

Runoff, sediment and nutrient exports from a Portuguese vineyard under integrated production

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Vineyard is one of the most important fruit crops in the world, and particularly in Portugal, where it represents 27% of permanent crops (INE, 2011). It has an unquestionable impact on Portuguese economy, due to direct impacts on primary sector, since it embodies 49% of drink industry sales and it is the seventh vegetable product best quoted (INE, 2015), but also due to indirect impacts on tourism. Although the economical relevance of vineyards, crop sustainability may be endangered due to land degradation. In the Mediterranean region, vineyards are reported as being the land use with highest erosion rates, threatening the long-term agricultural sustainability (Biddoccu et al., 2016). Several research studies have investigated runoff and erosion processes on vineyards, but relatively few focused on nutrient losses. This study aims to (i) quantify surface runoff, sediment and nutrient losses in a Portuguese vineyard managed under integrated production; (ii) relate these losses with rainfall pattern; and (iii) discuss the sustainability of vineyards under integrated production.

The study was carried out in a commercial vineyard framed in the specialized wine region of Bairrada, in North-Central Portugal. The vineyard was managed with minimum tillage (non-inversion), performed once per year in some plant rows (changing every year), in order to maintain partial vegetation cover. Fertilization, mostly foliar, is performed twice per year (between May and July), according with integrated production regulations. The climate is Mediterranean but with a significant influence of the Atlantic Ocean. The average annual rainfall is 1077 mm and the average annual temperature is 15.7°C. The soil is a Calcaric Cambisol, with clay texture, and gentle slopes (<10%). Six runoff plots were installed (78-122 m²) in September 2012. The plots were naturally bounded by a path on the top and by plant strips on the sides. At the bottom of each plot, a collector grid was buried and connected to a 80-L tank. Overland flow was periodically (once per week, depending on rainfall pattern) quantified and sampled for suspended sediment (TSS) quantification and dissolved nutrient analyses: total phosphorus (TP), total nitrogen (TN) and nitrates (N-NO₃). The study was performed from October 2012 until September 2014.

Over the two years period, plot runoff coefficient ranged from 10.7% to 18.3%, but between monitoring periods it reached 46.4 - 57.1% during winter storms. Suspended sediment exports recorded 3.5-8.1 ton/ha/year. Nutrient losses in overland flow reached 0.7 - 3.4 Kg TP/ha/year, 3.1 - 11.1 Kg TN/ha/year and 0.3 - 0.5 Kg N- NO₃/ha/year. Great export of sediments and nutrients are largely performed under storms in wettest conditions. These results highlight the great susceptibility of this kind of crops to land degradation and diffuse pollution, even with management practices concerned to minimize the environmental impacts, such as the ones involved in integrated production. Improved agricultural practices are required to mitigate land degradation and ensure long term crop sustainability in vineyards.