< 25%?
75%+?


Lepidium latifolium

22.4 cm MAP
13.9 cm (62%), July - Oct

Mean spacing – 1.4 m
No. primary stems (> 2.5 cm) – 5.6
Stem Diameter – 3.8 cm
Canopy height – 5.4 m
Litter depth, cover – 2.2 cm, 78%
Litter biomass – 7,475 kg ha^{-1}
(n = 120)


Texture = SCL, CL
EC = range 12.8-19.4,
μ = 16 mmhos cm-1
SAR = range 16.5-21.2,
μ = 19 meq L-1
pH = 8.4
OM = 1.1%
NO3-N = 1.7 ppm
P = 15.2 ppm
K = 618 ppm
Mycorrhizal presence = 0

Groundwater data

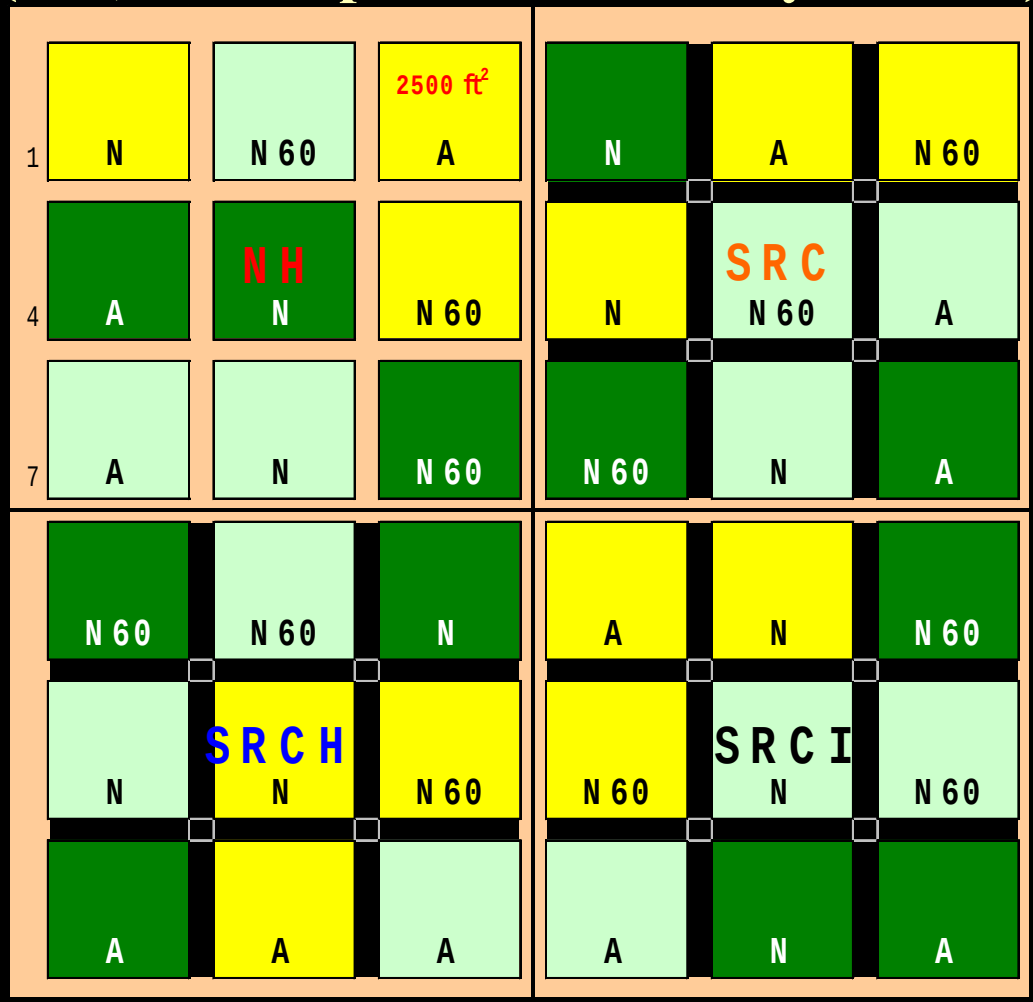
Mean depth = 2.1 m

EC = 3,500 µS cm^{-1}
pH = 7.5
$CaCO_3$ = 674 mg L^{-1}
$SO_4^{=}$ = 989 mg L^{-1}
Na^{+} = 573 mg L^{-1}
Cl^{-} = 282 mg L^{-1}
NO_3/NO_2-N = 0.03 mg L^{-1}

Al^{+} = 76,300 mg L^{-1}
Fe^{++} = 65,500 mg L^{-1}
Mn^{++} = 4,170 mg L^{-1}
Ca^{++} = 246 mg L^{-1}
Mg^{++} = 82 mg L^{-1}

STUDY 2 – Biocontrol Simulation

(NH, SRCH plots herbicidally treated)



EM38 readings – all plots
AM samples – 2 per rep

(4 Replications, 4.8 ha)

