Impact of reverse osmosis waste water on soil quality in a semi-arid soil

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INTRODUCTION

Reverse osmosis (RO) plants produce purified water free of unwanted salts and other minerals. RO water has applications in science and industry. Salty waste water is also generated during the RO process. RO waste water is often disposed without consideration for any beneficial use. In semi-arid areas, water availability is a major constraint for crop production, utilizing available water resources is essential for long-term sustainability (MacDonald, 2010; Cayan et al., 2010). Land application for the purpose of irrigating agricultural crops is a possible way to utilize the RO waste water. However, initial investigation of the impacts of the RO waste water on soil quality indicators needs to be assessed for sustainability.

Soil quality indicators (SQI) were assessed in adjacent fields: one that received waste water from a RO plant in northern New Mexico and another that was fallow native pasture.

Objectives:

i. To find out if significant SQI differences occurred between the waste water treated and untreated (non-irrigated) fields

ii. To assess variability of the SQI in both fields

MATERIALS AND METHODS:

Site Characteristics and Sampling:

- The RO waste water site (Figure 1) was planted in pasture grass in 2010 and flood/furrow irrigated from 2010-2011.
- An adjoining untreated fallow native pasture site was also sampled for comparison.
- 42 soil samples were taken to a depth of 20 cm from each site on a 63.7m x 198.4m grid.

Soil Analysis and Measurements:

- A Ro-tap shaker device was used to obtain dry aggregate size distribution including: mean weight diameter of the dry aggregates (MWD), dry aggregates >2mm (D >2mm), and dry aggregates <0.25 (D <0.25mm)
- Wet aggregate stability (WAS) using a rainfall simulation method
- Soil particle size analysis using hydrometer method
- Soil electrical conductivity (ECe) using saturated paste method
- Soil pH of the saturated paste extract
- Permanganate oxidizable carbon (POXC) after Weil et al. (2003)
- Organic matter by Walkley Black Method
- Chemical parameters measured include NO_3-N, P, K, Ca, Mg, Na, Zn, Fe, Mn and Cu according to standard soil analytical procedure of Agricultural Testing and Research Laboratory, Farmington, NM.

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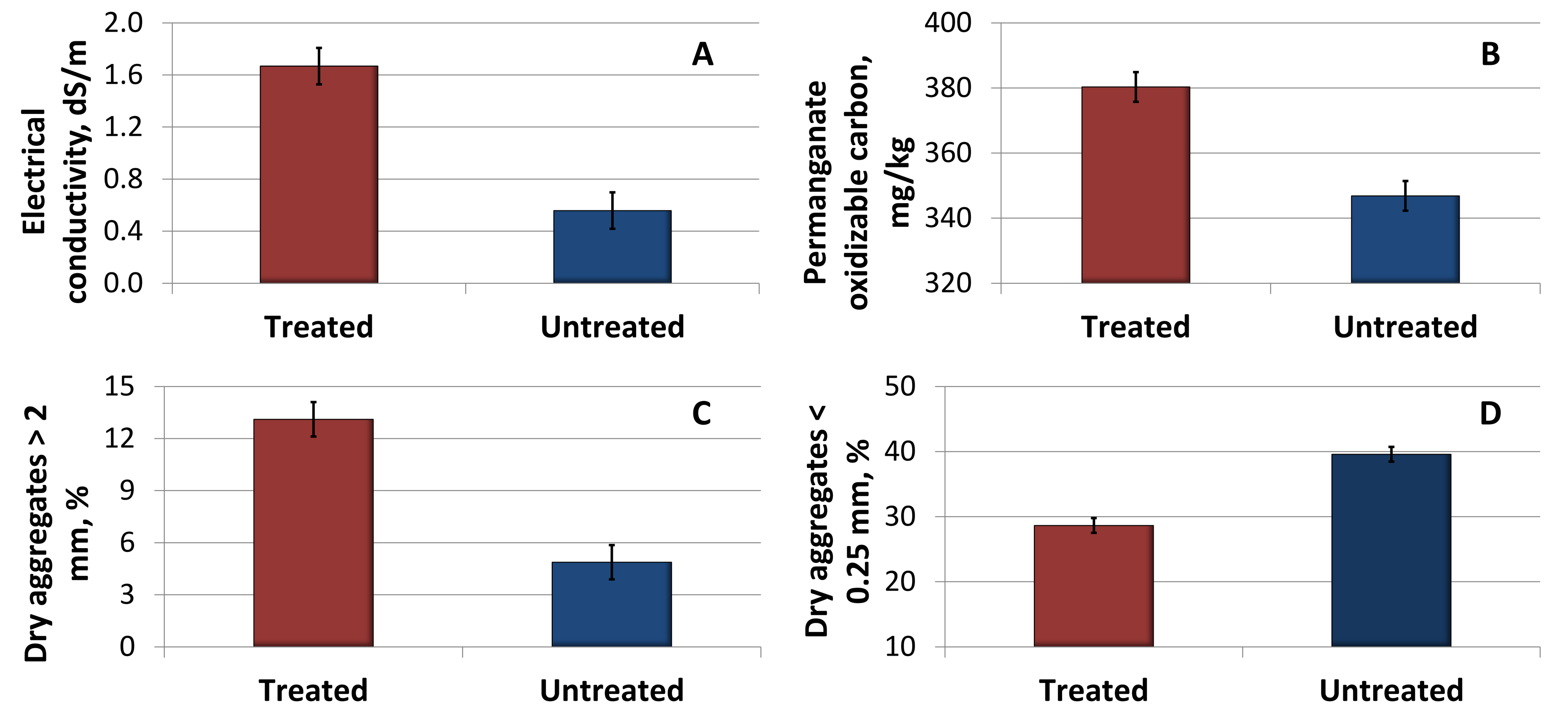

