Effects of conversion from vineyard to tree plantation on humus forms, soil organic carbon stock and other soil properties

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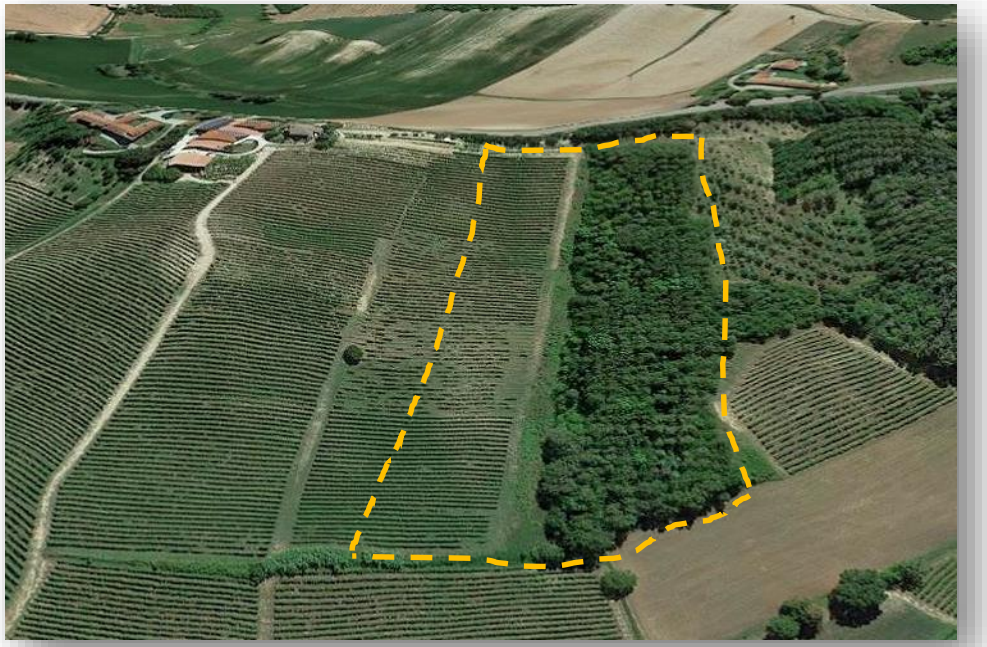
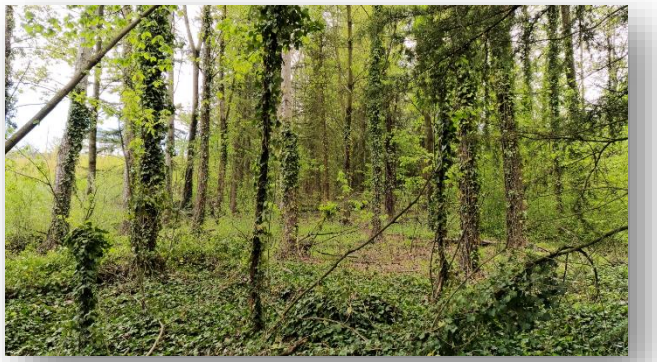
Study area and aims



The study area, located at Rosignano Monferrato (Italy - AL), includes a vineyard (VY) and a nearby 30-years-old tree plantation (TP) for wood production (eight poplar clones was consociated with some timber species such as wild cherry, European ash, manna ash, deodar cedar) that replaced an existing vineyard. The study area, covering a total surface of 3 ha, extends along a slighty-wavy slope with an average gradient of 15%; according to the WRB classification, soils are Calcaric Cambisols.
The effects of conversion from vineyard to tree plantation on soil organic carbon (SOC) stocks and other soil properties were investigated by sampling paired plots in a hilly area of Monferrato (Piedmont, Italy).

VY: Calcaric Cambisols
(Loamic, Aric, Ochric)



TP: Calcaric Cambisols
(Loamic, Humic)

Materials and Methods

a) Soil sampling was performed from 3 layers (0-10 cm, 10-40 cm and 40-70 cm), at 61 and 69 georeferenced points in VY and TP respectively, using a cylindrical core sampler (5.4 cm diameter) for the first two layers and a gouge auger (2.5 cm diameter) for the deeper layer;

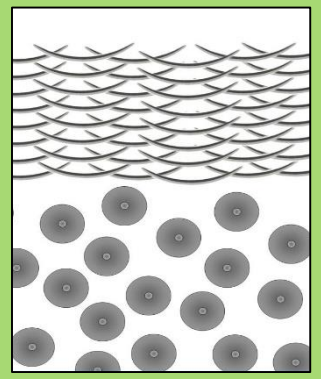
b) at TP humus forms were described and organic horizons were sampled and analyzed for OC content determination;

c) the common pedological origin of soils within the study area was verified and confirmed by comparability of soil texture and carbonates content of the deeper layer;

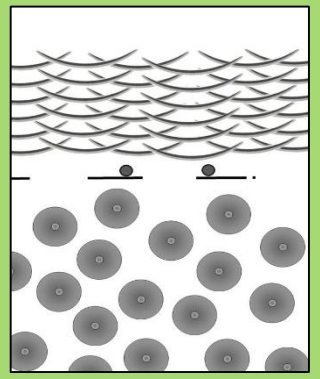
d) spatial distribution maps of soil pH in water, organic carbon content and stock, C:N ratio, soil texture and total carbonates were obtained using geostatistical methods;

e) the impact of land use change on soil properties was evaluated using the mixed effect model (LMM) procedure, testing for autocorrelation among the residuals.