Herbicide application (triclopyr) in simulation of insect injury

Mid-February 2002

Mechanical Shredding

Using HydroAx™ with Woodgator™ for plot delineation

San Marcial, NM Study Site

(Two studies – 22.6 acres)

April 2002

Study 2

Study 1

N

Completed plot shredding

Early July 2002

Broadcast seeding of four custom seed mixtures

+ mycorrhizal inoculation

+ soil nitrogen manipulation

Glomus

- *mosseae*
- *intraradices*
- *fasciculatus*

Enhance capture of:

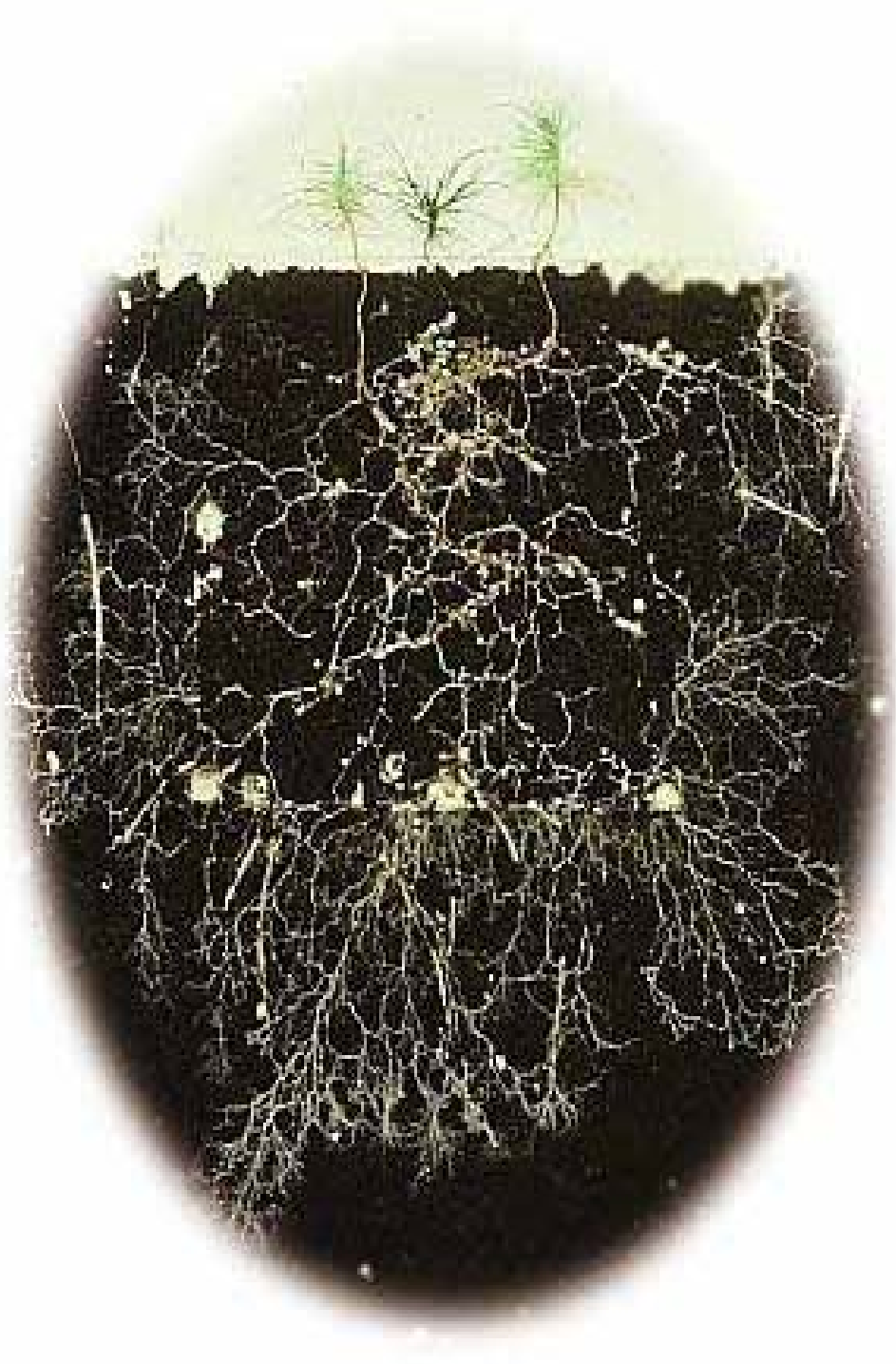
Soil moisture

Phosphorous

NH_4

Salt tolerance?