Figure 2 A-D. Mean values of the electrical conductivity, permanganate oxidizable carbon, AGG > 2mm and AGG < 0.25 in the RO treated and the untreated soils.

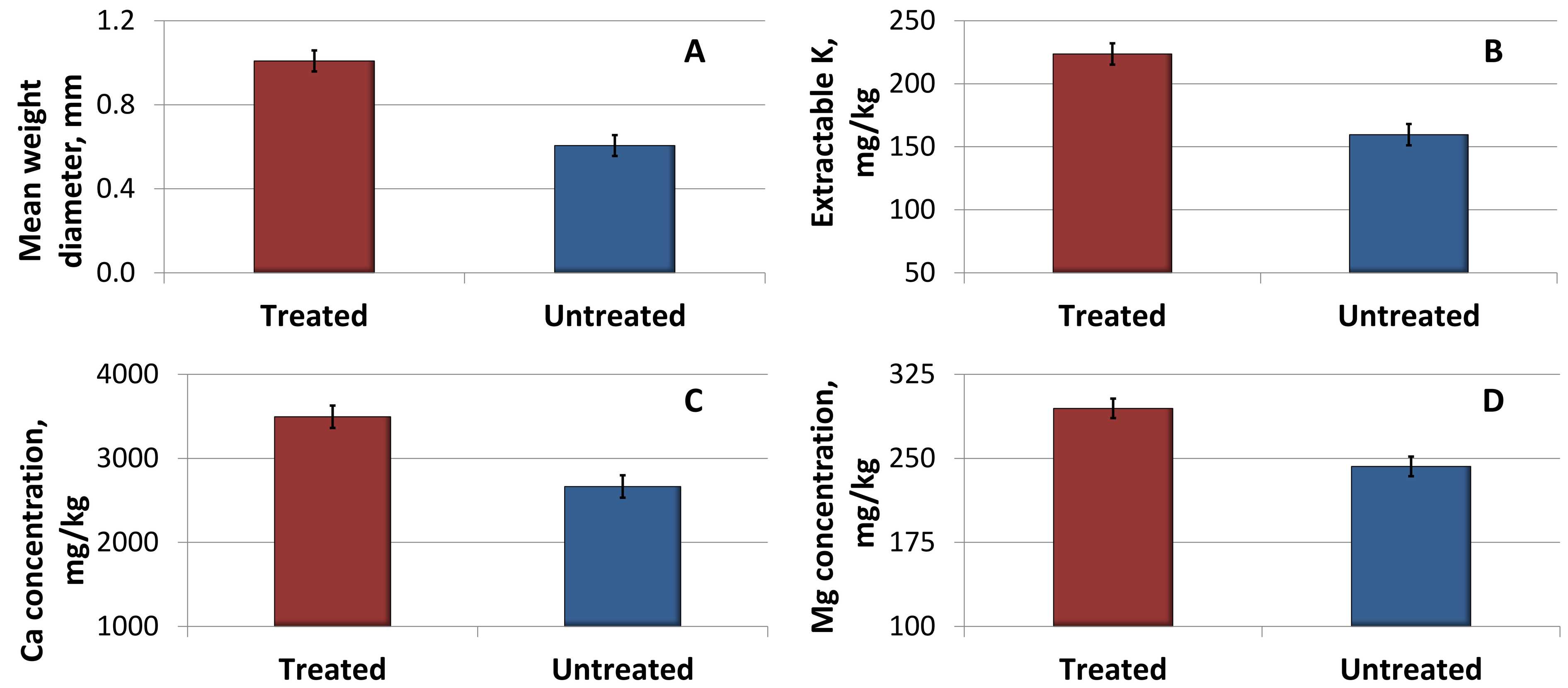

Figure 3 A-D. Mean values of the mean weight diameter, potassium, calcium and magnesium of the RO treated and the untreated soils.

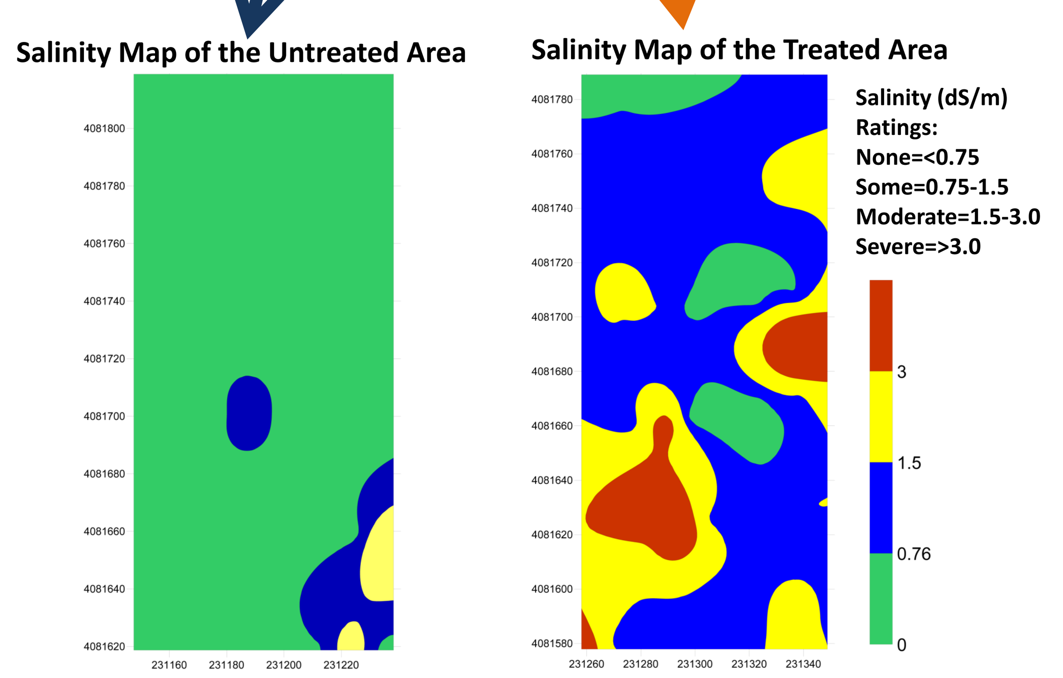

Figure 1: Aerial view of the study area and salinity maps. Untreated outlined in blue; Treated in orange.

Picture Source: http://oddanchatram.in/effluent-water-being-treated-using-reverse-osmosis.html

RESULTS:

- Applying RO waste water on pasture grass significantly affected measured soil quality indicators (Figures 2 & 3)
- Soil salinity as measured by ECe was significantly higher in soil with RO waste water application (Figure 2A).
- Soil dry aggregation parameters (MWD, D>2mm and D<0.25) were significantly improved by the RO waste water applied to pasture grass compared to native fallow without irrigation (Figures 2C-D & 3A).
- POXC was significantly higher in land with RO waste water (Figure 2B).
- K, Ca, and Mg concentrations were higher in soil that had RO waste water applied (Figure 3B-D).
- Individual measurements influenced the variability more than the overall treatment effect, i.e. RO waste water irrigation vs. no irrigation.
- The most variable measurements were ECe (Figure 1), D >2mm and MWD, while the least variable measurements were pH, POXC and sand content.

CONCLUSIONS AND RECOMENDATIONS:

- The field that received RO waste water and was planted to pasture grass had more favorable soil quality indicators than the adjacent fallow pasture.
- However, there was evidence of salinity buildup due to RO waste water application.
- Good salinity management strategy needs to be implemented to sustainably use the land that is receiving RO waste water for crop production.

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