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Soil resilience and yield performance in a vineyard established after intense pre-planting earthworks

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Conventional earthworks undertaken before vine plantation may severely compromise soil functions and vine production, as a consequence of a decline of soil fertility caused by loss of organic matter and biological activity, along with changes in chemical and physical features of the topsoil due to the upset of the soil profile.
This research was aimed at assessing the effects of conventional pre-planting earthworks on soil fertility and vine yield performance under organic farming. To this purpose, grape yield and quality along with soil chemical, physical and biological properties, were monitored over seven years in a young vineyard established in 2010 after soil leveling and deep ploughing, and in parallel in an older vineyard planted in 2000 after similar earthworks under the same soil and environment conditions. The vineyards (Vitis vinifera L., cv. Sangiovese) were located in the Chianti Classico district (Tuscany, Italy) on a stony calcareous soil classified as Cambic Skeletic Calcisol (loamic, aric) (WRB, 2014). Fertilization was based on annual applications of compost and shredded plant residues. According to the ordinary farming system, the older vineyard was kept free from grass covering during the first four years of growth by periodic tillage, in order to prevent nutritional competition, while in the following years it was managed by natural grass covering on alternate inter-rows. In the younger vineyard, grass covering needed to be postponed because of a delay in the vine development and grape yield induced by poor soil fertility.
The results showed significant differences between the two vineyard, with the younger exhibiting lower total organic carbon (0.4 – 0.6 % vs 0.6 – 1.1 %), lower total nitrogen (0.07 – 0.11 % vs 0.10 – 0.15 %) and higher carbonate contents (32 – 38 % vs 21 –30 % total $CaCO_3$), with no clear trend of recovery over time.
Pre-planting earthworks also affected the structure and diversity of microbial and microarthropod communities. Soil biological quality based on microarthropods was very low in the younger vineyard after planting (2010), but increased significantly in 2015.
Also the older vineyard showed non-stationary soil conditions, with increasing organic carbon and nitrogen contents over the last three experimental years in the grass-covered inter-rows (+ 15% and + 14 % per year, respectively).
Due to low soil fertility, the younger vineyard suffered from reduced growth and no significant yield until 2015. In 2016, the yield per vine was 5.6 clusters and 0.4 kg grapes in the younger vineyard, 7.2 clusters and 1.0 kg grapes in the older vineyard, with grape composition featuring, respectively, 1.1 and 0.8 g/l malic acid, 262 and 242 g/l reducing sugars, 15.7 and 14.5 % probable alcohol, 43 and 47 % anthocyanin extractability, 61 and 66 % seed maturity.
According to our findings, the choice of pre-planting earthworks should be carefully evaluated in relation to site-specific soil and environmental conditions, in order to prevent soil deterioration and preserve vine performance. In the considered production context, conservative management systems should be preferred to traditional slope reshaping and deep ploughing, for the benefit of sustainable wine productions.