Using Native Cottonwood to Improve Water Quality in Urban Streams

Dr. Salim Bawazir[1], Jabari Lee[2] and Juan Solis[1]

[1]New Mexico State University, [2]Florida Gulf Coast University

Re-Inventing the Nation's Urban Water Infrastructure

Abstract

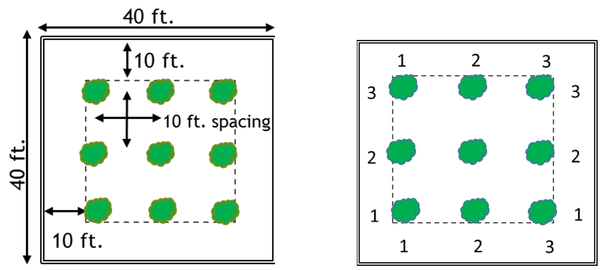
The slow disappearance of riparian habitat which once flourished throughout has been recognized to negatively impact surface water quality. Restoring riparian habitat can lead to improvements in water quality. This project investigated the ability of native riparian vegetation specifically, Rio Grande Cottonwood (*Populus fremontii*), and zeolite to improve water quality in nearby streams and drains. It was hypothesized that the use of low water consuming established native riparian vegetation along with zeolite mixed into the soil, will improve water in nearby urban drains through filtration and phytoremediation of contaminants. Findings from this research project contribute to the field of riparian zone restoration by quantifying the ability of native riparian vegetation to improve water quality.

Research Objectives

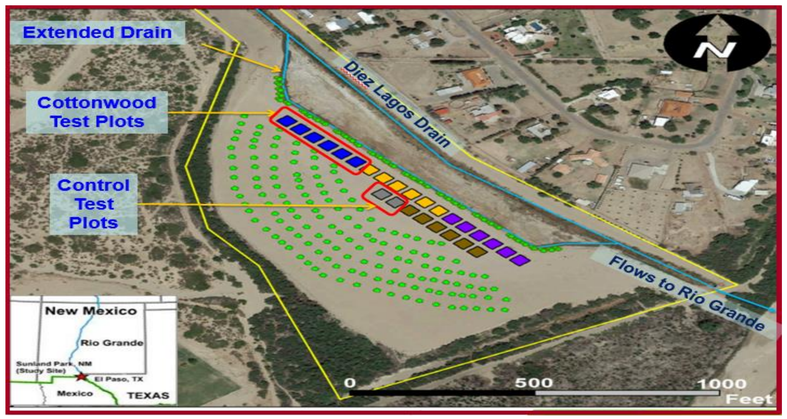
- Grow native riparian cottonwood trees and study their ability to improve water quality along urban rivers and streams.
- Grow the cottonwood trees in two soil treatments: in-situ riparian sandy soil and in-situ riparian sandy soil amended with a layer of clinoptilolite zeolite.

Sunland Park Urban Test Bed

- 6 cottonwood test plots, with 9 cottonwoods each
- Even number plots contain zeolite soil mixture
- Odd number plots contain native soil
- 2 control plots without plants, 1 with zeolite soil mixture the other without
- Cottonwoods in all plots were on average a year old



Cottonwood Test Plot Configuration



Map of the Sunland Park Urban Test-Bed

Approach

- Collect soil samples to determine the soil type, sodium adsorption ratio, and other soil chemical properties in each test plot
- Install drainage pipes to collect leachate samples from irrigation test
- Measure depth to groundwater
- Conduct health assessment of cottonwood trees in the experimental plots on a weekly basis to determine growth and survivability
- Measure water quality of irrigation and the leachate in the drainage pipes

Results

1) Maintenance on the cottonwood test plots was conducted. Maintenance involved removing weeds within plots and constructing fences around the plants to protect them from beavers.
2) Conducted weekly plant health assessments during which qualitative and quantitative data was collected for each plant in every plot.
3) Surface soil samples were collected from every plot for the summer season to be tested to determine its chemical and hydraulic properties.
4) Leachate collection pipes were installed roughly 8 to 10 inches below the soil surface in each plot. Care was taken to ensure that the pipes would not collect ground water.


Installation of leachate collection pipes in test plots


Addition of drainage layer for leachate collection system in test plots

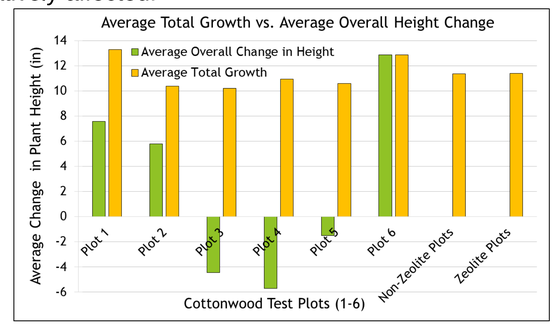

Cottonwood test plot with leachate collection system

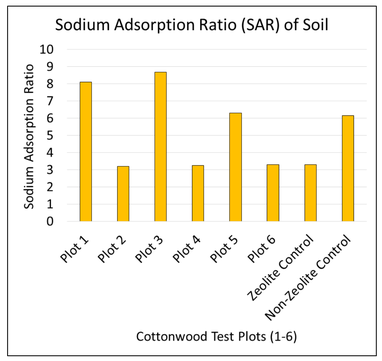

Installation of weather station at Sunland Park

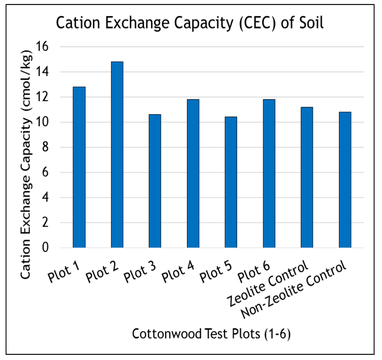
5) A weather station was installed onsite. The weather station has sensors to record the amount of precipitation, solar radiation, humidity, wind speed and direction, and temperature.
6) Soil samples were tested to determine the particle size distribution, pH, nutrients, salinity, conductivity, cation exchange capacity (CEC), organic matter content, and sodium adsorption ratio (SAR).
7) Leaf samples were taken from plants in each plot and sent to Harris AgSource Lab to have the nutrient content determined.
8) Depth to groundwater was measured at 4 wells throughout the site on a weekly basis throughout the months of June and July.

Summary

- The data collected served as baseline data for conditions of the soil and plants within the test plots prior to the irrigation test.
- A sieve analysis of the soil type in each plot classified the soil as sand. This information was used to help design the drainage pipes for leachate collection and which test to perform on the soil to identify its hydraulic properties.
- Data from plant assessments showed 100% survival rate of cottonwoods in all plots. Damage caused by beavers resulted in a negative average overall change in plant height for plots 3 through 5. Despite this, the average total growth of cottonwoods per plot were similar.
- The cation exchange capacity (CEC) of soil saturated paste (soil: distilled water slurry of 1:1) ranged from 10.4 to 14.8 cmol/kg which is typical for sandy and silt loam soils. The sodium adsorption ratio (SAR) for the plots ranged from 3.19 to 8.68. The sodium adsorption ratio (SAR) for the plots were below 13. At a SAR of 13 or above plants can be negatively affected.







Recommendations

Future steps include initiating irrigation test, collecting and testing leachate samples. As the irrigation testing continues further monitoring and analysis of the soil and plants within each plots will be conducted. including water quality, plant health, and nutrients will continue to be monitored as the project progresses.

Acknowledgements

We would like to thank all of the faculty and staff at National Science Foundation, New Mexico State University, and ReNUWIt for making this research possible.