(Lab / Greenhouse Studies)

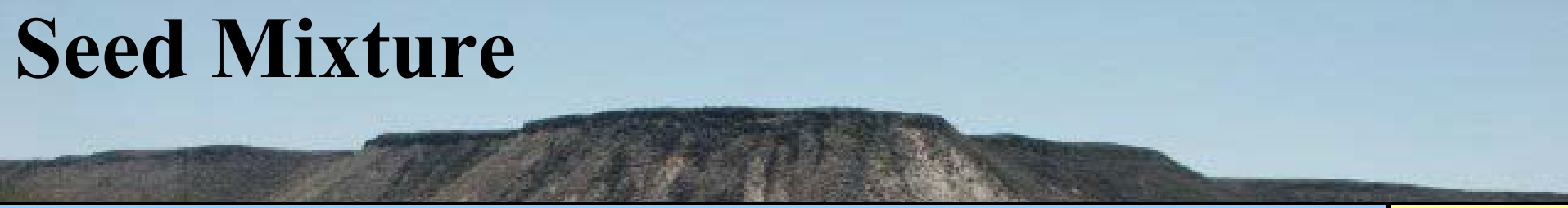


Roller chopping

- seed and inoculum incorporation;
- enhance moisture capture and retention;
- reduce surface soil salinity impacts.

Imprinting following roller chopping to further enhance moisture capture, and reduce salinity

Seed Mixture



Scientific Name	Common Name	Culivar or Pre-Release	Mixture Rate (%)
STANDARD MIXTURE - STUDY 2			
Bouteloua curtipendula	**Sideoats grama**	Niner	10.0
Elymus trachycaulus	**Slender wheatgrass**	Pryor	11.0
Panicum virgatum	**Switchgrass**	Blackwell	15.0
Pascopyrum smithii	**Western wheatgrass**	Arriba	10.0
Sporobolus airoides	**Alkali sacaton**	Salado	15.0
Sporobolus giganteus	**Giant dropseed**		5.0
Anemopsis californica	**Yerba mansa**		2.0
Plantago insularis	**Wooly plaintain**		2.0
Sphaeralcea coccinea	**Scarlet globemallow**		2.0
Atriplex canescens	**Fourwing saltbush**		12.0
Baccharis glutinosa	**Seep willow**		3.0
Atriplex lentiformis	**Quailbush**		4.0
Lycium andersonii	**Anderson's wolfberry**		7.0
Chrysothamnus nauseosus graveolens	**Rubber rabbitbrush**		2.0
		TOTALS =	**100.0**

