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Rill erosion in cohesive soils - Part I

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Rill erosion has been identified as the main process of erosion. Hydraulic parameters (e.g. flow velocity and shear forces) significantly vary from sheet to rill flow, changing erosion rates. This research work focuses on the transition of sheet to concentrated or rill flow and related parameters (flow velocity, Froude number, Reynolds number, sediment concentration, headcut velocity etc.). The influence of simulated rainfall on rill development was assessed.

A soil filled experimental flume (width 0.9 m, length 26.4 m) was used to simulate rill erosion. The experimental setup allowed variations in slope, discharge and rain intensity. The soil we used is a silt loam (FAO, 1990). The soil bulk density averaged 1.35 g/cm^3. The discharge ranged from 1.4 to 4.6 l/s. The slope was adjusted to 2% and 4%, respectively. We used 4 rainfall simulators at the down stream part of the flume covering each one an area of 1.2 m by 0.9 m.

A sediment laden water is used for runoff. Density and kinematic viscosity do not significantly change by the sediment.

At a slope of 2% a rill development is observed which does not occur at the rain exposed soil surface, whereas the rain have been no influence on rill development on 4% slope.

As soon as headcuts have been developed sediment concentration begins to increase. A maximum number of headcuts have been formed approximate 20 minutes from the initation of runoff. Rills formed also under conditions of selective transport. An armouring of the rill bed was observed.

A good correlation between sediment concentration and discharge (R^2=0,78) and a weakly correlation between sediment concentration to the number of headcuts (R^2=0.48) has been detected. The soil bulk density had only a small influence on sediment concentrations (R^2=0.33). Stream power was correlated to the number of headcuts (R^2=0.60).