☐ **Talk** ✓ **Poster**

Assessment of the Feasibility of Treated Oilfield Produced Water as an Agricultural Irrigation Source from the Perspective of Soil Chemistry

Katherine Coyle[1], Matthew Siebecker[1],

[1]*Texas Tech University, Lubbock, TX*

Author Email: katherine.coyle@ttu.edu

Due to dwindling groundwater resources, agriculture in semi-arid regions like the Texas Plains must explore alternative irrigation sources to produce critical fiber and food crops. One potential source is treated oilfield produced water (PW), a byproduct of oil and gas extraction typically reinjected into the subsurface. With recent advances in PW treatment and desalination, this water could be reused for irrigation. However, its impact on soil chemistry, particularly the accumulation of nutrients or contaminants, remains unclear. To assess this, soil column experiments were conducted using local agricultural soil. Columns (8 inches long, 2 inches in diameter) were irrigated with three water types: desalinated PW, polished/desalinated PW, and groundwater. Each was applied at 90% of the soil's saturated hydraulic conductivity (0.4186 mL/min) in two volumes: 6384.5 mL and 12769 mL, simulating five and ten seasons of cotton irrigation, respectively, under a 30 mm per week regime. Effluent was collected over time using a fraction collector, and soil from the columns was analyzed post-irrigation. Samples were analyzed with inductively coupled plasma optical emission spectroscopy (ICP-OES) to quantify nutrients, micronutrients, and potential contaminants. Total carbon (C) and nitrogen (N) were measured using a C-N analyzer. Phosphorus (P) speciation in soil and evaporative residues was assessed with X-ray absorption near edge structure spectroscopy (XANES) at the National Synchrotron Light Source II 8-BM. Table 1 shows ICP-OES characterization data for different water types before application to soil that indicates that both PW types contain less salt cations (i.e., Ca, Mg, Na) than West Texas groundwater, which would be beneficial from a salinity perspective. Additionally, the treated produced water types do not contain detectable amounts of heavy metals. XANES spectra revealed that the dominant P species in all samples is orthophosphate and soil treated with groundwater contains more Fe-bound P than soils irrigated with produced water.

Water Type	B mg L^{-1}	Ca mg L^{-1}	K mg L^{-1}	Mg mg L^{-1}	Mn mg L^{-1}	Na mg L^{-1}	S mg L^{-1}	Si mg L^{-1}	Sr mg L^{-1}
Desal PW	0.41 ± 0.015	3.04 ± 0.07	BDL	0.41 ± 0.01	BDL	6.18 ± 0.16	10.69 ± 0.38	2.22 ± 0.05	1.63 ± 0.03
Polished PW	0.14 ± 0.003	7.25 ± 0.25	0.73 ± 0.06	1.38 ± 0.04	0.02 ± 0.002	22.67 ± 0.35	31.42 ± 0.56	3.06 ± 0.05	1.67 ± 0.02
Irrig Water	0.41 ± 0.03	129.8 ± 1.84	12.46 ± 0.17	89.01 ± 1.04	BDL	74.54 ± 1.07	84.66 ± 0.7	34.21 ± 0.36	4.51 ± 0.05

Table 1. ICP-OES characterization data for desalinated produced water (Desal PW), polished/desalinated produced water (Polished PW), and West Texas groundwater (Irrig Water). BDL refers to values less than ~0.005 mg L^{-1}. Al, As, Cd, Co, Cr, Cu, Fe, I, Mo, Ni, P, Pb, Rb, Se, Th, U, V, and Zn were BDL for all water types.