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Effects of reduced soil functionality in European vineyards

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Improper or excessive land preparation methods in vineyards before planting can have a considerable impact on soil functionality. They include excessive levelling and deep ploughing leading to disturbances of the natural contour of slopes and destruction, truncation and burial of soil horizons. Manipulations may significantly modify chemical, physical, biological and hydrological balance of soils. Problems that may arise from these interventions relate to the reduction of organic substances, enrichment of calcium carbonate and soluble salts, impacting development and health of grapevines. Reduced water retention capacity can lead to increased water stress during dry season, decreased water permeability and circulation of oxygen in the soil, increased runoff volume, surface erosion and landslide risk, reduced biodiversity and limitation of biochemical processes (organic matter mineralization, bioavailability of nutrients, etc.).
Soil degradations can lead to the loss of soil functionality even after the planting as a result of accelerated erosion, compaction by agricultural vehicles, excessive loss of organic matter and nutrients, and the accumulation of heavy metals such as copper. In both conventional and organic vineyards, it is quite common to have areas with reduced soil functionality that have negative impact on vine health and grape production and quality. In the framework of the Core organic RESOLVE project, a study was conducted in organic vineyards showing areas with reduced and good soil functionality.
Degraded soils resulted in significantly lower amounts of grapes. The chlorophyll index (SPAD) of the grapevine during veraison was significantly lower in areas of degraded soils compared with the situation in areas of the same vineyard with non-degraded soils.
In general, causes of soil malfunctioning were related to a lower fertility, including reduced organic carbon, total nitrogen and cation exchange capacity, higher concentrations of carbonates, and increased stoniness in the topsoil. Degraded soils showed lower structure quality and rooting depth limited by shallow saprolite or horizon features such as compaction, scarce fertility and high content of carbonates. The soils in the non-degraded areas showed significant higher content of total nitrogen and higher carbon/nitrogen ratios, thus a better stability of organic matter.
On the other hand, biological diversity and activity, monitored by different proxies (microarthropods, nematodes, enzymes, organic matter turnover by Tea bag index) in some vineyards, all managed organically, did not show any clear and significant differences between degraded and not degraded areas. Similarly, no clear difference in overall microbial diversity indices (Shannon, Simpson) and diversity evenness (Pielou) were observed between non-degraded and degraded areas. All indices were relatively high and indicative for rich occurrence of abundant and rare microbial species, high diversity and low abundance of individual species and high species evenness.