

Flattened residue effects on wind speed and sediment transport

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Abstract

Mulching with flattened crop residues is widely used to protect soils from wind erosion. Several wind tunnel and field experiments have shown decreased protection of some soil covers with increasing wind speed. In some studies sediment transport was enhanced with flattened residue as compared with the bare soil condition. The purpose of this article was to determine the behavior of wind speed and sediment transport when the soil surface is covered with randomly applied, flattened crop residues. A literature review was conducted to evaluate recent insights in turbulent flow properties and related sediment transport. A conceptual model was then developed to explain decreasing soil protection of a certain residue quantity when the free stream wind speed increases. The main reason is the change in turbulent flow properties of the near-surface wind when non-erodible roughness elements are added to an otherwise smooth surface. The average wind speed is reduced by the roughness but the probability distribution of instantaneous wind speed becomes wider and positively skewed. If free stream wind speed increases, at a certain moment the changed turbulence will cause more wind gusts that exceed the threshold wind speed for soil particle movement than would occur over a bare surface. But it is likely that this only happens when soil cover is less than 10%. For higher soil covers, increasing wind speed will also cause a decrease in soil protection, but natural wind speeds are normally not sufficient to cause enhanced sediment transport, because average wind speed is sufficiently reduced.