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Assessment of the hydrological and erosional response of Mediterranean badlands through rainfall simulation experiments: a review

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Since the 30's rainfall simulation has been used by scientists worldwide to study soil hydrology and soil erosion processes under controlled conditions. Simulated rain experiments have contributed significantly to a better understanding of these processes under different environmental conditions, including a wide range of badland environments, particularly in the Mediterranean region. The objectives of those studies ranged from the assessment of soil erodibility under different vegetation and rock-fragment covers, runoff generation mechanisms, or process-oriented experiments focussing on surface sealing and crusting dynamics. This study provides a critical review of all studies using rainfall simulation experiments conducted over the last decades in Mediterranean badlands.

A database with the hydrological and erosional data collected by means of simulated rainfall experiments applied on badland areas (only data recorded in field conditions) was made. This database comprises data from 17 studies published in the last 20 years (i.e. mainly in international journals, national journals and conference proceedings). Different variables related to some controlling factors (i.e. soil surface area, slope gradient, rainfall intensity, rock fragment cover or antecedent soil moisture content), hydrological response (time to ponding, time lag, runoff coefficient and infiltration rate) and soil loss data (mean and maximum sediment concentration and soil detachment rate) were extracted from these sources.

Results indicate that the hydrological behaviour of badlands was characterized by rapid runoff responses, low to moderate infiltration rates and high runoff coefficients. Positive relationships were observed between antecedent soil moisture content and antecedent rain intensity, and between antecedent soil moisture content and runoff. Likewise, a negative relationship was observed between slope gradient and mean infiltration rate. Sediment concentration and sediment detachment rates were the highest measured values in the Mediterranean region. Results showed that rainfall intensity, runoff coefficient and slope angle have a positive effect on sediment concentration and sediment detachment.

Rainfall simulations contributed with fundamental information for a better understanding of the temporal and spatial variability of soil erosion processes. However, rainfall simulation methods provided mainly qualitative rather than quantitative information because of the small plot sizes and the simulated rainfall characteristics.