



Effectiveness of soil water conservation measures under different rainfall characteristics in hilly vineyards of Piedmont (NW-Italy)

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1. Background

Erosional processes are highly affected by the soil management practices and by climate variability, particularly changes in rainfall temporal pattern and intensity.

The use of grass cover (GC) in the inter-rows is one of the most common and effective soil and water conservation (SWC) practice available to reduce runoff and soil erosion in vineyards and is supported at local level by Rural Development Programmes (RDPs) addressing EU Common Agriculture Policy soil and water conservation priorities.

Contouring is an additional measure to limit the erosion phenomena. As typical in the Piedmont region, vineyards are arranged with rows along contour lines ("girapoggio") and up-and-down the slope ("rittochino").

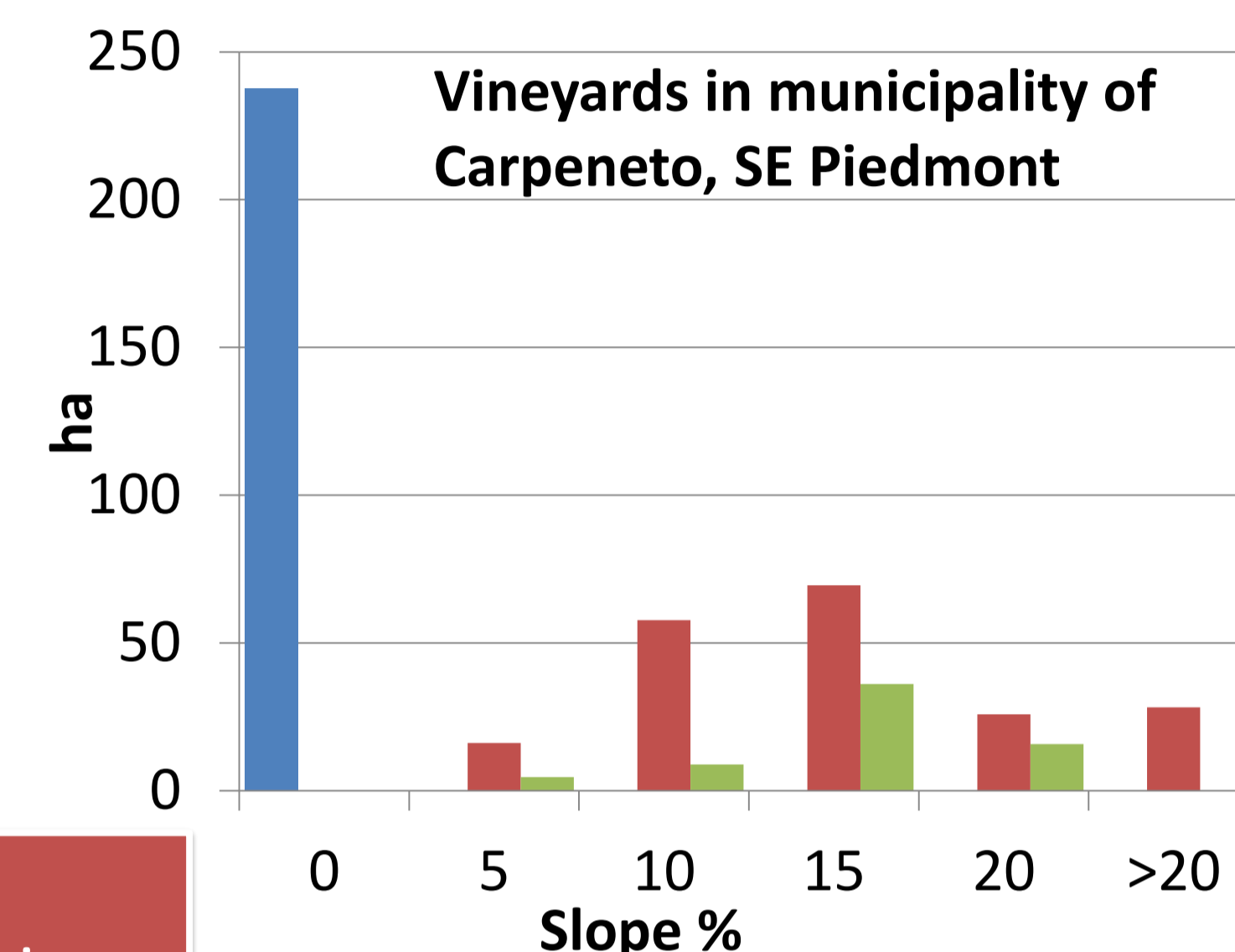
Grass cover is adopted on 15.4 % of orchards and vineyards surfaces in Piedmont (following 2007–2013 RDP) to contrast:

- + Runoff and soil erosion
- + OM decline



Contouring («girapoggio»)

- + traditional row disposition in the region
- + control runoff and soil erosion
- difficulties in mechanization
- less productive areas
- less machinery safety



3. Methods

Each monitored plot was hydraulically bounded. Runoff and transported sediments from each plots were collected by a channel surrounding the plot and connected to a sedimentation trap and, then, to a tipping bucket device to measure the discharge of runoff. After each erosive event, a 1.5 L sample of runoff sediment mixture was collected. Sediments deposited along drains and in the sedimentation traps were also collected and weighed after being dried.

Rainfall data for the experiment period were obtained from two agro-meteorological stations, both placed at about 200 m from the plots.

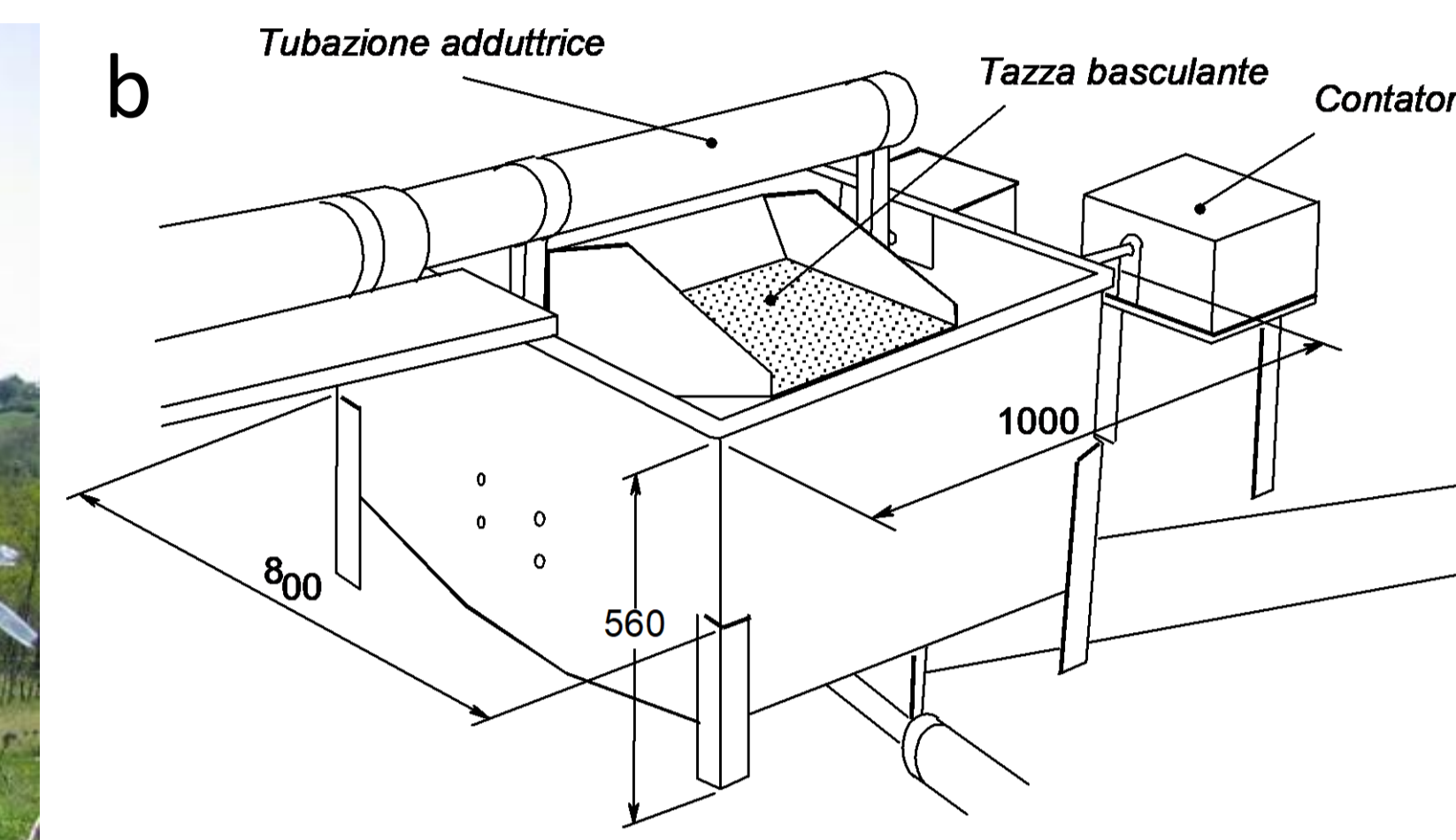


Fig. 2. The runoff measuring system: a) sedimentation traps and tipping bucket at the Tenuta Cannona Experimental Site; b) details of the tipping bucket system

Events with RO > 300 L ha⁻¹ and SSC > 0.01 g L⁻¹ in at least one of the plots were considered:

- Vezzolano Farm = 72 erosive events
- Tenuta Cannona = 56 erosive events

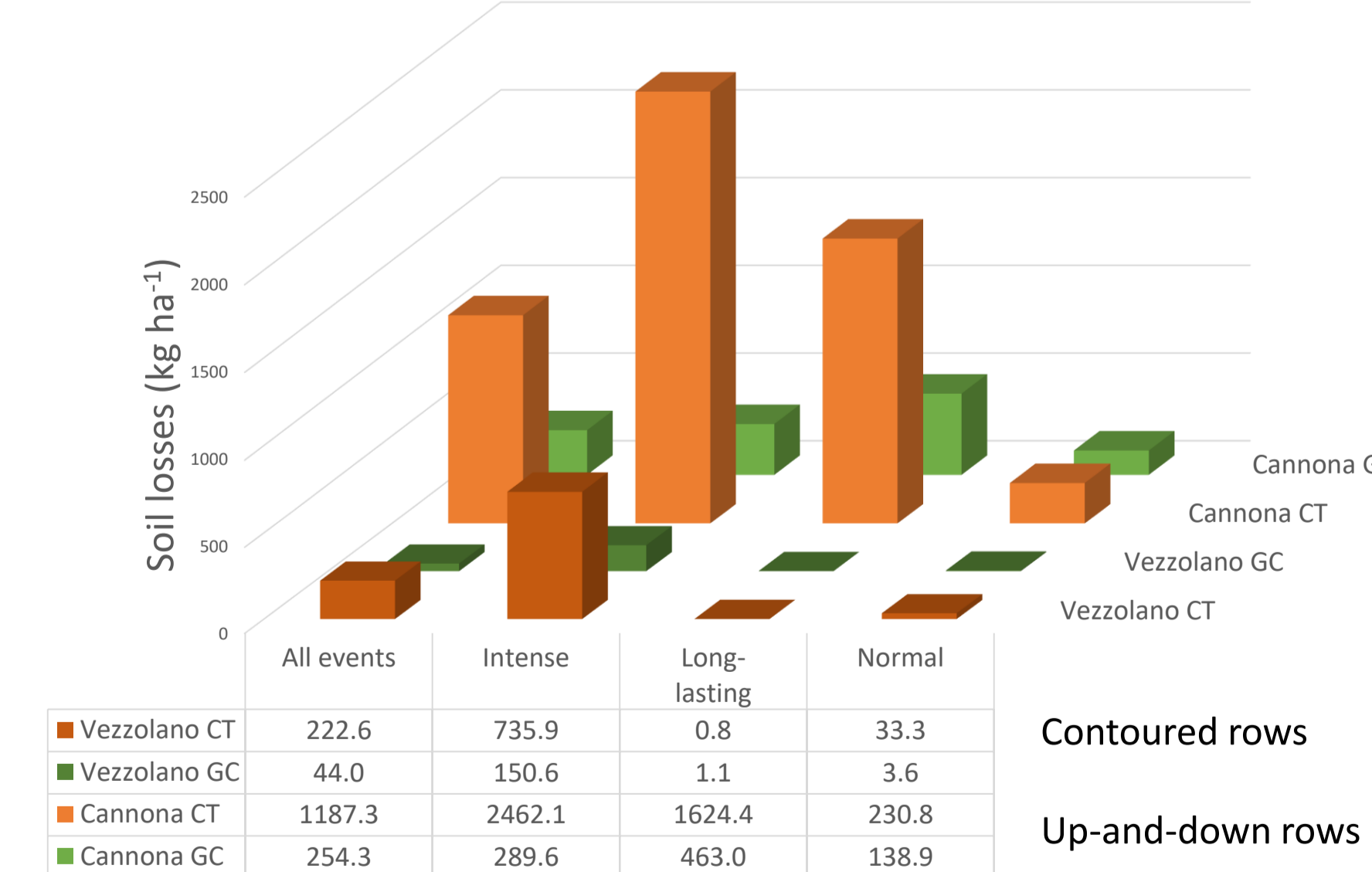
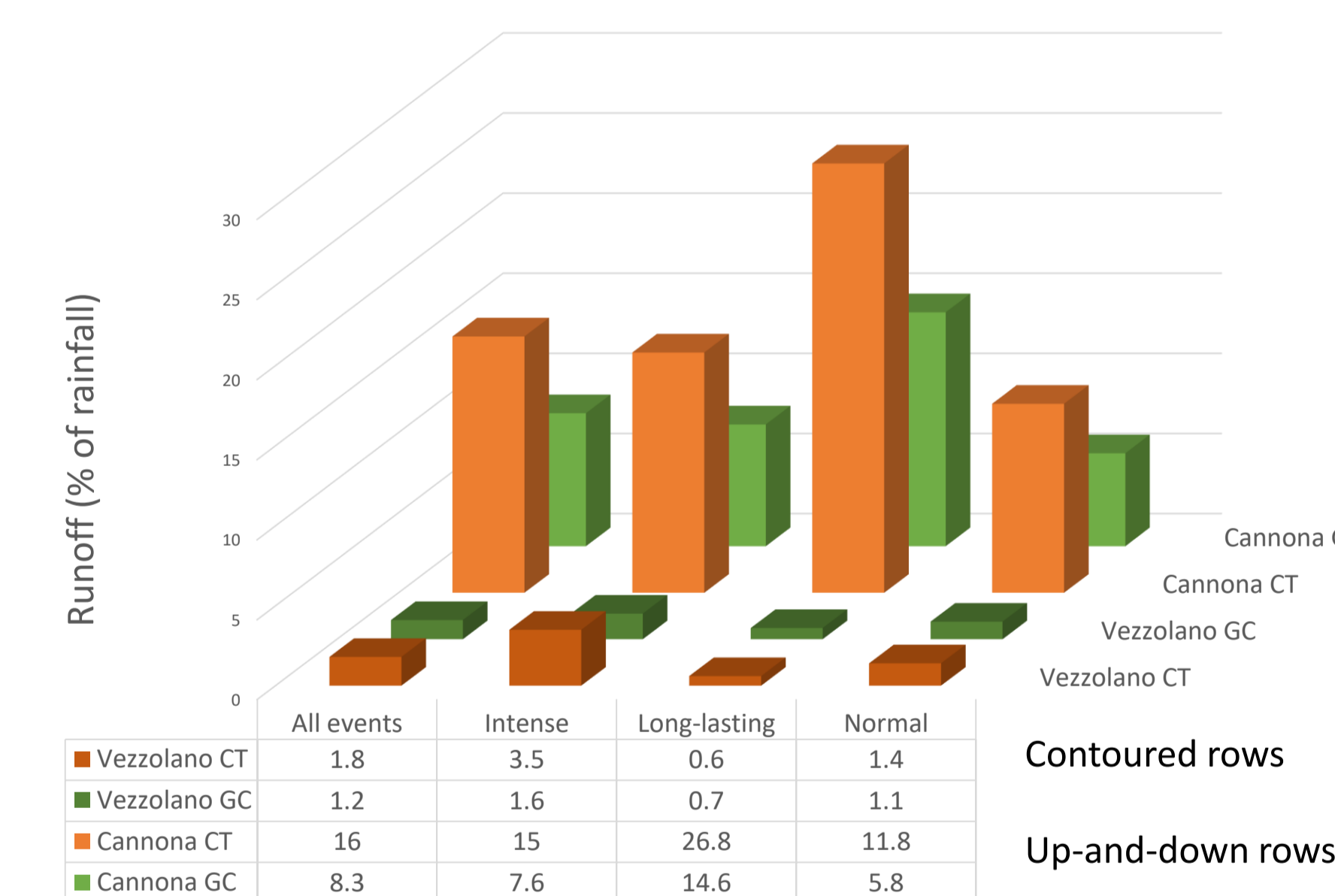
Rainfall events classification:

- long-lasting, with rainfall duration > 50 h
- intense, with 30-min max rainfall intensity > 16 mm h⁻¹
- normal, other events

Statistical analysis was carried out on the two datasets in order to:

- compare the effects of grass cover with tillage in the vines inter-rows in terms of runoff and soil loss in hillslope vineyards with different row orientation
- evaluate the influence of event rainfall characteristics in determining the hydrological and erosive response of vineyards with different row orientation

4. Results



In the contoured rows vineyard

runoff and soil losses were lower in GC than in CT:

- for 68% and 61% of rainfall events
- for all and intense events, only RO for normal (mean values statistically different)

Five largest rainfall records represent:

- 17% of the rainfall
- 94% of the erosivity
- 47% (CT) and 48% (GC) of RO
- 95% (CT) and 94% (GC) of SL

In the up-and-down rows vineyard

runoff and soil losses were lower in GC than in CT:

- for 86% and 92% of rainfall events
- for all, normal and intense events, only RO for long-lasting (mean values statistically different)

Five largest rainfall records represent:

- 20% of the rainfall
- 42% of the erosivity
- 34% (CT) and 40% (GC) of RO
- 59% (CT) and 54% (GC) of SL

The results show the fundamental role of contour-slope row orientation in reducing runoff and, particularly, soil losses (more than 80% in both treatments).

What is the effect of grass cover and contouring on soil water conservation? What is their effect considering different types of rainfall events?

2. Study site

Two experiments have been carried out in vineyards with similar soil management and inclination, but different vine rows orientation, to investigate the effectiveness of GC, compared to tillage (CT), and contouring as SWC practice.

Runoff, soil losses and rainfall characteristics have been recorded in rainfed hillslope vineyards to determine the hydrological and erosive response in plots with different inter-rows soil management.

