Title:
Salinity buildup, pedogenic carbonate accumulation, heat stress in a changing climate at a pecan orchard in Tornillo, TX: is dryland irrigation sustainable at American southwest?

Abstract: Along the Rio Grande valley in western Texas, soils are developed on floodplain sediments and have been irrigated to grow crops. In a pecan orchard at Tornillo, TX, USA, our studies have shown that soil salinity has exceeded the pecan trees' tolerance levels, stunting their growths, especially in soils with finer texture. To assess if irrigated agriculture can be sustained in the region, we have carried out extensive field investigation on chemistry of soil and groundwaters, water dynamics, and tree physiology, as well as reactive transport modeling, and focused on how this managed critical zone will respond to climate variability, and a shift of irrigation water source. Our results show that the salt accumulation rate may not be constant but projected to increase with time, especially when precipitation of secondary calcite clogs the pores, reduces infiltration and leads to more evaporative water losses. Indeed, the petrocalcic layer (caliche) can potentially be developed at soil surface after just another 200 years, leaving little to no pores for water infiltration or salt leaching. This could occur in even shorter period of time if the deep groundwater, much higher in TDS, is used for irrigation during megadroughts. The American southwest is projected to be dryer and hotter in the summer, potentially losing more water by evaporation and consequentially demanding more irrigation, but also stressing the trees via the heat waves and osmotic water pressure. This study helps to assess the soil quality deterioration by irrigation at aridland soils, and more importantly, better predict how this will challenge the future agriculture due to climate variability and intense management practices.

Bio: Lixin Jin is a professor at the Department of Earth, Environmental and Resource Sciences at the University of Texas at El Paso. Dr. Jin received her PhD at the University of Michigan in 2007, and was a postdoc scholar at Penn State from 2007-2010, before joining UTEP as an assistant professor in 2011. Her research focuses on dryland critical zone. In the American southwest, she is interested in the conditions, kinetics and mechanisms of the precipitation of pedogenic carbonates and the release of green-house gas CO_2 in flood-irrigated agricultural fields.