Abstract: Estimating erosion control and sediment entrapment in monotypic saltgrass (*Distichilis spicata)* using rainfall simulation

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In order to maintain the integrity of the water resources in the Southwestern U.S. it is paramount to preserve water quality and quantity. Erosion is of particular concern in arid regions with highly erodible soils and altered hydrological regimes due to anthropogenic and natural climate change, urbanization, and land use change (Vogt, 2013). The peri-urban riparian zone at the Diez Lagos Drain, located at the Sunland Park Test Bed (SPTB) in New Mexico, is particularly susceptible to wind and water-based erosion due to the highly sandy soil which lacks sufficient structure. Also, this area was recently disturbed and cleared of the invasive saltcedar (*Tamarix sp.)* to function as a detention pond to mitigate flooding, leaving minimal vegetation to stabilize the soil.

Inland saltgrass, *Distichilis spicata* var. stricta (L.) Greene, could effectively reduce the amount of sediment in runoff at Sunland Park, NM. This native grass grows densely and includes a thick, rhizomatous mat that effectively clings to the soil while also forming a physical barrier that covers the surface and prevents saltcedar germination. The vegetative structures in saltgrass could prevent erosion by reducing the impact of rainfall and slowing runoff to allow for settling (Van Dijk et al., 1996; Reubens et al., 2007; Gyssels et al., 2005; Baets et al., 2007). While soil loss and drain clogging may be of great concern, certain sediments may carry contaminants bound to their surface that are harmful to the surrounding aquatic ecosystem and human health (NERRS, 2014). The purpose of this study was to provide an initial attempt toward estimating the sediment entrapment that could be achieved by establishing saltgrass in riparian zones. The specific objectives were to (1) design and conduct an experiment to estimate the amount of sediment entrapped in an area covered with saltgrass compared with a control, bare soil area, (2) modify and adjust an existing rainfall simulation device to mimic an intensity similar to a 100 year storm, and (3) provide the framework and initial trial runs for the eventual estimation of erosion control provided by establishing saltgrass in an ecological rehabilitation project at SPTB.

Before conducting the experiment, the rainfall simulation device was tested and adjusted in the hydraulics lab at New Mexico State University to achieve a uniform distribution and intensity similar to 100-year convective thunderstorms for the region. The simulator consisted of a 225-gallon water tank connected to a clean water pump. The pressure was manipulated as the water passed through a valve connection section and monitored with a series of pressure gauges. Finally, the flow passed through a spray nozzle. The pressure was maintained through all trials at 14 psig, which produced an average rainfall intensity of 289 mm/hr. In order to test the potential for saltgrass to entrap sediment and prevent erosion, a densely vegetated saltgrass area and a bare soil area located within the Caballo research site in New Mexico, as well as a bare soil area at SPTB were selected. Triplicate simulation trials for each of the treatments listed above were conducted. The rainfall simulator was used in conjunction with a one by one meter wooden square frame coupled with a plastic lined trough inserted into the ground to collect surface runoff during the simulation. Antecedent conditions such as moisture content, bulk density, and slope were also measured.

After performing a Mann-Whitney-Wilcoxon test for comparing means, the results showed that saltgrass significantly reduced the amount of sediment present in runoff (Figure 1) as compared to bare soil at Caballo (p=0.004). The saltgrass plots had, on average, 86% less sediment in runoff than the bare soil plots. The bare soil plots at SPTB seemed to have the highest amount of sediment in runoff, but the installment methodology was not adequate for collecting all of the runoff in the poorly graded sandy soils. As figure 1 indicates, there was much more variability in the bare soil plots. This could be attributed to the impact of the water droplets as a factor in detaching sediment, as well as some preferential flow paths causing water to pass under the trough edge instead of being collected. These preliminary results suggest that establishing saltgrass will greatly reduce erosion caused by surface runoff and will entrap sediment that may contain bound contaminants at SPTB. Nevertheless, this study should be expanded and replicated in order to provide future quantitative estimations of the amount of erosion prevention provided by established saltgrass. These future estimations should take into account how abiotic factors such as soil type, structure, and texture; antecedent moisture content; bulk density; and slope could affect the erosion control provided by saltgrass.

