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Using a rainfall simulator to explore the influence of stone size and vertical position on overland flow, splash detachment and slopewash

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The Influences of rock fragments on overland flow and soil erosion are complex and much debated. The exact role played by differences in splash, pooling and channelling patterns associated with fragment covers of differing character in accounting for contrasting results found by studies is largely unexplored. This poster reports the findings of a study using a laboratory-based rainfall simulator to investigate the influences of rock fragment presence, size and vertical position on overland flow, slopewash and splash detachment. A set of 49 experimental runs of 15 minutes duration was conducted with a gravity-driven rainfall simulator delivering rainfall at a constant intensity of 125.4 mm hr-1. The experiment tested 3 rock fragment size classes: (small (10-20mm), medium (30-49mm) and large (50-70mm) and 2 vertical positions (free-standing and embedded so as to be flush with the soil surface). The rock fragments used were smooth in form. Experiments were conducted on a square plot, 900 cm2 in area and oriented diamond-fashion downslope at an angle of 2°. The soil comprised a dry topsoil (6 % silt, 94 % sand), which was replaced after each run, overlying a sandy subsoil. Seven replicate simulation runs were carried out on each of the 6 combinations of size and position, plus on a bare soil 'control' plot. All runs with rock fragments had a 50 % stone cover evenly and symmetrically arranged within the plot, with fragments equispaced from each other along 'staggered' horizontal lines. Overland flow at the downstream outlet of the plot was recorded at 5-minute intervals and then later filtered to yield slopewash data. Splash detachment was sampled by four splash funnels (127 mm diameter) lined with filter paper and sited just outside the plot at the midpoints of each side. Overland flow was over double bare soil values on plots containing rock fragments. Slopewash was lower on bare soil in the majority of cases. Recorded overland flow and slopewash amounts varied inversely with rock fragment size. Overland flow coefficients in free-standing rock fragment experimental runs were 10.84%, 3.68% and 2.90% for small, medium and large fragment sizes respectively. Embedded rock fragment runs had higher slopewash and overland flow than free-standing rock fragment runs in most cases. Splash detachment results were more complex and varied with vertical position of rock fragments. For free-standing rock fragments, splash was twice as high than on bare soil for small fragments, but smaller than on bare soil for medium and large fragments. In contrast, for embedded rock fragments, splash detachment was over three times higher than on bare soil for medium fragments, but lower than on bare soil for small and large fragments. The lower splash detachment for free-standing cover is attributed to the splash 'interception effect' provided by vertical sides of stones. The slopewash and overland flow differences with size and vertical position are tentatively linked to differences in degrees of pooling and channelling caused by the different fragment combinations. Limitations of the experiments are discussed and future laboratory and field experimental needs are identified.