November 2002

- ✓ Frequency
- ✓ Density

Atriplex lentiformis

Atriplex canescens


Bouteloua curtipendula

Elymus trachycaulus


Lycium andersonii

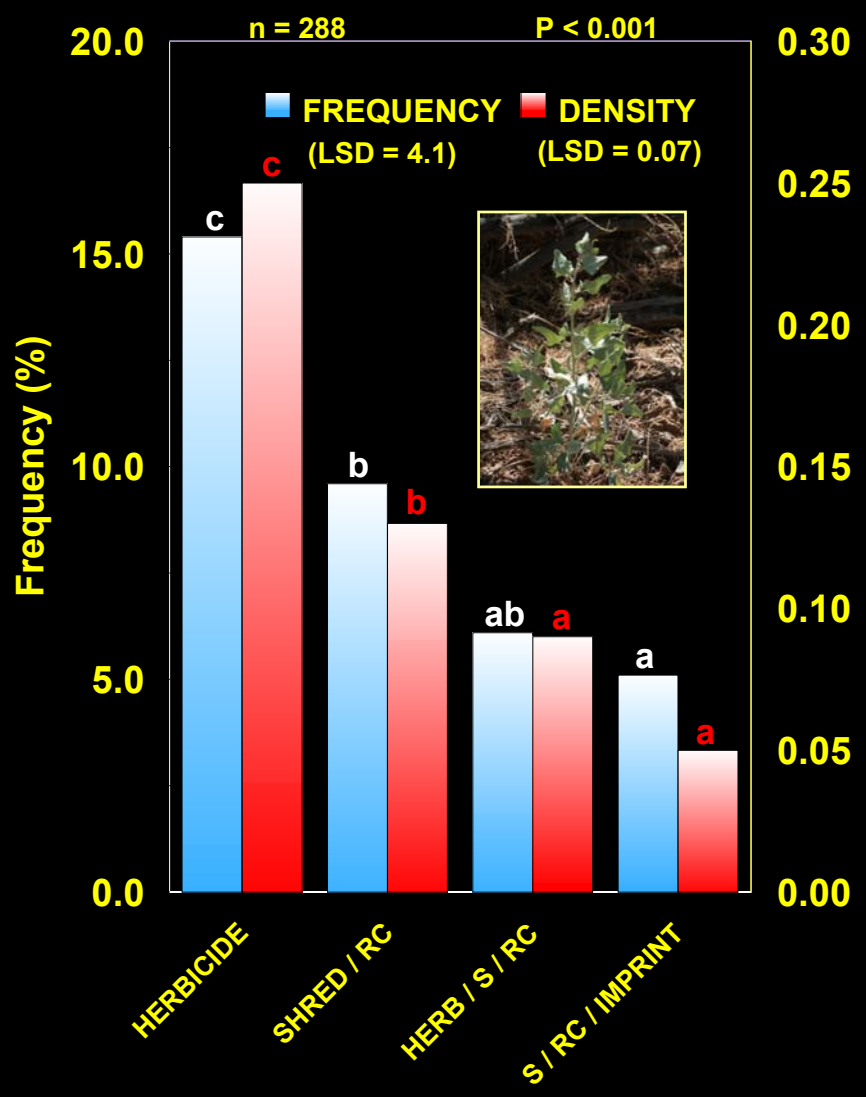
Non-Seeded Species

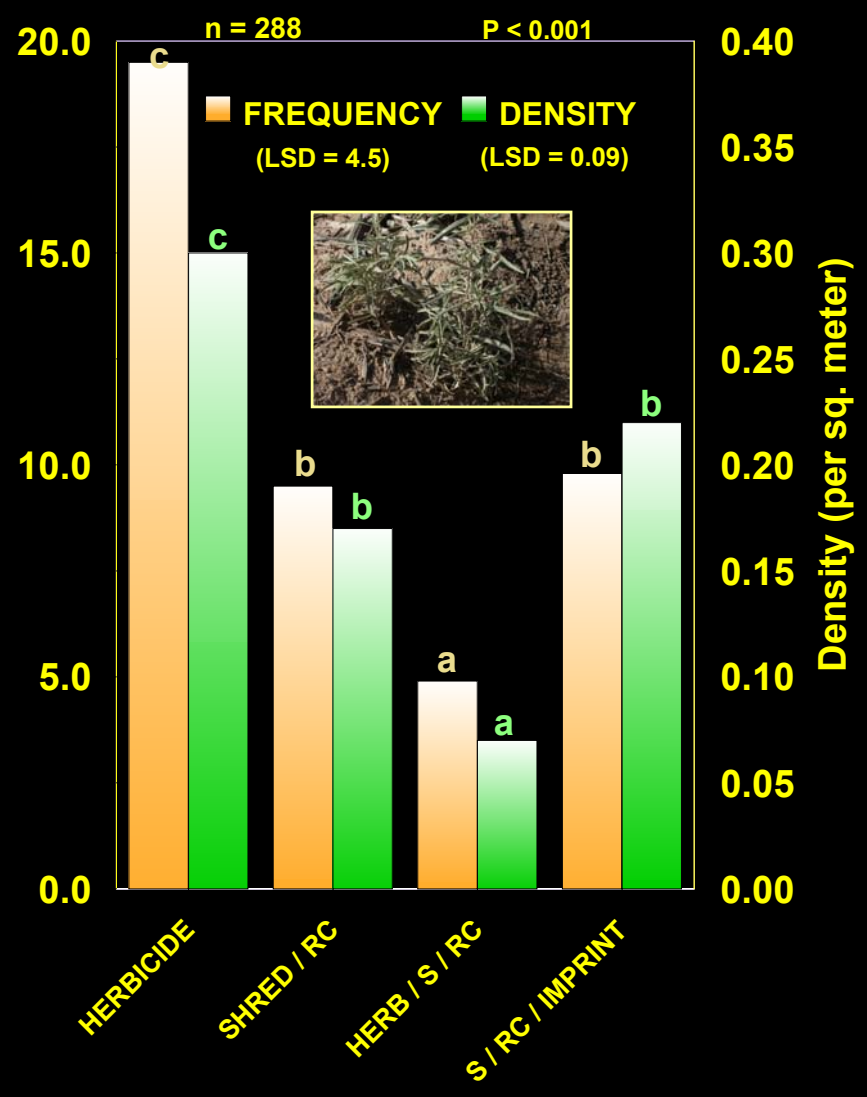
Panicum obtusum

Cucurbita foetidissima

