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Assessment of soil ecosystem in degraded areas of vineyards after organic treatments

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In Italian vineyards, it is quite common to have areas characterized by problems in vine health, grape production and quality, often caused by improper land preparation before vine plantation and/or management. Causes for soil malfunctioning can include reduced contribution of the soil fauna to the ecosystem services such as nutrient cycles and organic matter turnover.
ReSolVe is a transnational and interdisciplinary project, supported by Core-Organic+ program, aimed at testing the effects of selective agronomic strategies for restoring optimal soil functionality in degraded areas within organic vineyard. For this purpose, the evaluation and biomonitoring of the abundance of soil mesofauna, nematodes and microarthropods, represents an efficient tool to characterize the effects of crop management on soil quality. Assessing enzyme activities involved in the main biogeochemical cycling of C, N, P and S can also provide indication of soil functions and health status.
Italian experimental plots are situated in two commercial farms in Tuscany: i) Fontodi, Panzano in Chianti (FI), which has been managed organically for more than 20 years and ii) San Disdagio, Roccastrada (GR), under organic farming since 2014. In each farm, three plots (250 m2 each) in the degraded areas and three relative control plots in the non-degraded areas were selected. The different restoring strategies implemented in each area were: i) compost, produced on farm by manure + pruning residue + grass, ii) faba bean and winter barley green manure, iii) dry mulching after sowing with Trifolium squarrosum L. Each treated and control plot has been studied for soil nematodes, microarthropods, enzymatic activity, and organic matter turnover using tea-bag index, as well as total organic carbon (TOC) and total nitrogen (TN). Soil sampling was carried out to 0-30 cm depth for TOC, TN, enzymes and nematodes and to 10 cm for microarthropods. Tea-bag index was determined following the Keuskamp et al. method (2013), in order to gather data on decomposition rate and litter stabilisation by using commercially available tea bags as standardised test kits.
The extraction of nematodes and microarthropods were performed by the Bermann method and the Berlese-Tullgren selector, respectively. The biological soil quality was evaluated by the Maturity Index of nematodes (MI) and Biological Soil Quality index of microarthropods (QBSar).
The results from soil sampling before restoring showed significantly lower values of SOC and TN in degraded areas, but no significant differences between degraded and non-degraded areas for enzymes, QBSar, nematode abundance and MI.
Fontodi farm, under organic management since many years, showed significantly higher abundance of microarthropods, nematodes and enzymes than San Disdagio farm.
The application of restoration techniques in 2016 showed a significant increase of TOC and TN only under compost addition treatment. As regards microarthropod communities, all the treatments showed a sensible increase in abundance and the conservation of high QBSar values. All the treatments increased the fungal feeder activity of nematodes and decreased the number of plant parasitic nematodes taxa. The major pest of grapes, the virus-vector Xiphinema index (Longidoridae), disappeared in the treated plots, whereas it remained in the control plots.