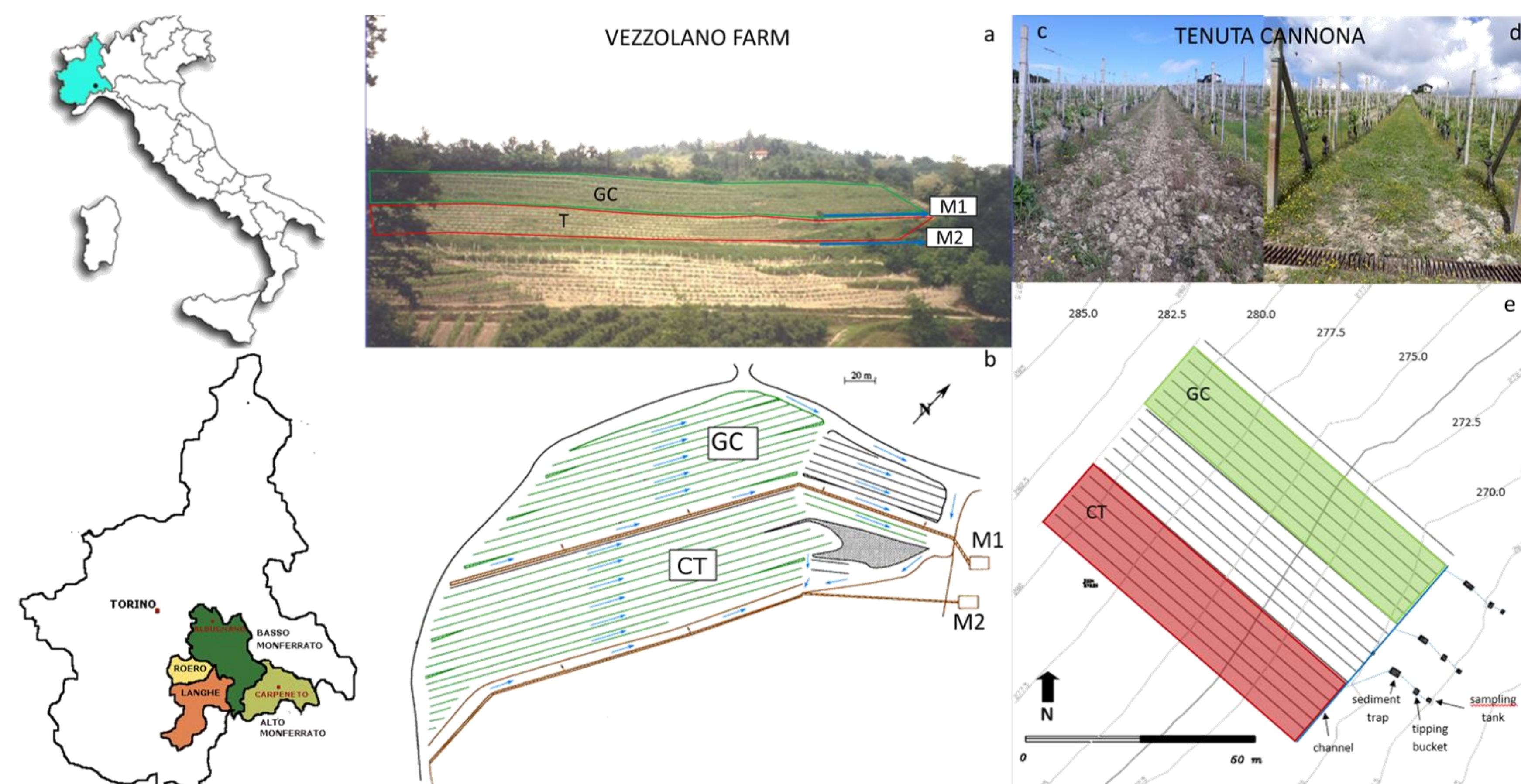


Fig. 1. Study sites: a) localization of the study sites in Italy; b) views and c) schematic representation of the vineyard monitored in the Vezzolano farm. M1 and M2 indicates the measurement devices; view of the tilled (d) and a grassed (e) inter-rows and (f) schematic representation of the Tenuta Cannona monitored plots and runoff collection and measurement systems. GC indicates the plots with soil managed with controlled grass cover, CT indicates the plots with soil managed with tillage. (from: Bagagiolo, G. et al., Environmental Research (2018), <https://doi.org/10.1016/j.envres.2018.06.048>)

	CT	GC
Vezzolano Farm Contoured rows 1992-1996	autumn ploughing and summer hoeing	grass cover mowed and chopped three times per years
Tenuta Cannona Up-and-down rows 2000-2014	Cultivated with chisel, 0.25 m depth, spring and autumn	Spontaneous grass, mulched, spring and autumn (occasionally in summer)

Vezzolano Farm (1992-1996)
MAP (1962-2004) = 846 mm
Silt loam
Original slope = 15-35 %
Contoured rows on terraces
2 plots, A = 5200 m²

Tenuta Cannona
MAP (2000-2018) = 828 mm
Clay to clay-loam
Up-and-down rows
2 plots, A = 1221 m²

