Nick Handelman

Summary of: "The Mechanism of Raindrop Splash on Soil Surfaces"

splash weight - the amount of material ejected from the soil during impact
splash angle - the angle at which the material is ejected
soil detachment - erosion
matric potential - force required to break the adhesion of water molecules to soil particles?
void - empty space in a material, high ratio = loose soil, low ratio = dense soil

This paper discusses the effects of a raindrop impacting a soil surface. Previous research discussed the effects of a raindrop impacting various surfaces including rigid, water, sand and soil paste, and it is the authors' intent in this paper to discuss the effect of a raindrop impacting the surface of "soil materials having variable water potential, bulk density and shear strength values." Of particular importance are splash weight and splash angle, as these values are important to the study of soil erosion. The authors note that raindrop kinetic energy is a strong predictor of these values. Other predictors are also discussed in the paper.

The paper gives a detailed description of the materials and methods, including graphs, tables and pictures. "Six soil materials were used in this study." These were each composed into a particular form, with specific ranges for water content, volume, bulk density and matric potentials applied. 4.6 mm diameter raindrop were dropped onto the soil from a height of 890 cm, and a high speed camera was used to photograph the impact event. Splash angles were determined both from the original film and the developed photographs using a protractor. The authors note that splash angle increases through the duration of the impact event, and they use the maximum measured angle for each event. The results section mentions the fall-cone method (discussed in detail in a previous paper?), used to measure splash angle vs. soil shear strength.

Using the experimental data and previous work, the authors make several statements about their findings. "Splash angles were highly correlated ($r^2 = 0.93$) with the soil shear strength", regardless of the soil material. Additionally, the velocity of detached soil particles and size of the cavity formed during impact correlated to soil shear strength. Velocity increased with shear strength, and cavity volume decreased with shear strength. However, due to equipment limitations, these were only observed qualitatively. Upon raindrop impact, compressive force forms the cavity and bulge around the circumference of the cavity. Both the bulge size and cavity volume are smaller in high shear strength soils. The compressive force is transformed into shearing force due to the lateral jetting of water. Shear causes soil detachment, more so in high shear strength soils, but due to soil resistance (what is this?) being much higher in high strength soils, total soil detachment is greater in low strength soils.

The paper employs two mathematical models. $\Theta_s=40.5\tau^{-0.425}$ was developed from figure 1 and relates splash angle (Θ_s, degrees) to shear strength (τ, kPa). $S=a+b(KE/\tau)$ was developed in a previous paper and relates splash weight (S, mg/drop) to KE (kinetic energy, joules) and shear strength(τ, kPa), with a and b as constants. Figure 4 plots splash angle vs. splash weight, and the authors note that splash angle is not always a predictor of splash weight due to soil properties such as deformability and cohesion among soil particles. The paper concludes with a suggestion that future work should include study of the process of soil detachment by the lateral jetting of water after raindrop impact. This will further clarify the relationship between splash angle and splash weight.

This was an interesting paper. I had to read some parts a few times, and check online for further explanations, but I understood it for the most part. Possibly, the results discussion on splash angle vs. soil shear strength could have been condensed, but this could just be me not recognizing different points the authors are trying to make.