EGU24-190, updated on 24 Jan 2025
https://doi.org/10.5194/egusphere-egu24-190
EGU General Assembly 2024

Effects of the Initial Soil Moisture Contents on Rill Erodibility and Critical Shear Stress of the Clay-rich Soils

selen deviren saygin[1], Fikret Ari[2], Cagla Temiz[3], Sefika Arslan[4], Mehmet Altay Unal[5], and Gunay Erpul[6]

[1]Ankara University, Faculty of Agriculture, Soil Science and Plant Nutrition, Ankara, Türkiye (sdeviren@agri.ankara.edu.tr)
[2]Ankara University, Faculty of Engineering, Department of Electrical and Electronics Engineering (fari@eng.ankara.edu.tr)
[3]Ankara University, Faculty of Agriculture, Soil Science and Plant Nutrition, Ankara, Türkiye (almond_cagla89@hotmail.com)
[4]Ankara University, Faculty of Agriculture, Soil Science and Plant Nutrition, Ankara, Türkiye (sefikaarslan77@gmail.com)
[5]Ankara University, Stem Cell Institute, Ankara, Türkiye (altay.unal@ankara.edu.tr)
[6]Ankara University, Faculty of Agriculture, Soil Science and Plant Nutrition, Ankara, Türkiye (erpul@ankara.edu.tr)

Rill erosion is one of the most significant water erosion types in the agricultural areas as a complex type of concentrated flow erosion process. And, it is known that hydraulic conditions are closely related to rill development in terms of the initial soil moisture contents. However, the impact of the subsoil hydrology on sediment discharge potentials is somewhat entangled. Thus, many recent studies point out that the change in soil erosion depends on hydrological conditions in the subsoil and suggest that the evaluation of those changes would increase the success of soil erosion estimates to more efficiently manage natural resources. This study was aimed to investigate the effects of different soil moisture settings (referred as dry, saturated and drainage) on rill erodibility (Kr) and critical shear stress (τcr) values of the soils as the significant variables of process-based WEPP model, and the relations between basic soil properties (e.g. particle size distribution, aggregate stability, soil mechanical cohesion, organic matter etc.) and these model variables for the heavy textured 12 soil types (clay contents change between 33 and 52 %). Flume experiments were performed by using a V-shaped mini-flume apparatus, which was 0.046 m wide, 0.5 m long, and 0.12m deep, specifically designed for rill experiments. Two V-shaped channels with a length of 0.2 m were cemented to the flumes, one on each side. The soil samples were packed in boxes to attain natural bulk densities of the soils after passing through a 2 mm screen opening. The slope steepness was set to 3% for the slope bed and the flow rate was controlled with a flow meter from 0.10 L min^{-1} to 0.65 L min^{-1}. Within the scope of the study, the mechanical soil cohesion values of the soils were determined by the fluidized bed approach. Obtained results clearly showed that the initial moisture contents had significant effects on sediment concentrations. The lowest Kr values were observed for the drainage condition in all soils while the highest Kr value was obtained for the soils with higher clay than silt content in the saturated conditions. Under dry conditions, on the contrary, the latter reversed and there was the highest Kr value for the soils having higher silt contents than clay. The inverse relationship between Kr and τcr was very pronounced and the highest τcr value was measured under drainage conditions. In addition, it was observed that there were significant correlations between rill erodibility (Kr) and

silt contents and mechanical soil cohesion variables of the soils. Conclusively, rill erodibility potential of the soils observed under concentrated flow conditions had statistically close relationships with initial moisture conditions and primary physical soil properties ($p<0.01$). The research findings experimentally confirmed that variations in subsoil hydrology would play a crucial role in new generation studies of process-based modelling of the rill erosion.

Key words: Rill erodibility, critical shear stress, WEPP, initial soil moisture content

Acknowledgements: This work was supported by the Scientific and Technological Research Council of Turkey [TUBİTAK-3001, Project no: 118O111].