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Effect of Rock Fragment Cover on Hydraulics Properties of Surface Flows and Rill Initiation with Simulating Runoff under Natural Conditions

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Introduction: Rock fragments on soil surfaces can also have several contrasting effects on the hydraulics of overland flow and soil erosion processes. Many investigators have found that a cover of rock fragments on a soil surface can decrease its erosion potential compared to bare soil surface (1, 12 and 18). This has mainly been attributed to the protection of the soil surface by rock fragments against the beating action of rain. This leads to a decrease in the intensity of surface sealing, an increase in the infiltration rate, a decrease in the runoff volume and rate, and, hence, a decrease in sediment generation and production for soils covered by rock fragments. Parameters that have been reported to be important for explaining the degree of runoff or soil loss from soils containing rock fragments include the position and size (15), geometry (18), and percentage cover (11 and 12) of rock fragments and the structure of fine earth (16). Surface rock fragment cover is a more important factor for hydroulic properties of surface flows such as flow depth, flow velocity, Manning s roughness coefficient (n parameter) and flow shear stress and geometrics properties of formed rill such as time, location, number, length, width and depth of rill. Surface rock fragment cover is directly affected soil erosion processes in dry area specially in areas that plant can not grow because of sever dryness and salinity. Also, Surface rock fragment prevent the contact of rain drops to aggregates, decreasing physical degradation by decreasing flow velocity. The objective of this study was to investigate the effect of different surface rock fragment cover on hydraulic properties of surface flows and geometrics properties of formed rill.

Materials and Methods: For this purpose, 36 field plots of 20 meter length and 0.5 meter width with 3% slope were established in research field of agricultural faculty, Shahrekord University. Before each erosion event, topsoil was tilled and smoothed with hand tools to remove soil irregularities and soil sealing, update aggregates which come from deeper soil. Then, for beginning the experiment, surface rock fragment cover is scattered randomly on plot surface. Experiment equipment such as collecting the runoff systems installed at the end of plots. In each experiment after setting the surface flow, surface runoff inter to soil surface and testing continued for 60 minutes after starting runoff. Flow velocity was measured using a dye-tracing technique (potassium permanganate) and depth, width and length of rill were measured using a ruler. Treatments were including four level rock fragment cover (0, 10, 20 and 30%) and three rate runoff (2.5, 5 and 7.5 L min^{-1}) with three replications that experiments were done in a factorial with randomized complete block design. Surface runoff samples were oven-dried and weighed to determine sediment loads. Sediment concentration was determined as the ratio of dry sediment mass to runoff volume, while the erosion rate was calculated as the sediment yield per unit area per period of time.

Results and Discussion: The results of this study showed that surface rock fragment cover plays an important role in water distribution. Based on the results, the positive effects of rock fragment cover on Manning s n and the negative effect on flow velocity. Increasing surface rock fragment cover increased hydroulic properties such as flow depth, Manning s n and flow shear stress significantly ($p<0.05$) as linearity. Also, increasing surface rock fragment cover decreased flow velocity exponentially. Statistically comparison of effect different rock fragment cover on geometrics properties of rill indicated that incresing surface rock fragment cover decreased time, number, depth of the formed rill significantly ($p<0.05$). However, increasing surface rock fragment no effect statistically on location, length and width of rill.

Conclusion: The results of this study showed that increasing of surface rock fragment cover is affected hydraulic properties of surface flows and geometrics properties of formed rill. Threshold rill formation was delayed with increasing surface rock fragment cover. This delay of rill formation is very important for areas such as Charmahal va Bakhtiari that has short-term rainstorms and cross-sectional runoff.

These findings have implications for soil water conservation and soil erosion modeling under semi-humid

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climatic conditions. Similar soils to these studied here are widespread in Shahrekord region, and therefore, these conclusions can be applied widely.

Keywords: Geometric properties of rill, Soil erosion and conservation, Surface cover