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Effects of Near Soil Surface Characteristics on the Soil Detachment Process in a Chronological Series of Vegetation Restoration

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The effects of near soil surface characteristics on the soil detachment process might be different at different stages of vegetation restoration. This study was performed to investigate the effects of the near soil surface factors of plant litter, biological soil crusts (BSCs), dead roots and live roots on the soil detachment process by overland flow at different stages of restoration. Soil samples (1 m long, 0.1 m wide, and 0.05 m high) under four treatment conditions were collected from 1-yr-old and 24-yr-old natural grasslands and subjected to flow scouring under five different shear stresses ranging from 5.3 to 14.6 Pa. The results indicated that the effects of near soil surface characteristics on soil detachment were substantial during the process of vegetation restoration. The total reduction in the soil detachment capacity of the 1-yr-old grassland was 98.1%, and of this total, 7.9%, 30.0% and 60.2% was attributed to the litter, BSCs and plant roots, respectively. In the 24-yr-old grassland, the soil detachment capacity decreased by 99.0%, of which 13.2%, 23.5% and 62.3% was caused by the litter, BSCs and plant roots, respectively. Combined with the previously published data of a 7-yr-old grassland, the influence of plant litter on soil detachment was demonstrated to increase with restoration time, but soil detachment was also affected by the litter type and composition. The role of BSCs was greater than that of plant litter in reducing soil detachment during the early stages of vegetation recovery. However, its contribution weakened with time since restoration. The influence of plant roots accounted for at least half or up to two-thirds of the total near soil surface factors, of which more than 72.6% was attributed to the physical binding effects of the roots. The chemical bonding effect of the roots increased with time since restoration and was greater than the effect of the litter on soil detachment in the late stages of vegetation restoration. The correction coefficients of near soil surface characteristics for rill erodibility were provided for the Water Erosion Prediction Project (WEPP) model.