2950 Niles Road, St. Joseph, MI 49085-9659, USA
269.429.0300 fax 269.429.3852 hq@asabe.org www.asabe.org

SALINITY AND SODICITY EFFECTS ON SOIL ERODIBILITY AND DUST EMISSIONS

R.S. Van Pelt[1], S. Ravi[2], G.M. Zhang[3], P. D'Odorico[4]

Presented at the

Soil Erosion Research under a Changing Climate Symposium

Punta Borinquén Resort, Aguadilla, Puerto Rico, USA

January 8-13, 2023

A Specialty Conference of the

American Society of Agricultural and Biological Engineers

ASABE Symposium Abstract # 23067

DOI: https://doi.org/10.13031/soil.23067

[1]R. Scott Van Pelt, Research Soil Scientist, USDA-ARS Wind Erosion & Water Conservation Research Unit, Big Spring, Texas, 79720, USA; [2]Sujith Ravi, Assoc. Professor, Dept. of Earth & Environmental Science, Temple Univ., Philadelphia, Pennsylvania, 19122, USA; [3]Guoming M. Zhang, Engineer, Beijing Normal University, Beijing, China; [4]Paolo D'Odorico, Professor, Dept. of Environmental Science, Policy, & Management, Univ. of California, Berkeley, California, 94720, USA. (Corresponding author email: scott.vanpelt@usda.gov)

Salinity and Sodicity Effects on Soil Erodibility and Dust Emissions

R.S. Van Pelt[1], S. Ravi[2], G.M. Zhang[3], P. D'Odorico[4]

Abstract

The accumulation of salts and accelerated soil erosion are two major soil degradation issues affecting agriculture around the world, particularly in regions with high evaporative demand, shallow water tables or in those irrigated with water rich in dissolved solids. The effect of salinization on soil erodibility by wind and the associated dust emissions remain poorly understood. These processes are responsible for numerous impacts on human health, soil productivity, ecosystem dynamics, and climate over large areas of the United States and the world. We investigated a degradative fundamental soil and geomorphic process (i.e., salt-induced enhancement of soil erodibility) to provide a new mechanistic framework for its explanation. The research used a combination of experimental and theoretical analyses to investigate the effect of soil salinity and sodicity on interparticle bonding forces and, consequently, soil erodibility by wind. Soils investigated in the laboratory wind tunnel included a Brownfield fine sand (loamy, mixed, superactive, thermic Arenic Aridic Paleustalf), Amarillo fine sandy loam (fine-loamy, mixed, superactive, thermic Aridic Paleustalf), and Olton clay loam (fine, mixed, superactive, thermic, Aridic Paleustoll), all of which are important agricultural soils on the Southern High Plains of Texas. The levels of salinity and sodicity were created using salts present in southwestern irrigation water sources and included sodium chloride, calcium chloride, magnesium chloride, sodium sulfate, and magnesium sulfate. Laboratory tests were used to evaluate soil erodibility under a wide range of soil salt concentrations, soil sodicities, soil textures, and atmospheric moisture scenarios using a suction-type wind tunnel fitted with an aspirated dust capturing system. Field sites were chosen with the help of soil specialists with the USDA Natural Resources Conservation Service in Texas and New Mexico along with Extension and Experiment Station personnel in those states. We tested soil erodibility and dust emissions in the field using a Portable In-Situ Wind Erosion Laboratory (PI-SWERL) also fitted with an aspirated dust capturing system. Soil loss in the laboratory wind tunnel tests was estimated using loss of soil mass during a 20-minute test run and qualitatively estimated in the field by PM10 (particles with a diameter less than 10 microns) emissions during a nine-minute test using a series of ramped friction velocities separated by periods of constant friction velocity. Total Suspended Particulates (dust) emissions were quantified by dust capture on aspirated quartz fiber filters and soluble components (salts) present in the dust were quantified by loss of filter weight following water dissolution of the captured dust and oven drying of the filter. Laboratory experiments directly and indirectly measured the changes in interparticle bonding forces associated with such scenarios. Initial results will be presented and a theoretical framework will be developed to explain the observed changes in soil erodibility by accounting for the changes in interparticle bonding forces in salt-affected soils.

Keywords. Dust, Erodibility, Salinity, Wind Erosion.

[1]R. Scott Van Pelt, Research Soil Scientist, USDA-ARS Wind Erosion & Water Conservation Research Unit, Big Spring, Texas, 79720, USA; [2]Sujith Ravi, Assoc. Professor, Dept. of Earth & Environmental Science, Temple Univ., Philadelphia, Pennsylvania, 19122, USA; [3]Guoming M. Zhang, Engineer, Beijing Normal University, Beijing, China; [4]Paolo D'Odorico, Professor, Dept. of Environmental Science, Policy, & Management, Univ. of California, Berkeley, California, 94720, USA. (Corresponding author email: scott.vanpelt@usda.gov)