Sequestration of Salt from In-Situ Riparian Soil Using Saltgrass

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Introduction

The southwestern U.S. is a primarily arid environment where little rainfall (< 300 mm/yr) is available to percolate through the soil. Most of the rain water evaporates leaving concentrated salt in the top soil. This often leads to a buildup of salt in the plant-root-zone of the top soil layer. The salt affects the soil properties and hinders plant growth. In New Mexico, the Rio Grande was channelized historically in support of irrigation for agriculture purposes. However, this channelization stopped river bank flooding in riparian areas. Flooding is used to leach salt from the soils allowing a variety of plants to thrive. Overtime, the salt in riparian soils along the Rio Grande has accumulated. Native plants that are salt intolerant have disappeared while salt tolerant plants, including exotic and plant species considered invasive, have flourished. These changes in riparian ecosystems have resulted in a less ecologically diverse environment that is not desirable by wildlife. This study assesses the use of inland saltgrass [*Distichlis spicata* var. stricta (L.) Greene] to sequester salt from riparian soil at the ReNUWIt test-bed site, referred to as Sunland Park throughout this abstract, located at Sunland Park in New Mexico. Saltgrass is native to New Mexico and many other states west of the Mississippi. Saltgrass thrives in salty soils where the drainage is poor; it is salt-tolerant (halophyte). However, the amount salt within the plants at any given time is not currently known. This study focused on measuring salinity levels in saltgrass as part of an on-going study to rehabilitate a riparian area at Sunland Park.

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

Methodology

Soil, saltgrass, and groundwater were randomly sampled on four occasions from six 40 ft by 40 ft established saltgrass plots at Sunland Park. Of the six plots, three plots had the top three inches of top soil amended with clinoptilolite zeolite at a volumetric ratio of 50% zeolite and 50% native riparian soil and three plots had were not amended with zeolite. Soil was first sampled from three locations from each plot at four depths (surface, 2 in, 6 in, and 10 in) to determine salinity levels within and below the plant root-zone. Subsequent soil samples were taken randomly from three locations from each plot at the soil surface within the 2-in depth where the highest percentage of plant roots exist. Saltgrass was sampled randomly from three locations from each plot on each visit. A groundwater sample was collected from a well upgradient from the plots on each visit.

Soil, saltgrass, and groundwater samples were all tested for salinity, pH, electrical conductivity, and total dissolved solids. Soil samples were air-dried for 24-48 hours. A slurry of 1:5 ratio by volume of soil:distilled water was created. The mixture was agitated for 20 minutes, rested for 24 hours, and then centrifuged. A portion of the solution was then removed from each vial and analyzed for salinity, pH, electrical conductivity, and total dissolved solids using the HACH HQ30d and the HACH Sension5. Plant samples were washed with tap water and deionized water and then dried in oven for 48 hours at 65 °C. Each sample was then ground and mixed for homogeneity. A 1:5 saltgrass:distilled water mixture was created, agitated for 20 minutes, rested for 24 hours, and then filtered using a vacuum filter and 47 mm glass fiber filters. The filtered solution was then analyzed using the same two instruments. Groundwater samples were tested on-site using the same two instruments.

Results

Data show a range of salinity values in saltgrass samples from 13.50-60.00 parts per thousand (ppt) with an average of 24.40 +/- 8.43 ppt. Saltgrass before a major rain event show values from 17.50-60.00 ppt with an average of 29.37 +/- 8.56 ppt. Saltgrass after a major rain event show values from 13.50-34.00 ppt with an average of 19.43 +/- 4.49 ppt (Figures 5 & 6).

Zeolite amended plots showed greater salt uptake on the first and third sampling events while the fourth sampling event showed unamended plots with greater salt uptake. The second sampling showed no difference between plots. Saltgrass from unamended plots show values from 14.00-42.15 ppt with an average of 23.82 +/- 6.17 ppt. Saltgrass from zeolite amended plots show values from 13.50-60.00 ppt with an average of 24.97 +/- 10.27 ppt.

Salinity levels in soil at the surface show values from 12.33-63.00 ppt with an average of 33.39 +/- 18.41 ppt. Salinity levels in soil at the 2" depth show values from 2.11-7.39 ppt with an average of 3.82 +/- 1.92 ppt. Salinity levels in soil at the 6" depth show values from 1.06-4.89 ppt with an average of 2.60 +/- 1.80 ppt. Salinity levels in soil at the 10" depth show values from 0.72-4.06 ppt with an average of 1.54 +/- 1.26 ppt (Figures 7 & 8).

