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The effect of temporal distribution pattern of rainfall intensity on runoff and soil loss in a hillslope in a semi-arid region

Ali Reza Vaezi[1], Farzad Besharat[2], Fereshteh Azarifam[3]

Abstract

The temporal distribution pattern of rainfall can play a role in the production of runoff and soil loss during rainfall. In this study, four rainfall patterns including uniform, advanced, intermediate and delayed rainfall were investigated in field condition. The rainfall height in all rainfall patterns was 20 mm. In the uniform rainfall pattern, a constant rainfall intensity (40 mm h^{-1}) was used and in the non-uniform rainfall patterns, a maximum rainfall intensity of 40 mm h^{-1} was applied for 15-min duration. The experiments were carried out in 60 cm × 80 cm plots on a hillslope with a slope gradient of 9% at three replications. Rainfall patterns were set upped on the plots in five events with an interval of one week. The results showed that there is a significant difference between rainfall patterns in runoff and soil loss ($p<0.01$). This difference was due to the destruction of surface soil structure and the reduction of water infiltration rate, especially during peak time of rainfall intensity (40 mm h^{-1}). The highest runoff occurred in the delayed rainfall (3.43 mm) while the highest soil loss (61.47 g m^{-2}) occurred in the intermediate rainfall, which was associated to the peak intensity of rainfall at the end of the rainfall and its role in destruction of the soil structure on one hand, and the loss of infiltration rate on the other hand. Variation of runoff and soil loss from each event to other indicated that soil loss is in line with runoff production in uniform rainfall, while soil loss did not follow runoff in other rainfalls. Soil loss in theses rainfalls was affected by both runoff production and availability of erodible soil particles. These results reveal the necessity of studying the rainfall intensity distribution pattern for accurate prediction of soil erosion and determine soil loss variation event by event in the semi-arid region.

Keywords: Erosion plot, Rainfall pattern, Runoff, Simulated rainfall, Soil loss

[1]. Professor, Department of Soil Science and Engineering, Faculty of Agriculture, University of Zanjan, Iran.
[2] Former Master's Student, Department of Soil Science and Engineering, Faculty of Agriculture, University of Zanjan, Iran
[3] PhD Student, Department of Soil Science and Engineering, Faculty of Agriculture, University of Zanjan, Iran.