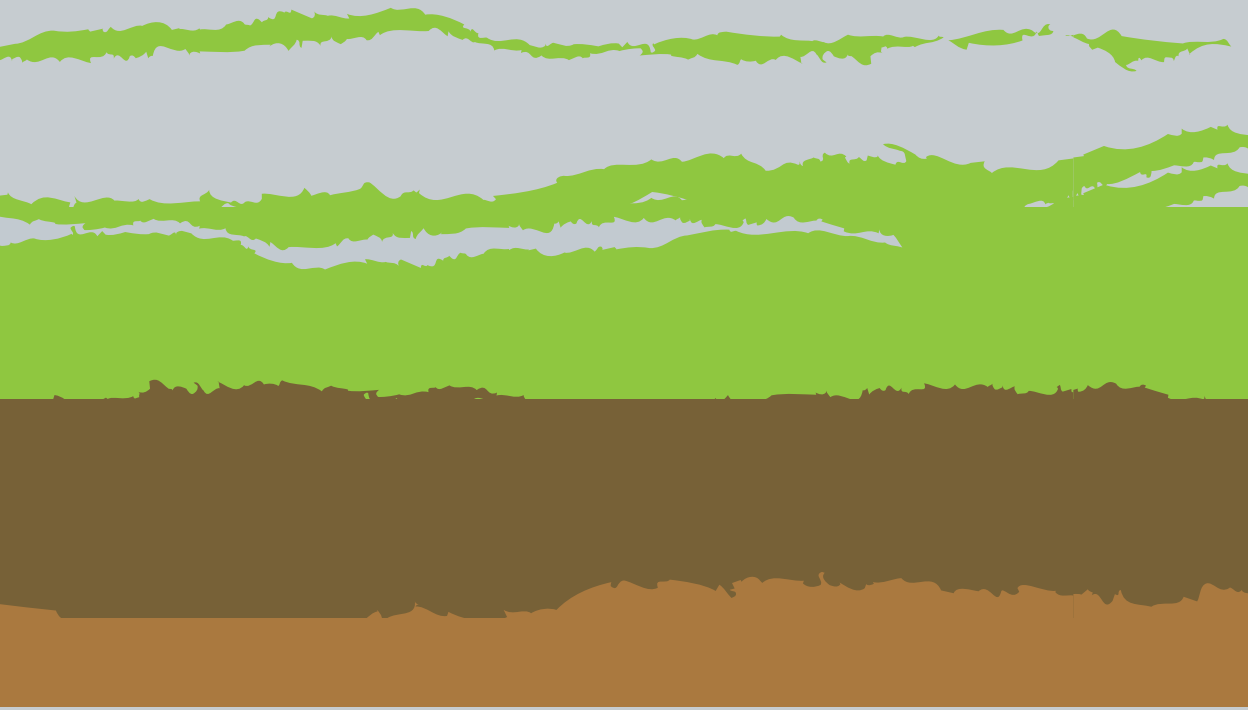
Soil management practices in the Alps

A selection of good practices - Case Study 1



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CS1.

Soil research towards a sustainable mountain vineyard management – limiting soil erosion on steep slopes and preserving cultural heritage; Valle d'Aosta, Italy

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Country, Region:	*Italy – Aosta Valley*
Organisation:	*University of Turin (UniTO-DISAFA) and Institut Agricole Régional (IAR)*
Sector:	*agriculture, erosion control*
Land uses:	*agriculture*
Main soil threat:	*soil erosion*
Key soil ecosystem services:	*agricultural biomass production, surface run-off regulation, nutrient cycle regulation, recreational and spiritual services*
Summary:	*Vineyards on steep slopes are very common in the Alpine region. In this case study we investigated the effect of permanent grassing on erosion rates with respect to weed killing practices, and we assessed rainfall erosivity thresholds for an experimental site located in Aosta Valley (NW Italy).*
Keywords:	*soil erosion, prevention, vineyard, permanent grass cover, herbicide, Aosta Valley*

Background and description of the problem

Soil erosion is affecting large areas worldwide, especially on steep slopes and where the soil formation rate is particularly low. In such conditions, when the vegetation cover is scarce or discontinuous, it has been suggested that even relatively limited erosion rates (e.g. < 5 t ha^{-1} y^{-1}) can lead to irreversible soil loss, and through this to severe landscape degradation and a significant decline of soil ecosystem services.