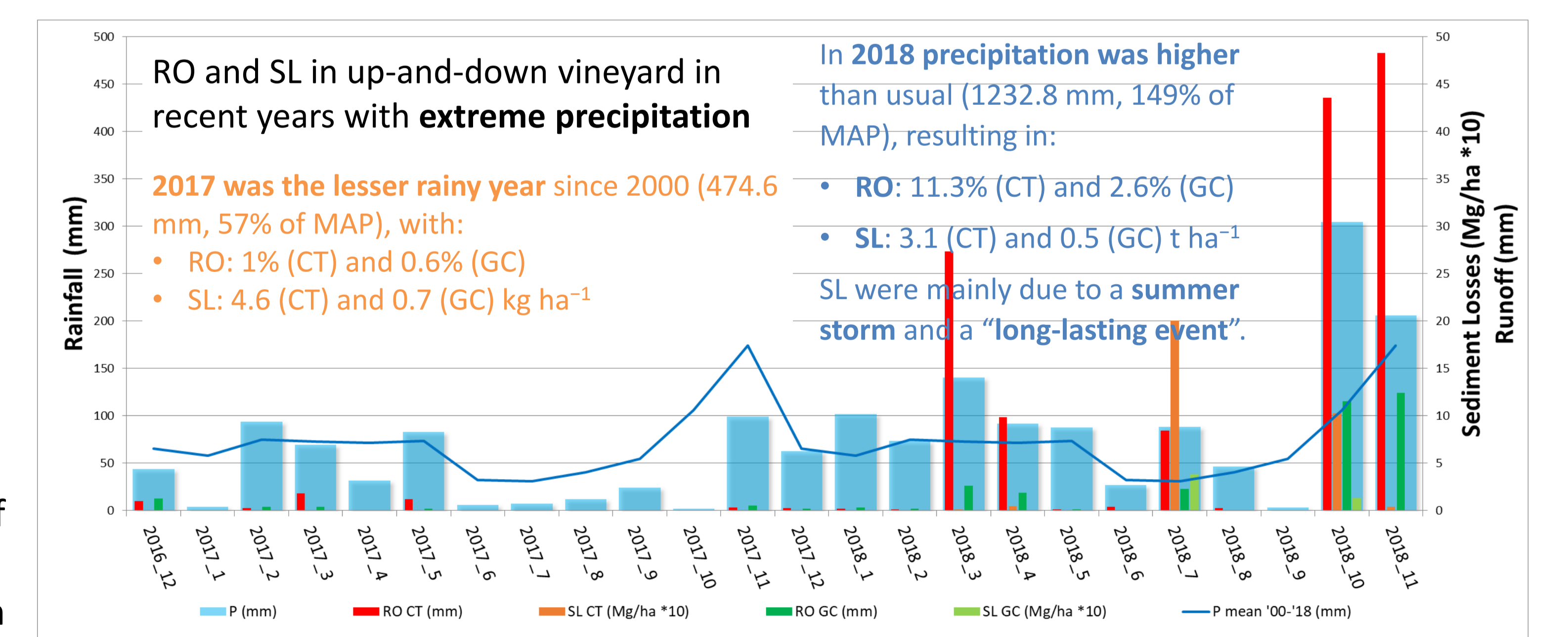
5. Conclusions

The results of direct monitoring conducted during the study:

- demonstrate the positive effect of **contouring** as a measure to prevent runoff and to reduce soil loss, even when soil tillage is adopted;
- highlighted the effectiveness of **grass cover** with respect to soil tillage in preventing runoff and soil erosion in sloping vineyards, varying according to the characteristics and distribution of the rainfall and in relation to rows orientation.

References:

Bagagiolo, G. et al., Environmental Research (2018), <https://doi.org/10.1016/j.envres.2018.06.048>
Biddoccu M. et al. 2018. Effect of tractor passes on soil compaction and field-saturated hydraulic conductivity in tilled and grassed vineyards. Geophysical Research Abstracts, Vol. 20, <https://meetingorganizer.copernicus.org/EGU2018/EGU2018-1140.pdf>



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