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The effect of rain power on raindrop detachment and soil erosion

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The amount of erosion from raindrops has been linked to the rainfall characteristics such as rainfall intensity, drop diameter, rainfall kinetic energy and to the soil surface conditions (e.g. slope, soil moisture and bulk density). The aim of this study was to relate rain power (R, W m^{-2}) to the rate of detachment of soil particles by raindrops and to evaluate effect of soil surface slope and rainfall intensity on erosion process.

Studies were conducted on silt loam soil developed from loess. Soil samples were placed in a small box (25x36x14 cm) under 4, 12 or 25% slope and exposed to simulated rainfall with the intensities of 19 and 54 mm h^{-1} (cumulative rainfall 54 mm), and 33 mm h^{-1} (cumulative rainfall 33 mm). Different initial soil moisture and status of soil surface conditions were used in this study. The conditions were consequences of various rainfall parameters and breaks between the rainfall events.

Concept of rain power (R, W m^{-2}) includes cosine of angle of soil surface slope and decreases with increasing steepness of slope, although numerous experiments showed an increase of erosion with increasing slopes. So, we used transferred vertical drop fall velocity to the surface-parallel dimensionless velocity magnitude and its probability density $f(\theta)$, where θ – angle about the centre of drop impact (θ = 0 coincides with the downslope direction). We defined the coefficient f_E as the ratio of $f(\theta)$ for all downslope directions to $f(\theta)$ for round angle. Then the function f_E was related with expression describing rain power (R, W m^{-2}) for horizontal soil surface (i.e. cosine of slope = 1) and then the effective rain power (R_E, W m^{-2}) was obtained. The effective rain power compared to the rain power was more correlated with the rate of soil particles detached by raindrops for various slope of soil surface. This was due to better fitting of the effective rain power to the detachment by standardizing the trend of interrelations.