Heliotropium curassavicum

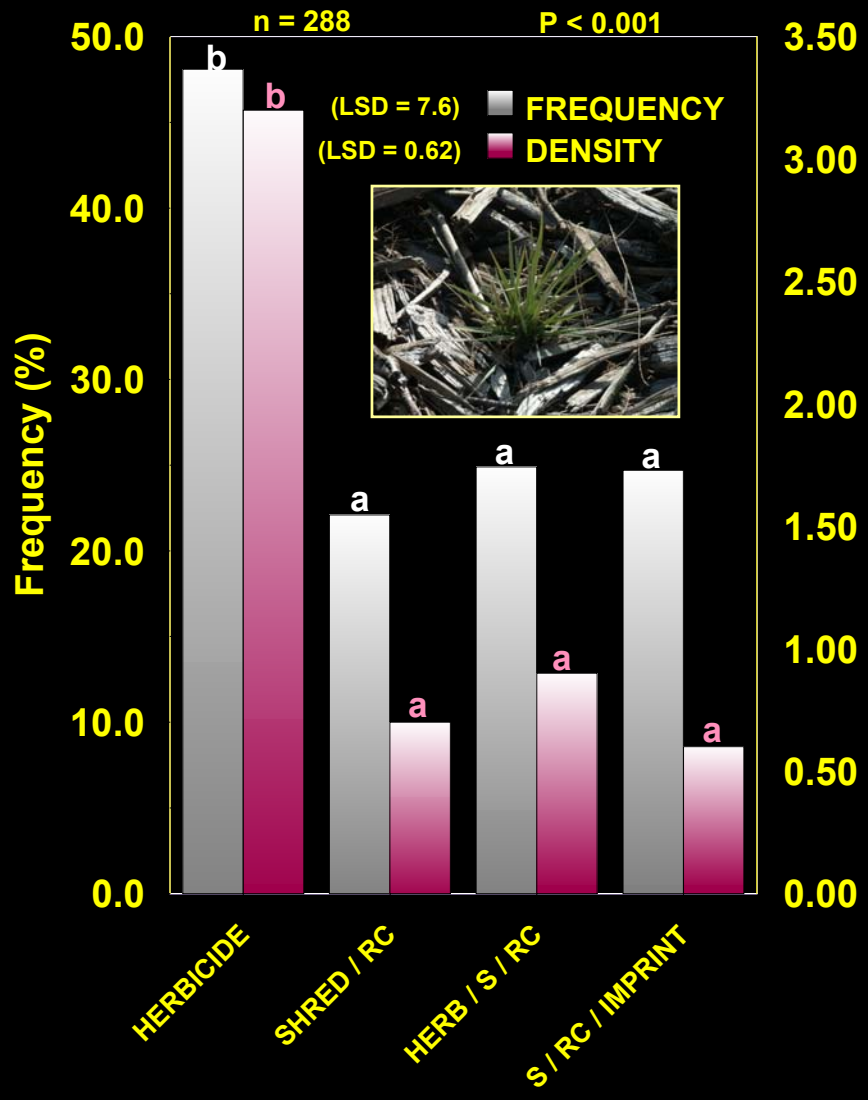
Datura stramonium





SALTCEDAR TREATMENT

Elymus trachycaulus



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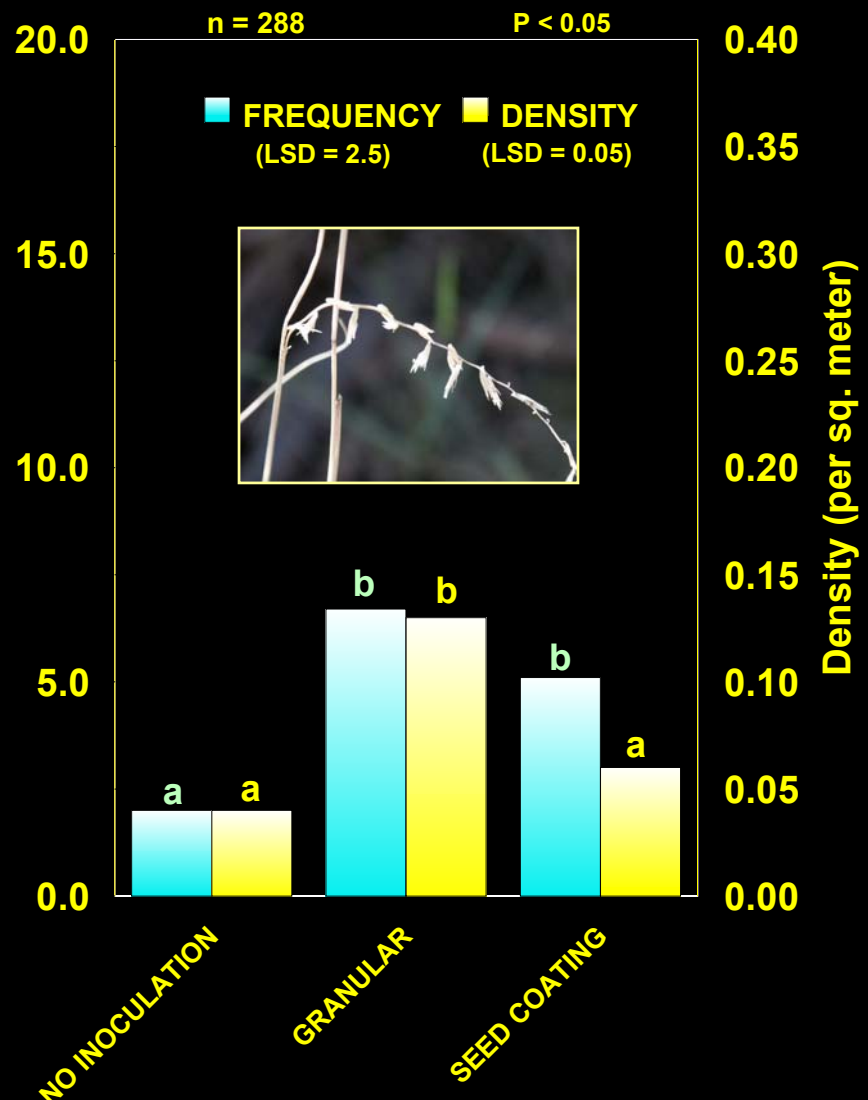
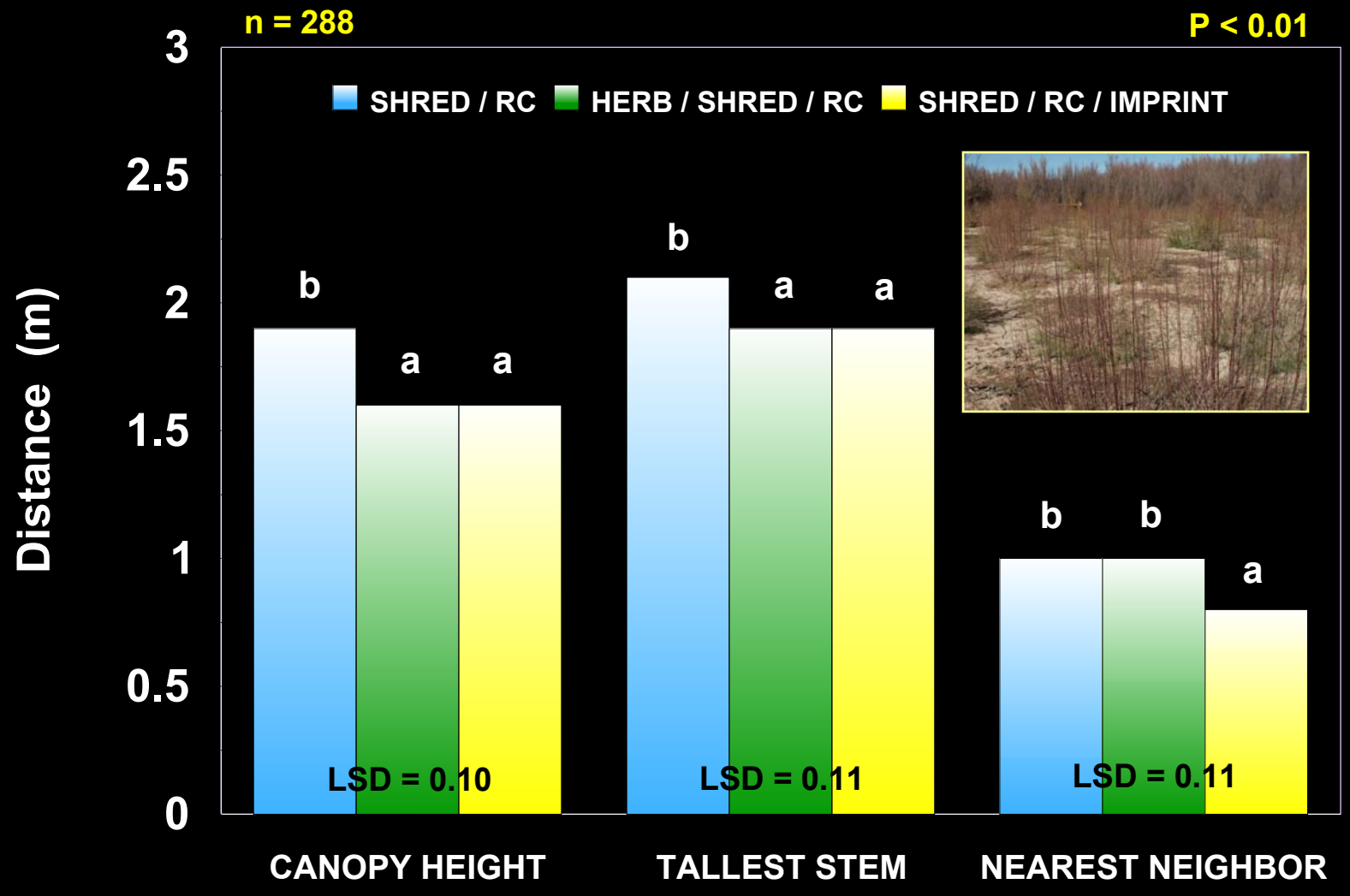
Bouteloua curtipendula



MYCORRHIZAL INOCULATION

Tamarix ramosissima



SUMMARY OF PRELIMINARY RESULTS
(1st Year Data, 2002)

- ATLE, ATCA, ELTR
  - Frequency, density highest in seeded herbicide plots (no mechanical treatment) - 1.5-2X
  - **Plants in herbicide plots stunted (2-5 cm), weak, stressed**

