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Soil Organic Matter Erosion by Interrill Processes from Organically and Conventionally farmed Devon Soil

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Globally, between 0.57 and 1.33 Pg of soil organic carbon (SOC) may be affected by interrill processes. Also, a significant amount of phosphorus (P) is contained in the surface soil layer transformed by raindrop impact, runoff and crust formation. In the EU, the P content of a crusted (2 mm) surface layer corresponds to 4 to 40 kg ha^{-1} of P on arable land (1.094 mil km2). Therefore, the role of interrill processes for nutrient cycling and the global carbon cycle requires close attention. Interrill erosion is a complex phenomenon involving the detachment, transport and deposition of soil particles by raindrop impacted flow. Resistance to interrill erosion varies between soils depending on their physical, chemical and mineralogical properties. In addition, significant changes in soil resistance to interrill erosion occur during storms as a result of changes in surface roughness, cohesion and particle size. As a consequence, erosion on interrill areas is selective, moving the most easily detached small and/or light soil particles. This leads to the enrichment of clay, phosphorous (P) and carbon (C). Such enrichment in interrill sediment is well documented, however, the role of interrill erosion processes on the enrichment remains unclear. Enrichment of P and C in interrill sediment is attributed to the preferential erosion of the smaller, lighter soil particles. In this study, the P and organic C content of sediment generated from two Devon silts under conventional (CS) and organic (OS) soil management were examined. Artificial rainfall was applied to the soils using two rainfall scenarios of differing intensity and kinetic energy to determine the effects on the P and C enrichment in interrill sediment. Interrill soil erodibility was lower on the OS, irrespective of rainfall intensity. Sediment from both soils showed a significant enrichment in P and C compared to the bulk soil. However, sediment from the OS displayed a much greater degree of P enrichment. This shows that the net P export from organically farmed soils is not reduced by a similar degree than soil erosion compared to conventional soil management. The enrichment of P and C in the interrill sediment was not directly related to SOC, P content of the soil and soil interrill erodibility. A comparison of soil and sediment properties indicates that crusting, P and C content as well as density and size of eroded aggregate fragments control P and C enrichment. Due to complex and dynamic interactions between P, SOC and interrill erosional processes, the nutrient and C status of sediments cannot be predicted based on soil P content, SOC or interrill erodibility alone. Clearly, further research on crust formation and the composition of fragments generated by aggregate breakdown and their transport in raindrop impacted flow under different rainfall conditions is required. Attaining this critical missing knowledge would enable a comprehensive assessment of the benefits of organic farming on nutrient budgets, off-site effects of interrill erosion and its role in the global C cycle.