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Effects of terraced vineyard abandonment on soil organic carbon in a mountainous Mediterranean environment

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Extensive areas of arable land have been abandoned in many countries around the world, including vineyards in the Mediterranean region, due to changing socioeconomic conditions. Many studies in semiarid Mediterranean environments showed that vineyard abandonment and the subsequent recolonization by natural vegetation caused an increase in SOC concentrations (%). However, there are few scientific articles that compared SOC stocks (t ha-1) between abandoned and productive vineyards. The objectives of this study are to quantify SOC stocks in abandoned and productive terraced vineyards and to assess soil loss and associated SOC stock. The study is conducted in the Troodos Ophiolite Complex on the island of Cyprus. The study area covers 2374 km2 with a maximum elevation of 1944 m above sea level and an average slope of 34%. Annual average precipitation is 596 mm and temperature ranges from an average daily minimum of -2 °C in January and to an average daily maximum of 32 °C in July and August. A paired-site approach was selected for the study: a productive vineyard located next to an abandoned vineyard. Twenty four paired-sites were identified through a stepwise, random sampling method. Soil depth was measured by hammering in an 80-cm metal rod. Composite soil samples and bulk density samples were collected from depths of 0-10 cm, 10-20 cm, 20-40 cm, and 40-80 cm. The loss on ignition method was used for quantifying SOC. Soil pH was measured with a probe and soil texture was estimated by hand-feel method. SOC stock was calculated per site with and without a coarse fragment correction. A t-test was was conducted to analyse significant differences between sites.
The paired sites were located at an average elevation of 1183 m above sea level and had an average slope of 26%. All paired-sites were terraced with dry-stone walls with different degrees of degradation. The productive sites had significantly (p=0.01) deeper soils (mean 70 cm) than the abandoned sites (mean 59 cm), indicating high erosion rates after abandonment. Soil coarse fragment content was also higher in the abandoned sites (42%) than in the productive sites (34%). SOC concentrations were significantly higher in the top 10 cm soil in abandoned sites than in productive sites (p=0.03), with 3.8% and 3.1%, respectively. The SOC concentrations and differences between abandoned and productive sites became smaller with soil depth, with increasing p-values. Although concentrations were higher in the abandoned sites, SOC stock calculations with coarse fragment corrections resulted in lower values for the abandoned sites (116 t ha-1) than for the productive sites (153 t ha-1). The results showed that measurement of SOC concentrations in bulk soil alone is not representative of carbon storage and might be easily misinterpreted. A significant increase in the SOC concentration in the soil surface layer does not imply a significant overall change in the total SOC storage, due to changes in soil bulk density and depth as a result of soil erosion in these terraced landscapes.