Sequestration of Salt from In-Situ Riparian Soil Using Saltgrass

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ReNUWIt
Re-inventing the Nation's URBAN WATER INFRASTRUCTURE

Introduction

- Southwestern U.S. is a arid environment (< 300 mm rainfall/yr.) where most rain water evaporates and concentrates salt in soil
  - Affects soil properties
  - Hinders plant growth
- Rio Grande was channelized in support of agriculture irrigation
  - Stopped river bank flooding in riparian areas
  - Flooding, however, leaches salt from soils
  - Salt accumulated in riparian soils along Rio Grande
    - Native salt intolerant plants disappeared
    - Salt tolerant plants flourished
    - Less ecologically diverse environment not desirable by wildlife
- This study assesses the use of saltgrass to sequester salt from riparian soil at the Sunland Park ReNUWIt Test-Bed site as part of an on-going study to rehabilitate riparian areas.
- Inland saltgrass [*Distichlis spicata* var. stricta (L.) Greene] **(Fig. 1)**
  - New Mexico native
  - Thrives in salty soils where drainage is poor
  - Halophyte (salt-tolerant)
  - Amount of salt retained within plants is currently unknown

Objectives and Long-Term Goal

- Determine the amount of salt sequestered in the saltgrass over time under field conditions
- Determine the effects of clinoptilolite zeolite amendment on salt uptake by saltgrass
- Long-term Goal: Use saltgrass as a method to remove salt from riparian soils so that other salt intolerant riparian plants can thrive

Figure 1. Saltgrass with its root system. Highest density of root system in top 3 inches of subsurface soil.

Figure 2. Saltgrass at ReNUWIT test-bed site.

Figure 3. 1:5 saltgrass:distilled water solutions (left) and ground saltgrass (right).

Figure 4. Analysis with the HACH sension5 (left)and the HACH HQ30d (right).

Methodology

- Field site - ReNUWIt Sunland Park Test-Bed for Riparian Rehabilitation in Sunland Park, NM
  - Drainage canal on-site containing groundwater flow, flood runoff, and irrigation return flow
  - 6 established 40' x 40' saltgrass plots that alternate between clinoptilolite zeolite amended and unamended soils **(Fig. 2)**
- Sampling: 4 times over a 2 month period
  - Each soil sampling was of 3 holes/plot
    - 1st sampling: 4 depths: surface, 2", 6", 10"
    - 2nd-4th sampling: 2" depth only
  - Each plant tissue sampling: 3 plants/plot
  - Each groundwater sampling: 1 upgradient well
- Analysis
  - Soil
    - Air-dried for 72 hours
    - Triplicate 1:5 soil:distilled water solution by weight per sample
  - Plant tissue
    - Oven-dried for 48 hours at 65 °C
    - Ground **(Fig. 3)**
    - 1:5 plant tissue:distilled water solution by weight per sample **(Fig. 3)**
  - Soil, plant tissue, and groundwater **(Fig. 4)**
    - HACH HQ30d: pH
    - HACH sension5: EC, TDS, and salinity

Results

- Saltgrass salinity **(Fig. 5)**
  - Range: 13.50-60.00 ppt
  - Average: 24.40 +/- 8.43 ppt
  - Before a major rain event **(Fig. 6)**
    - Range: 17.50-60.00 ppt
    - Average: 29.37 +/- 8.56 ppt
  - After a major rain event **(Fig. 6)**
    - Range: 13.50-34.00 ppt
    - Average: 19.43 +/- 4.49 ppt
- Salinity differences due to zeolite amendment **(Fig. 5)**
  - Amended plots showed greater salt uptake: 1st and 3rd sampling events
  - Unamended plots showed greater salt uptake: 4th sampling event
  - No difference between plots: 2nd sampling event
  - Unamended plot salinity
    - Range: 14.00-42.15 ppt
    - Average: 23.82 +/- 6.17 ppt
  - Amended plot salinity
    - Range: 13.50-60.00 ppt
    - Average: 24.97 +/- 10.27 ppt
- Soil salinity levels (**Figures 7 & 8)**
  - Surface
    - Range: 12.33-63.00 ppt
    - Average: 33.39 +/- 18.41 ppt
  - 2” depth
    - Range: 2.11-7.39 ppt
    - Average: 3.82 +/- 1.92 ppt
  - 6” depth
    - Range: 1.06-4.89 ppt
    - Average: 2.60 +/- 1.80 ppt
  - 10” depth
    - Range: 0.72-4.06 ppt
    - Average: 1.54 +/- 1.26 ppt

