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Effects of Litter Incorporation on Soil Detachment Processes on the Loess Plateau of China

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Plant litter incorporation into soil is a widespread phenomenon in the natural environment. Accurate estimation of the soil detachment capacity (D_c) driven by overland flow under litter incorporation effects is crucial for improving soil erosion prediction. However, the effects of litter incorporation on soil detachment processes are often ignored, and the temporal variation of D_c under litter incorporation effects remains unclear for the Loess Plateau of China. In this study, we conducted flume tests to determine the temporal variation of D_c for soils incorporating two typical plant litters (*Bothriochloa ischaemum* (L.) Keng. litter, and *Artemisia sacrorum* Ledeb. litter) between May 2017 and October 2018 (a 524-day period). Furthermore, the key factors affecting D_c were identified. Our results showed that the temporal variation in D_c was consistent across the different soil treatments (two litter incorporation treatments and one bare soil control), showing a rapid decline and then fluctuating at a low level, with D_c ranging from 0.115 to 6.876 $\text{kg m}^{-2} \text{s}^{-1}$. Incorporation of litter effectively reduced D_c , with the D_c of soil treatments incorporating litter being 15% to 29% lower than that of bare soil (2.110 $\text{kg m}^{-2} \text{s}^{-1}$). Further analysis showed that the temporal variation in D_c was mainly affected by the development of a physical soil crust. D_c can be successfully estimated using a nonlinear equation incorporating flow shear stress and soil cohesion ($R^2 = 0.77$, $\text{NSE} = 0.65$), which represent the erosive force and soil erosion resistance, respectively. Our study reveals the important role of plant litter in the soil detachment process and aids the understanding of soil erosion pathways. Further studies are needed to investigate the effects of a physical soil crust on the soil detachment process driven by overland flow.