



# Determining Impacts of Long Term Use of RO Concentrate on Atriplex Species, Soil Characteristics and Microbial Habitats

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### Mission Issue

Environmentally beneficial methods for disposal of saline concentrate wastewater from reverse osmosis.

### Lead Researcher

Scott O'Meara  
Botanist,  
Technical Service Center  
[someara@usbr.gov](mailto:someara@usbr.gov)

### Research Office Contact

Yuliana Porras-Mendoza  
Developing Water Supplies  
Research Coordinator,  
Research and Development  
Office  
[yporrasmendoza@usbr.gov](mailto:yporrasmendoza@usbr.gov)

### Problem

As drought conditions persist in the western United States, growers must consider using brackish and saline groundwater in agricultural practices due to surface water decreases. Reverse osmosis (RO) can be used to desalinate the groundwater sources, but the concentrate waste that is created can cause disposal concerns. Current options to dispose of RO concentrate are expensive and/or may harm the environment by contamination or by increasing soil salinity.

*Atriplex canescens* and *A. lentiformis* are native plants to the western United States that can be grown under irrigation with RO wastewater due to their halophytic and phytoremediation characteristics, and can be used as feed supplements for livestock. However, the effects of RO wastewater on soil microbial communities, a critical component of healthy soils, is largely unknown.

### Solution

This study was conducted at the Brackish Groundwater National Desalination Research Facility in Alamogordo, New Mexico to assess soil microbial responses to irrigation of *Atriplex* species with RO saline concentrate. Irrigation was conducted at 60% and 80% of plant requirements based on evapotranspiration calculations. Soils were sampled at two depths throughout the study to evaluate changes in soil characteristics related to increased salinity. Microorganism community responses were assessed using Next Generation Sequencing.

*Atriplex canescens* and *A. lentiformis* were also grown in a greenhouse at the Agriculture Experimental Station of New Mexico State University in Las Cruces, New Mexico to examine germination rates and growth/vigor characteristics when irrigated with water at different saline concentrations.

***“Irrigation with RO concentrate can change the soil microbial habitats. With increasing ion accumulation in the soil, microbes are expected to adapt to the environment and could show a greater abundance of extremophile bacteria.”***

Manoj, Shukla  
Professor of Soil Physics  
New Mexico State University

### **More Information**

<https://www.usbr.gov/research/projects/detail.cfm?id=1780>

## **Application and Results**

Electric conductivity of soil samples increased along the wetting front of the irrigation line and sodium adsorption ratios (SAR) increased throughout the three-year study. Soil microbial communities shifted slightly, but the shift was not statistically significant. Germination of *Atriplex* species and infrared reflectivity (IR) increased with higher salinity in higher saline water sources, but chlorophyll content and plant height were not significantly affected by increased water salinity.

A better understanding of the long-term impacts of using RO concentrate as an irrigation source will serve to promote better management guidelines and broader adoption of using RO concentrate to irrigate halophytic plants, which may become imperative when facing prolonged drought conditions.



*Atriplex canescens* and *Atriplex lentiformis* study plots at BGNDRF, Alamogordo, New Mexico, August, 2019. Photo taken by S. Cerra

## **Future Plans**

Next steps for this research include additional testing of microbial community changes to determine long-term impacts and using different methods such as RNA transcriptomes. Further development of *Atriplex* species as a feed supplement for cattle should include assessment of nutritional value changes as salinity increases in irrigation water, and salinity thresholds should be better established. Modeling of this system will allow for further exploration of marketability of *Atriplex* species, while ensuring a beneficial use of RO concentrate as an irrigation source with a full understanding of soil degradation and other potential impacts to the environment.