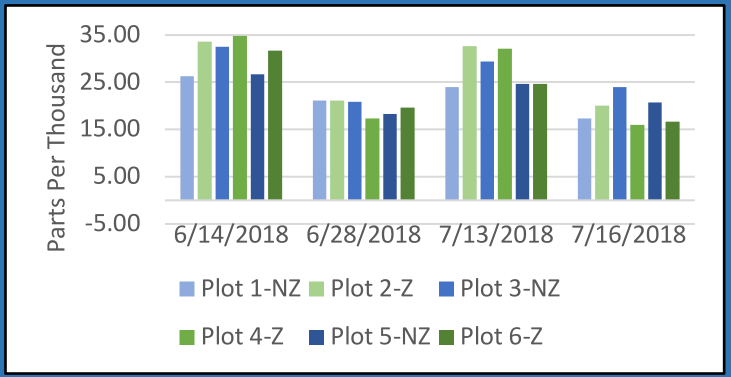

Figure 5. Saltgrass salinity measurements. (NZ = No Zeolite Z = Zeolite)

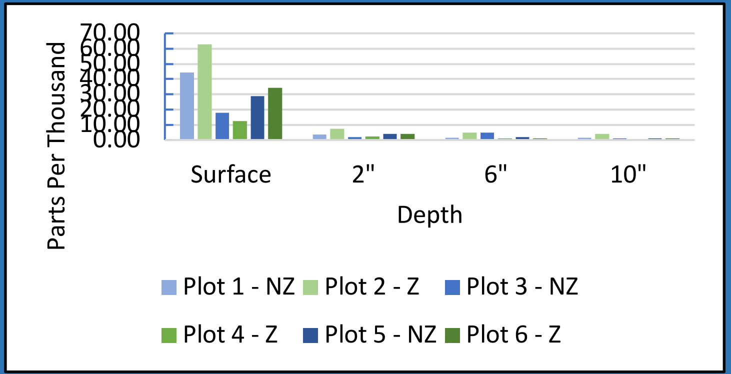

Figure 7. Soil salinity measured at various soil depths. (NZ = No Zeolite Z = Zeolite)

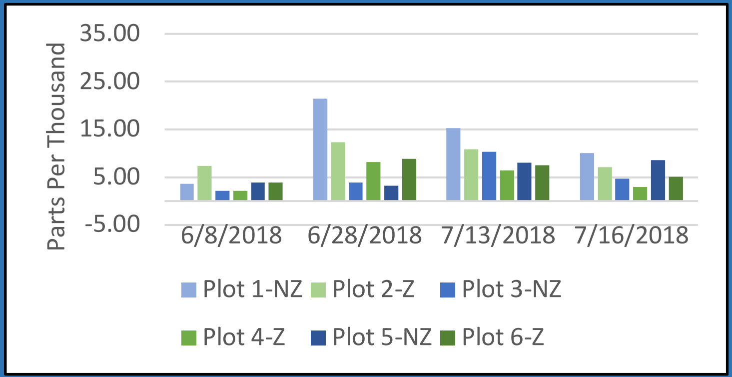

Figure 8. Soil salinity measurements at top 2” of soil layer. (NZ = No Zeolite Z = Zeolite)

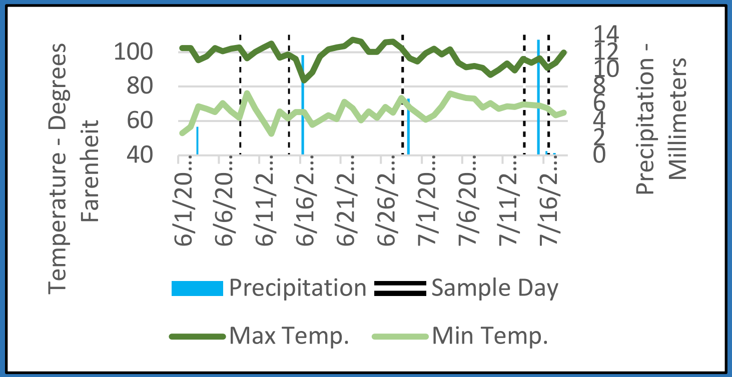

Figure 6. Test bed site maximum temperature, minimum temperature, and precipitation.

Conclusion

Saltgrass sequestered a range of 13.50-60.00 ppt salt. Results showed that saltgrass salinity levels declined after large precipitation events. This data can inform management decisions in that saltgrass can be used to remediate saline soils and should be cut prior to large irrigation or precipitation events to maximize salt removal.

Data is inconclusive concerning differences in salinity uptake by saltgrass due to zeolite amendment of the soil. No statistical significance was shown in an ANOVA interpretation of the results. A long-term study is recommended to determine a statistically significant difference.

Salt is retained primarily at the soil surface. Salinity levels in surface soils were ten times greater than sub-surface soil salinity levels on average.