Table 1. Hydraulic parameters determined for simulation trials (Note: C: Caballo, SP: Sunland Park)

Trial	Slope	Time until runoff collection (min)	Length of simulation (min)	Θ_v (cm^3/cm^3)	Texture
Saltgrass-1	7.0%	3.0	4.0	0.231	Sandy Loam
Saltgrass-2	6.0%	1.8	3.0	0.172	
Saltgrass-3	5.0%	1.3	3.0	0.192	
Bare Soil C-1	1.0%	-	2.7	0.161	
Bare Soil C-2	2.0%	0.8	1.5	0.102	
Bare Soil C-3	0.5%	-	1.5	0.089	
Bare Soil SP-1	1.4%	6.3	8.2	0.040	Sand
Bare Soil SP-2	1.0%	8.7	12.2	0.052	
Bare Soil SP-3	0.5%	2.5	8.2	0.031	

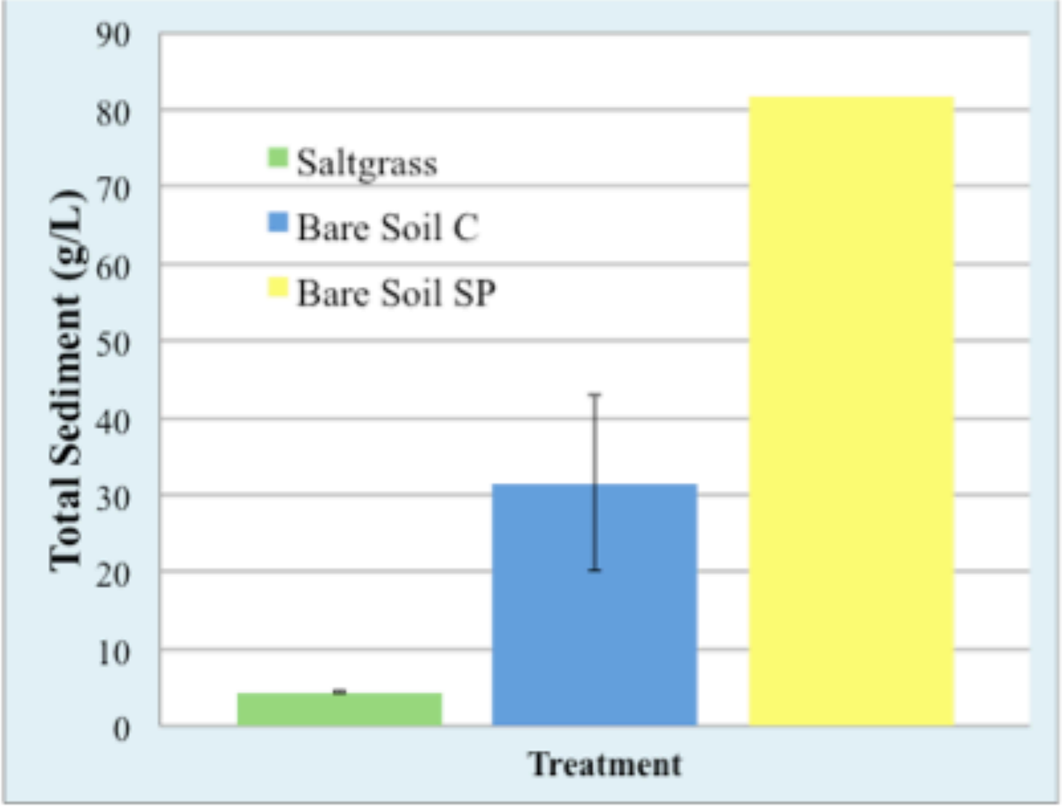

Figure 1. Average total sediment (g/L) collected in triplicate saltgrass covered and bare soil plots at Caballo, NM and at SPTB.