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Short term recovery of soil biological functions in a new vineyard cultivated in organic farming

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Deep earthwork activities carried out before vineyard plantation completely upset soil profile and characteristics. The resulting soil features are often much more similar to the underlying substratum than original soil profile. The time needed to recover soil functions is ecologically relevant and affects vine phenology and grape yield, particularly in organic viticulture. The general aim of this research work was to investigate the time needed to recover soil functions after the earthworks made before vine plantation. This study compared for a four years period physical and chemical properties, microbial and mesofauna communities, in new and old vineyards, cultivated on the same soil type.

The experiment was conducted in a farm of the Chianti Classico district (Central Italy), on hills of high altitude (400-500 m a.s.l.) on clayey-calcareous flysches, with stony and calcareous soils (Haplic Cambisol (Calcaric, Skeletic)). The reference vine cultivar was Sangiovese. The older vineyard was planted in 2000, after slope reshaping by bulldozing and back hoe ploughing down to about 0.8-1.0 m. The new vineyard was planted in 2011 after an equivalent earthwork carried out in the summer of 2009. Both vineyards were organically managed and only compost at the rate of 1,000 kg ha-1 –a was added every year. The new vineyard was periodically cultivated by mechanical tillage, while the older only at alternate rows.

Soil samples from the first 15 cm depth were collected in 4 replicates in the younger as well as in the older vineyard during the springtime of 2010-2013; in the older vineyard, two samples were from the periodically cultivated swaths and two under permanent grass cover. Samples were analysed for physical (particle size, field capacity, wilting point), chemical (pH, electrical conductivity, lime, active lime, organic carbon, total nitrogen), microbiological (soil respiration, microbial biomass, DGGE), and mesofauna features (abundance, taxa richness, BSQ index and soil biological classes).

Physical soil characteristics remained unchanged after the first year from the earthworks and did not change under grass cover. Chemical analysis only indicated a significant effect of earthworks. Over the 2010-2013 period, the new vineyard showed a slight increase of TOC and total N contents; as compared to the old vineyard, it averaged lower TOC and total N, and higher $CaCO_3$ contents, suggesting still evolving equilibrium conditions.

Microarthropod analysis showed significant different abundances and communities' structures both by management system and by year, increasing where the land use pressure was reduced by permanent grass cover and along with the aging of vineyard. Though the euedaphic forms, well adapted to soil life, were always rare.

Microbiological analysis showed a different structure of eubacterial communities and a lower microbial activity in the new vineyard, especially during 2010-2012. In contrast, significant differences were not observed between the two vineyards in 2013, and grass cover effect was controversial.

To sum up, the consequence of deep earthworks on chemical and biological properties were still evident after four years from planting and more time was needed to recover soil functions. Permanent grass cover did not always show a consistent positive effect.