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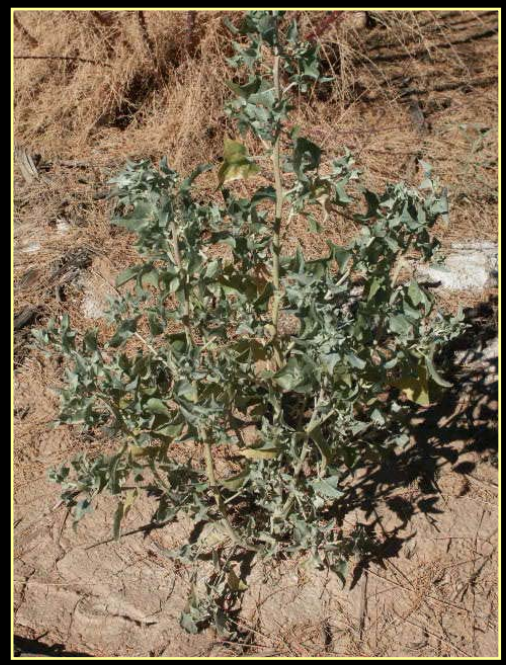
  - Fewer plants but much greater productivity in mechanically treated plots:
    - **ATLE: up to 1.2 m**
    - **ATCA: up to 0.9 m**
    - **ELTR: up to 30 cm**



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  - Fewer plants but much greater productivity in mechanically treated plots:
    - **ATLE: 3-4'**
    - **ATCA: 2-3'**
    - **ELTR: 12"**
  - **Negligible response to mycorrhizal inoculation or N**
  - ***** 2nd year data (2003):**
    - **anticipate reversal of frequency, density results**
    - **additional species emerging, breaking dormancy**

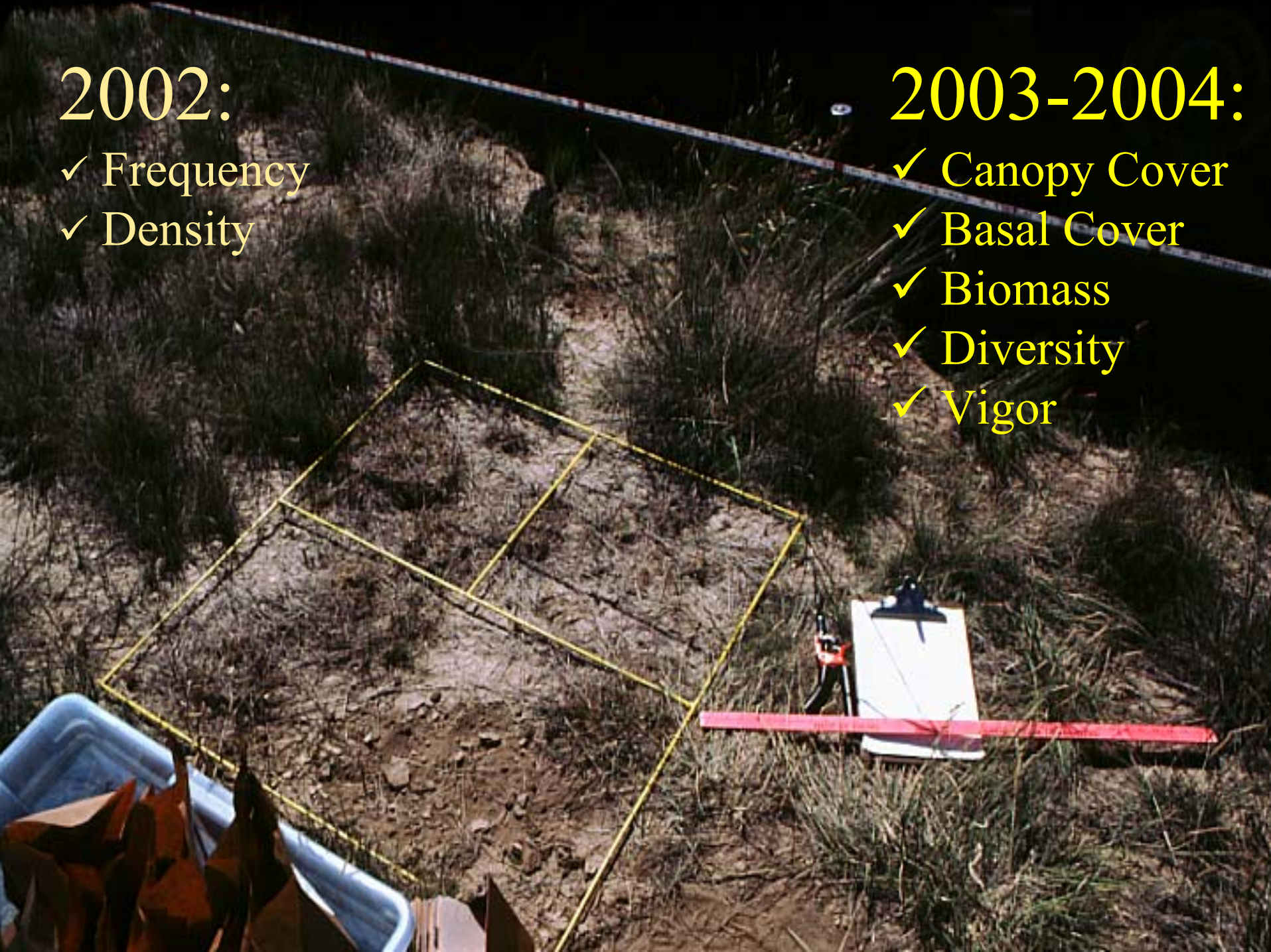
SUMMARY OF PRELIMINARY RESULTS
(1st Year Data, 2002)

