

# Simulation of the aggregate breakdown in splash and overland flow transport processes for the soils of different land uses

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## ABSTRACT

Soil aggregate stability as a measure of the resistance of the soil structure against to the destructive effects is closely associated with the soil degradation, and particularly soil susceptibility to detachment and transport sub-processes of erosion is generally controlled by aggregate breakdown mechanism. In this study we aimed to simulate splash and surface erosion processes in laboratory conditions in terms of aggregate size distributions of three different land uses (agricultural area, grassland and forest) and slope degrees (9, 15 and 20), and two rainfall intensities (80 and 120 mm h<sup>-1</sup>) under saturated soil conditions by a rainfall simulator. The soil samples were taken from a semi arid catchment, located in Ankara, Turkey. Soil aggregate breakdown was evaluated by the mean weight diameter values (MWD, mm) of the collected splash and runoff sediments. The results indicated that aggregate size distributions obtained from the splash and runoff sediments were mostly changed with the land uses types. The MWD values were between 0.22 and 0.68 mm; 0.26 and 0.65 mm; and 0.46 and 1.26 mm for the soils of the agricultural land, grassland and forest, respectively. The forest soils having higher soil organic carbon content than those of agricultural land and grassland had more stable soil structure under destructive rainfall conditions (\*P < 0.05) than grassland and agricultural area. The differences in the soil organic carbon content played a very crucial role in protecting the soils of the semi arid ecosystem against the aggregate breakdown by the interrill soil erosion processes. Additionally, the highest runoff generation and sediment amount were obtained with the rainfall simulations over the agricultural soils. Increases in the rainfall intensity or in the rainfall energy flux also resulted in MWD variations for both splash and runoff particles. For example, as the rainfall intensity increased from 80 mm h<sup>-1</sup> to 120 mm h<sup>-1</sup>, the MWD values (mm) of the splash sediments were 36.36% lower for the rainfall simulations incident over the forest soils with the slope gradient of 20%. For the same runs, the decrease in the MWD values of the runoff sediments was 27.78%. However, this decreasing trend in MWD with the increases in the rainfall intensity was not clear with the soils of both agricultural land and grassland. Especially, there were increases in the MWD values of the splashed aggregates with the soils of the agricultural land and grassland (17.07% and 17.09, respectively) by the 120 mm h<sup>-1</sup> rains. Although the same trend as it was in the forest soils was observed with the runoff aggregates, the decreases were relatively lower (13.73% and 7.90%, respectively for the agricultural land and grassland). These findings showed that a given degree of the selectivity occurred in the detachment and transport of the soil aggregates depending upon the natural aggregate size distributions of the soils of different semi-arid land uses.

**Keywords:** aggregate breakdown, splash erosion, surface erosion, rainfall simulation, different land uses