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Dust and nutrient enrichment by wind erosion from Danish soils in dependence of tillage direction

Ali Mohammadian Behbahani (1), Wolfgang Fister (2), Goswin Heckrath (3), and Nikolaus J. Kuhn (2)

(1) Gorgan University of Agricultural Sciences and Natural Resources (GUASNR), Department of Watershed and Arid Zone Management, Gorgan, Iran, (2) University of Basel, Physical Geography and Environmental Change, Environmental Sciences, Basel, Switzerland (wolfgang.fister@unibas.ch), (3) Aarhus University, Department of Agroecology, Aarhus, Denmark

Wind erosion is a selective process, which promotes erosion of fine particles. Therefore, it can be assumed that increasing erosion rates are generally associated with increasing loss of dust sized particles and nutrients. However, this selective process is strongly affected by the orientation and respective trapping efficiency of tillage ridges and furrows. Since tillage ridges are often the only protection measure available on poorly aggregated soils in absence of a protective vegetation cover, it is very important to know which orientation respective to the dominant wind direction provides best protection. This knowledge could be very helpful for planning erosion protection measures on fields with high wind erosion susceptibility. The main objective of this study, therefore, was to determine the effect of tillage direction on dust and nutrient mobilization by wind, using wind tunnel simulations. In order to assess the relationship between the enrichment ratio of specific particle sizes and the amount of eroded nutrients, three soils with loamy sand texture, but varying amounts of sand-sized particles, were selected. In addition, a soil with slightly less sand, but much higher organic matter content was chosen. The soils were tested with three different soil surface scenarios - flat surface, parallel tillage, perpendicular tillage.
The parallel tillage operation experienced the greatest erosion rates, independent of soil type. Particles with D50 between 100-155 μm showed the greatest risk of erosion. However, due to a greater loss of dust sized particles from perpendicularly tilled surfaces, this wind-surface arrangement showed a significant increase in nutrient enrichment ratio compared to parallel tillage and flat surfaces. The main reason for this phenomenon is most probably the trapping of larger particles in the perpendicular furrows. This indicates that the highest rate of soil protection does not necessarily coincide with lowest soil nutrient losses and dust emissions. For the evaluation of protection measures on these soil types in Denmark it is, therefore, important to differentiate between their effectivity to reduce total soil erosion amount, dust emission, and nutrient loss.