- BOCU
  - ✓No difference in frequency, density between treatments (limited 1st year emergence)
  - ✓Emerged plants 30-45 cm, vigorous
    - **1st year seed production**
  - ✓**Positive mycorrhizal response**
    - Granular and seed coating inoculation 1.5-2X no mycorrhizae (frequency and density)
    - No difference between granular and seed coating
  - ✓ Recent cooperative research start with Dr. Anna Sher, DU-Denver, on mycorrhizal adaptation and inoculation potential across salinity gradients and SW riparian species.

SUMMARY OF PRELIMINARY RESULTS
(1st Year Data, 2002)

- TARA
  - Relative cover, stem count – no difference
  - Canopy and tallest stem height
    - SRC – 1.9 m
    - SRCH, SRCI – 1.6 m
- **No correlation of emergence or establishment with soil salinity / sodicity.**

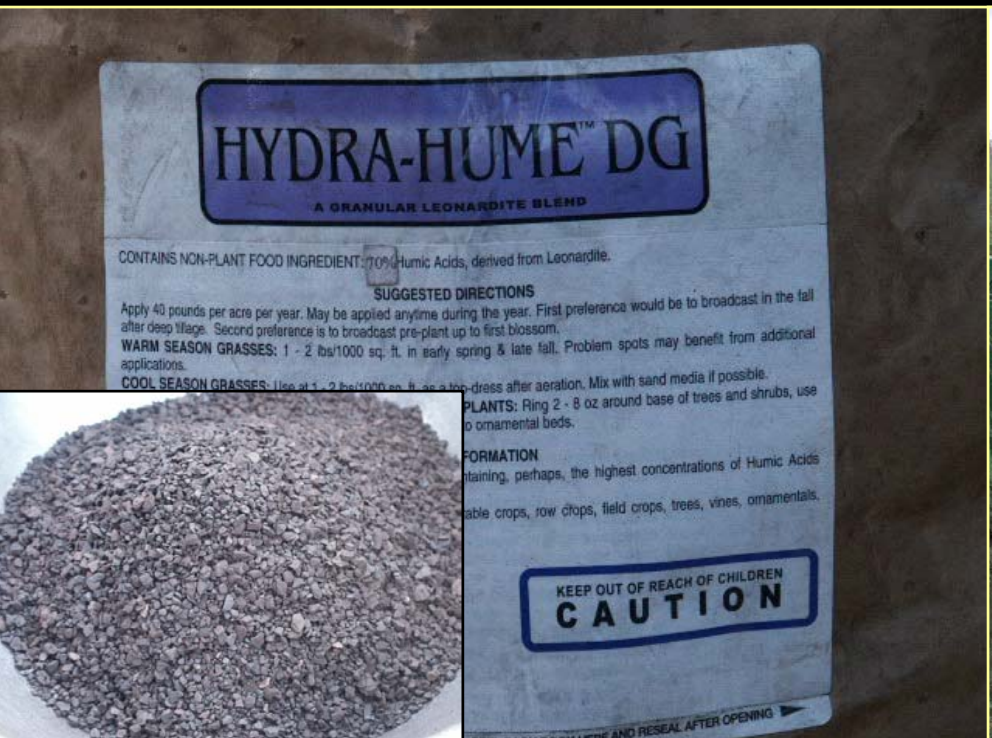

Absence of weed pressure (1º KOSC)


2002:
✓ Frequency
✓ Density
2003-2004:
✓ Canopy Cover
✓ Basal Cover
✓ Biomass
✓ Diversity
✓ Vigor

HYDRAHUME AND SODIUM

HELENA®

HELENA CHEMICAL COMPANY



Bureau of Reclamation

Managing Water In The American West

Tamarix ramosissima

Dumas

Lake Meredith National Recreation Area

Plum Creek

McBride Canyon

Bonita Creek

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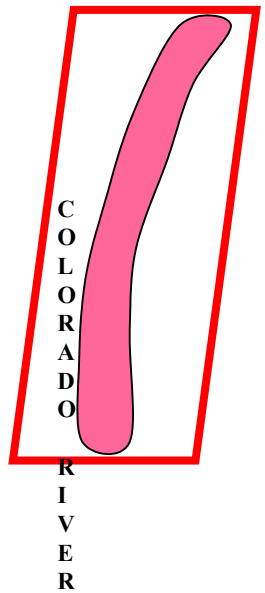

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