A rainfall simulation experiment to evaluate two sediment tracers in a furrow-shoulders system

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The use of tracers in soil erosion research is a technique that tries to overcome problems of traditional soil erosion measurements by focussing on the spatial distribution of soil erosion. Tracers may have anthropogenic or cosmogenic origin and may either be naturally present or get incorporated into soil artificially. However, none of the variety of available tracers fulfils all the requirements for being an ideal one. This is why the use of new substances to be used as tracers is under continuous development. Two of these new tracers appear to be organophilic clays and magnetic iron oxide. Each of these tracers has been tested under lab conditions; however, to our knowledge, a joint application within one experimental setup has not been undertaken so far. We therefore have set up an experiment to study similarities and differences in the application of these tracers.

For this we used an indoor rainfall simulation setup consisting of a furrow-shoulders system which was set in a metal box (2 x 1.11 m) at two different slopes (7 and 14 %). The surface of the box was divided in six strips, forming two independent furrow-shoulders systems. Soil was air dried and sieved by 2 mm and 6 mm, for blank soil and tagged soil respectively and mixed with the two tracers in a way of stepwise dilution in order to obtain a homogeneous mix of soil and tracer. A layer of 5 cm of soil was placed over a geotextile using tagged soil for the shoulders and untagged soil for the furrows. The system was slowly saturated by a rising water table. After saturation, soil was drained during 48 hours. A portable rainfall simulator with deionised water was used to simulate rainfall with an intensity of 60 mm/h. The rain was applied until steady state runoff conditions were reached after 40 min. Soil samples of the first 1 cm were taken before each rainfall simulation to determine tracer concentration, soil moisture and bulk density. During the rainfall events total runoff and sediment were collected to determine tracer concentration. Flow velocity was also determined by recording the flow velocity of brilliant blue as a tracer. After the events, soil samples were taken along the shoulders and furrows with high spatial resolution. In total, 140 samples were taken from on plot consisting of the top 1 cm in shoulders and the top 2 cm in furrows (0-1 and 1-2 cm).

At this session we will present the results of the understanding of the sediment transport in a furrow-shoulder system at small scale under controlled conditions of rainfall and slope. The general applicability of the two tracers for indoor rainfall simulation conditions will be presented. Moreover, the combined use of organophilic clays and magnetic iron oxide will provide additional information about soil redistribution in the system and the contribution of shoulders and furrow to the sediment.