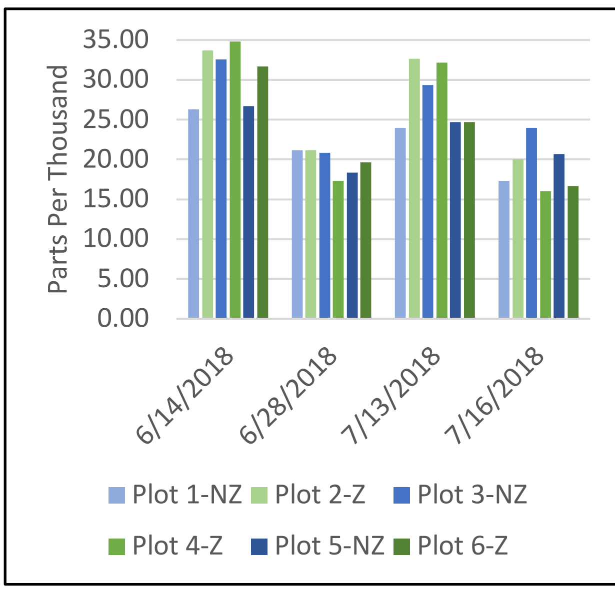

Figure 5. Saltgrass salinity measurements. (NZ = No Zeolite Z = Zeolite)

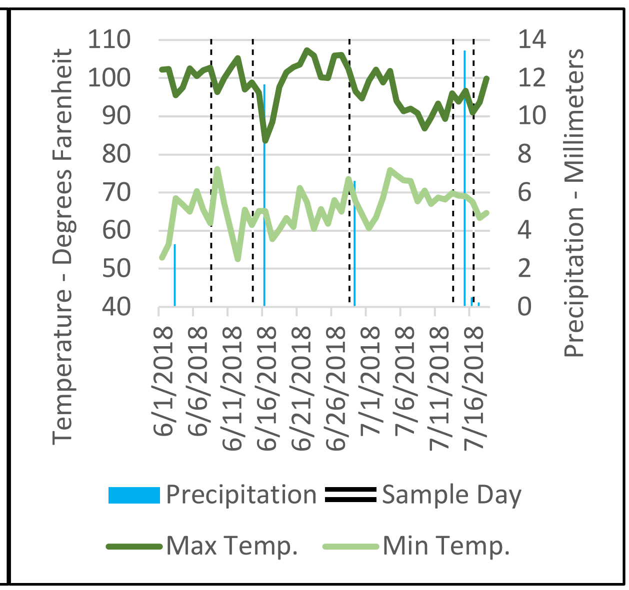

Figure 6. Test bed site maximum temperature, minimum temperature, and precipitation.

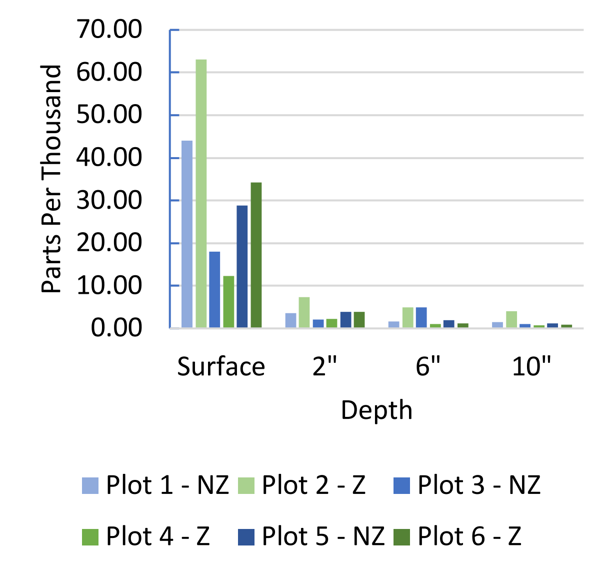

Figure 7. Soil salinity measured at various soil depths. (NZ = No Zeolite Z = Zeolite)

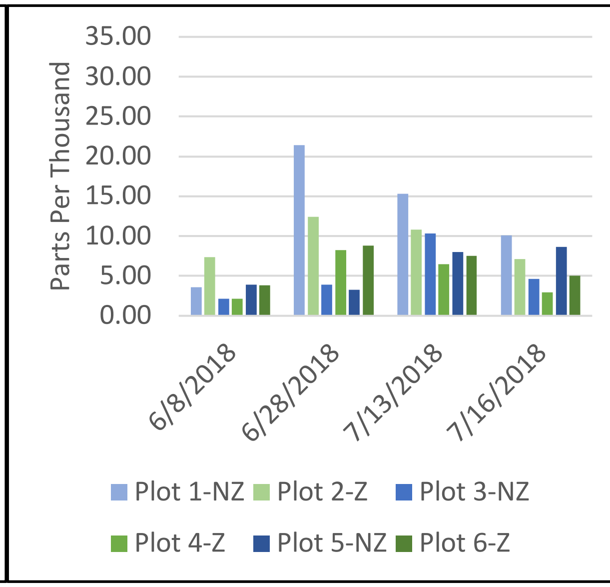

Figure 8. Soil salinity measurements at top 2” of soil layer. (NZ = No Zeolite Z = Zeolite)

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.