



Effects of tractor traffic on soil compaction, water infiltration and soil erosion in tilled and grassed vineyards

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Soil erosion is affected by rainfall temporal pattern and intensity variability. In vineyards, machines traffic is implemented with particular intensity from late spring to harvest, and it is responsible of soil compaction, that likely affects soil hydraulic properties, runoff, and soil erosion. Additionally, hydraulic and physical properties of soil are highly influenced by vineyards' inter-rows soil management. The effect of machines traffic on soil compaction, hydrological and erosional processes has been investigated on a sloping vineyards with different inter-row soil managements (tillage and permanent grass cover) in the Alto Monferrato area (Piedmont, NW Italy). During the investigation (November 2016 – October 2018) soil water content, rainfall, runoff, and soil erosion were continuously monitored. Field-saturated hydraulic conductivity (Kfs), soil penetration resistance (PR) and bulk density (BD) were recorded periodically in portions of inter-rows affected and not by the machine traffic. In order to take into account temporal and management variability of soil compaction and hydrological properties, field-monitored data were statistically analysed, in order to identify existing relationships between climate and management variables and soil physical and hydrological variables. Very different yearly precipitation characterized the observed period, leading to higher bulk density and lower infiltration rates were in the wetter year, especially in the tilled vineyard, whereas soil penetration resistance was generally higher in the grassed plot, and in drier conditions. Soil bulk density and penetration resistance in tracked soil of the tilled plot increase, compared to the grassed plot, after only one to three tractor passages following tillage operation, especially in the topsoil (first 10 cm). Soil compaction affects water infiltration, especially in the wet year. In the tilled vineyard, one tractor passage on wet soil after tillage operation dramatically reduced Kfs from over 1000 to near 1 mm h⁻¹, while with grass cover Kfs remained above the usual rain-intensity values, allowing water to infiltrate the soil. By means of linear and multilinear regression, significant relationships have been found to relate hydraulic conductivity and soil penetration resistance with soil water content, weather variables and a factor that takes into account the number of tractor passages and the elapsed time from last soil disturbance. Lastly, runoff and soil erosion were higher in the tilled plot, even if lower than the long-period average values. Indeed, in the wet year, management with grass cover reduced considerably runoff (-76%) and soil loss (-83%) compared to tillage and, in the dry season.