In NW Italy, severe storms are frequent, and soil loss in the range 20–50 t ha^{-1} y^{-1} has often been predicted in mountain areas. To mitigate accelerated erosion, the sustainable agricultural management practices are crucial for soil conservation and natural hazard mitigation.

Steep-slope Alpine vineyards are often characterised by high-quality wine production but are prone to severe erosion when the soil is left bare, i.e. grass-cover is removed and herbicides are applied regularly. By maintaining permanent grass cover, proper management can significantly limit run-off and soil erosion in the area of steep-slope Alpine vineyards. This approach was studied and demonstrated at an experimental site that was designed to assess the effect of permanent grassing on erosion rates with respect to weed killing practices.

Expected improvements / contribution to better soil management

The demonstration area aims at disseminating knowledge on mitigation/better management of soil erosion in steep-slope Alpine vineyards. In addition, being a typical landscape component of the Alpine regions, the mountain vineyards in Aosta Valley have a considerable economic and aesthetic value. Namely, vineyards have been present in Aosta Valley since the Roman age, thus they represent a true cultural heritage that is important to local people and interesting to tourists.

The ancient practice of terraced vineyard slopes helped prevent various forms of land degradation such as severe erosion (Figure 1), soil creeping, landslides and floods. Where terraces are not present, or where slopes are too steep, erosion can lead to permanent soil and nutrient loss, compromising the main ecosystem functions, triggering hydrogeological hazard and loss of cultural heritage. The critical goal of the sustainable mountain viticulture is to find a compromise between economically viable production, erosion control and prevention of natural disasters, and loss of heritage.

Stakeholders and knowledge transfer

Farmers are interested in sustainable vineyard management and environmentally sound wine production. Local communities and the tourist sector support the preservation of vineyards that represent cultural heritage.

At the moment, the site is managed by the Institut Agricole Régional and the University of Torino who are jointly carrying out the experimental activities to collect knowledge for sustainable and economically viable management of vineyards and erosion decrease. Research activities are focused on planning, site maintenance, run-off and sediment collection, sediment analysis, interpretation of results.

Data and methods

The IAR experimental site located in Aosta Valley (NW Italy, Figure 2) is a mountain vineyard characterised by up and down the slope tillage, with an average 40% slope. Eighteen tanks for run-off and sediment collection were installed in the vineyard (one per vine-row, Figure 3). Three treatments (i.e. weed killing, permanent grassing, and buffer zone) were taken into consideration. For three years, sediments and

surface runoff were collected during the vine-growing season. Sediments were weighted and analysed for texture, organic C and N contents in order to assess the effect of management on sediment delivery and depletion of nutrients. The climatic data (precipitation, temperature) were continuously measured at a nearby weather station and evaluated against the run-off data.

At the beginning of the experiment, representative soil profiles were described and characterised at the experimental site. Soils were predominantly skeletal, moderately deep and moderately developed (Inceptisols according to the USDA Soil Taxonomy). Chemical and physical analyses were carried out (pH, cation exchange capacity, C and N contents, carbonates, texture, aggregate stability and Atterberg limits). Geological maps and land management history were evaluated.

Prior to the start of the Links4Soils project, a 3-year soil erosion experiment was conducted (between the years 2014 to 2016). The experiment data will be merged in order to obtain more statistically sound results.

Results and conclusions

Since 2014, ten erosive events have occurred. In general, major events occurred in July and October. In 2017, there was a severe summer draught.

