Water Stress in Desert Willow (*Chilopsis linearis*) Planted in Clinoptilolite Zeolite for Riparian Rehabilitation

By

Juan C. Solis

New Mexico State University

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Introduction

Riparian zones are important in areas near rivers, streams, drainage canals and other water bodies and have been among of the most valuable natural areas in the Southwestern United States. However, riparian areas are slowly disappearing.

– Irregular hydrologic trends within the southern semi-arid region of NM.

– Higher risks of Native plant species becoming endangered.
  • Cottonwood, Saltgrass, Willows, etc.

– Introduction of exotic plant species that are adaptable to deeper groundwater tables and poor environmental conditions.

– Riparian Areas along the Rio Grande have become exposed to unhealthy vegetative communities due to a lack of diversity among species.
Introduction (Continued)

• Previously utilized re-establishment techniques:
  • Deep planting techniques
    – Labor intensive and expensive
    – Plants face desiccation in areas where groundwater table is deep and capillary rise is insufficient.

• Recent studies included the implementation of Clinoptilolite Zeolite (CZ) as a wicking material.
  – Applied in areas where groundwater was found at depths less than 3 meters.
  – Used to sustain plant growth
  – Lack of understanding of water stress involved in plants.

• This research seeks to better understand the water stress using desert willow planted in Clinoptilolite zeolite.
Research Objective and Hypothesis

Main Objectives:
- Measure Midday Stem Water Potential (SWP) for Desert Willow (*Chilopsis linearis*) plants growing under:
  - Planted in zeolite columns
  - Planted in-situ riparian sandy soils

Hypothesis:
- Desert Willow planted in zeolite (CZ) exhibits less water stress than those planted in riparian sandy soils (RS)
- Water stress in Desert Willow will increase as depth to groundwater table increases in both zeolite and sandy soils
Background

- **Desert Willow (Chilopsis linearis):**
  - Native to the southwest
  - Found in drain washes, dry creek beds and along riverbanks
  - Acclimated to semi-arid environment, capable of thriving in most types of soils including sandy soils
  - Serves multiple purposes:
    - Horticultural
    - Riparian restoration
    - Erosion Control
    - Wildlife cover among other things.
Clinoptilolite Zeolite (CZ)
- Naturally occurring volcanic sedimentary mineral composed of aluminosilicates
- Due to its crystal structure (Tetrahedral Honeycomb Arrangement):
  - High Cation Exchange (CEC)
  - High porosity/ Surface area
- High adsorption abilities.
  - Ideal for filtering heavy metals
  - Agricultural Practices
    - Leaching Nutrients (Nitrates)
    - Water absorption
- Water “wicking” capabilities
  - Increasing capillary rise
Sunland Park
Urban Test-Bed

Located in the City of Sunland Park

36 miles (58 km)
South of Las Cruces, NM

Between TX and NM Border.
Experimental Setup (Continued): Site Layout for Desert Willows
Pouring of Zeolite
Augered boreholes

Poured Zeolite after augering boreholes
Desert willow established at the study site
Midday Stem Water Potential

- Measured stem water potential during midday hours (12:00 – 16:00)
  - Plant experiences maximum water demand

- Selected leaves are placed inside a foiled bag approximately for an hour
  - Bagging of leaves allows for photosynthesis and water loss to halt and reach equilibrium
Results: Midday Stem Water Potential

Stem Water Potential, $\psi$ (MPa)

Mean; Whisker: Mean±SE
- CZ1 : GWD = 1.21 m
- RS1: GWD = 1.21 m
- CZ2 : GWD = 2.14 m
- RS2: GWD = 2.14 m

Stress

Non-Stress
Results (Continued):
Vapor Pressure Deficit and Temperature
Results (Continued): Depth to Groundwater

![Graph showing depth to groundwater over time with precipitation as a variable.]

- Depth to Groundwater, DGW (mm)
- Precipitation (R)
- GW1
- GW7
Conclusion

• Desert willow planted in zeolite exhibited less water-stress than those planted in riparian sandy soils

• Stem water potential increased as DGW increased in both treatments (CZ and RS)

• Larger differences in stress was observed in sandy soils as DGW increased

This study demonstrates that CZ can applied in arid regions to grow desert willows where DGW is less than 3 m with minimum rainfall and no irrigation.
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Questions?