Geophysical Research Abstracts
Vol. 12, EGU2010-11722-1, 2010
EGU General Assembly 2010

Evaluation of the MMF (Morgan-Morgan-Finney) model based on soil loss experimental data from vineyards in Alto Monferrato area (NW Italy)

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Soil erosion in sloping vineyards is a serious threat, made worse by climate change and mechanisation. Machinery traffic influences soil physical properties resulting in lower water infiltration capacity, higher runoff and soil losses.

Between 2000 and 2008 measurements have been conducted at an experimental vineyard with rows along the slope in the "Alto Monferrato" area (Piedmont, NW Italy) in order to evaluate runoff and soil losses. Three plots are monitored to compare different inter-rows management practices: controlled grass cover, conventional and reduced tillage. Agriculture soil management practices affect soil losses.

Each plot is 1200 m^2 wide and its average slope is about 25 %. Rainfall was recorded and runoff and sediments were collected at the bottom of each plot by a drain connected with a tipping bucket device. This was designed to measure total runoff and to sample a portion of the runoff-sediment mixture. Collected sediments were then ovendried and weighed.

Collected data show that runoff generally increased with the rainfall amount and was lower from the grass covered plot than others, especially when the event rainfall was higher than 60 mm. Soil loss increased with the maximum rainfall intensity registered during the event. Mean annual soil losses measured over the 9 years period are 16.1 Mg ha^{-1}in the reduced tilled plot, 13.4 Mg ha^{-1} in the traditionally tilled plot and 3.2 Mg ha^{-1} with the controlled grass cover. A single summer storm caused the highest soil losses, which were higher than 18 Mg ha^{-1} in the tilled plots.

The maintenance of controlled grass cover inter-rows allows protecting soil from erosion: the total soil loss was up to 80% lower than in the tilled plots. The protective action of the grass cover is effective also during storms and intense rainfalls, which are more erosiveness.

Soil physical properties were also measured. Field data about percentage of clay, silt and sand, soil moisture at field capacity, bulk density and hydraulic conductivity are available for each plot. They have been used, besides to climate data and land cover guide values, as input parameter in the modified Morgan-Morgan-Finney model (Morgan & Duzant, 2008), specifically elaborated to evaluate effects of crops and vegetation on soil erosion.

The model output has been compared with experimental data, in order to validate the model performance. Expected annual soil loss calculated for each plot is consistent with the mean value obtained in the period of observation.