Considering the entire experiment, soil loss for single events ranged from almost negligible for low rainfall intensities to ~4 t ha^{-1} (bare soil with tractor passage, recorded for a maximum rainfall rate of 95 mm h^{-1}). Although the erosion rates in most cases were below 1 t ha^{-1} for single events, differences among weed-killing and permanent grassing were sometimes ten-fold. The effect of tractor passage was very relevant as well, and favoured the generation of channelled surface run-off. With respect to the original soil, the collected sediments were enriched in fine fraction and nutrients.

We draw the following conclusions:

1) in order to mitigate soil erosion loss and nutrients depletion, permanent grassing and reduced tillage (i.e. minimum machinery and tractor passage) are strongly recommended in sloping vineyards, in particular in old vineyards where the vines were planted up and down the slope.

2) buffer strips (i.e. 10 m permanent grassing in the bottom 5 m part) are still quite effective in erosion mitigation and should be preserved in order to find a compromise between erosion control and habitat and biodiversity functions.

Transferability and applicability

The good practices resulting from the case study can be transferred to similar contexts (i.e. mountain vineyards on steep slopes) in Aosta Valley. The results will provide a basis for best practices and guidelines for erosion prevention at similar sites, and by this contribute to sustainable management of important economic resources, preservation of tourist appeal, and protection of the cultural heritage.

Photos / illustrations / maps

Figure 1: Intense erosion after a summer storm in 2012 *(Photo: O. Zecca).*

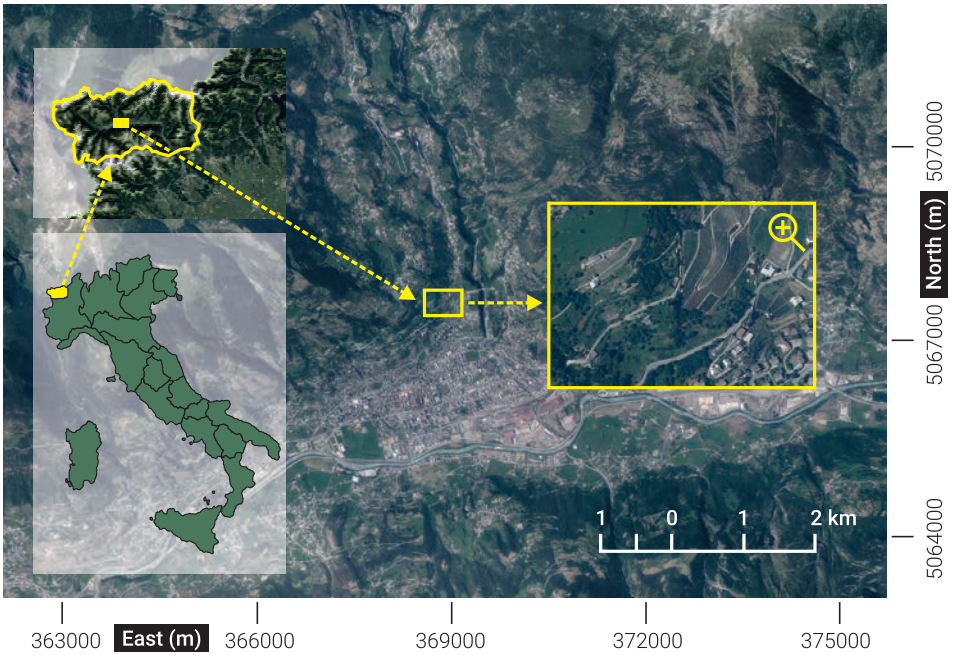

Figure 2: Study site location with indication of the Aosta Valley Region and the experimental site of Moncenis (WGS 84/UTM Zone 32N).

Figure 3: Experimental setting. View of the 18 vineyard rows from the opposite side of the valley. Rows with continuous grass cover are clearly identifiable, as well as the buffer-rows with ½ grassed surface, and the white tanks for the collection of sediments *(Photo: O. Zecca)*.

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