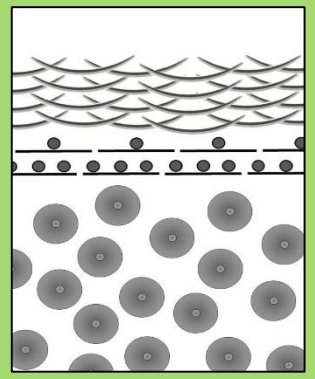
Results-Effects on organic horizons



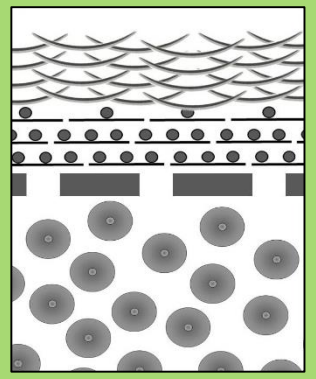
Mesomull



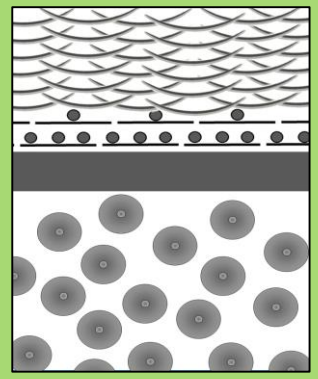
Oligomull



Dysmull



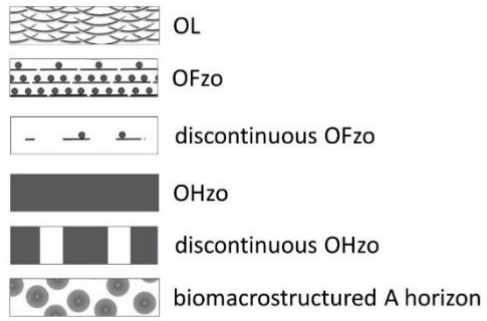
Leptoamphi



Eumacroamphi

The conversion from vineyard to tree plantation resulted in the appearance of organic horizons; the main humus forms were Mull and Amphi. The sum of OC of all the organic horizons averaged to 1.0 ± 0.7 kg m^{-2}.

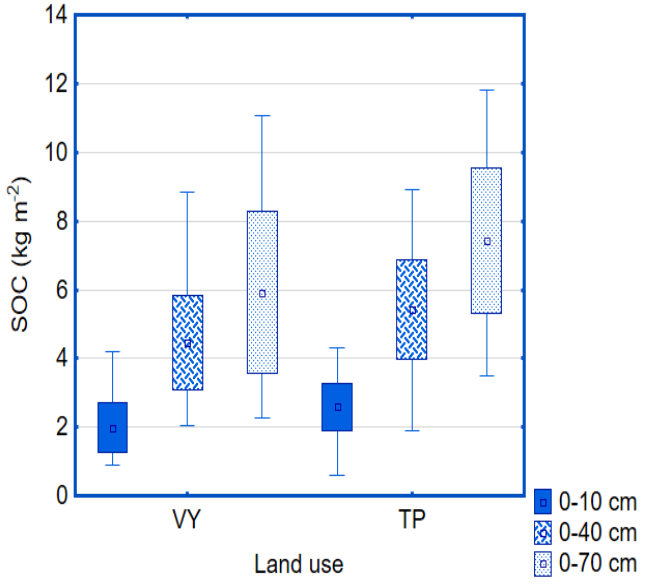
LEGEND



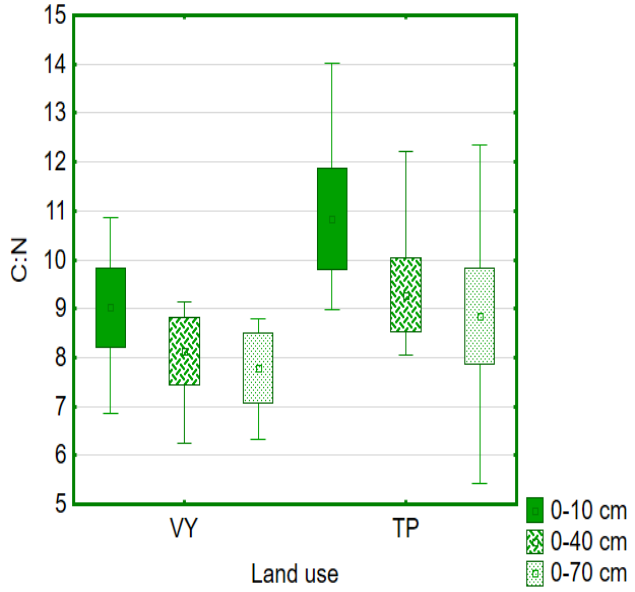
Results-Effects on mineral soil

The land use change affected the mineral soil till 70 cm depth. Statistical analyses showed significant (pvalue < 0.05) differences between the investigated land uses for all the layers with regard to pH, SOC stock and C:N ratio; soil acidification, increase in C:N ratio (reflecting change in organic matter characteristics) and higher SOC stock at TP compared to VY were observed.

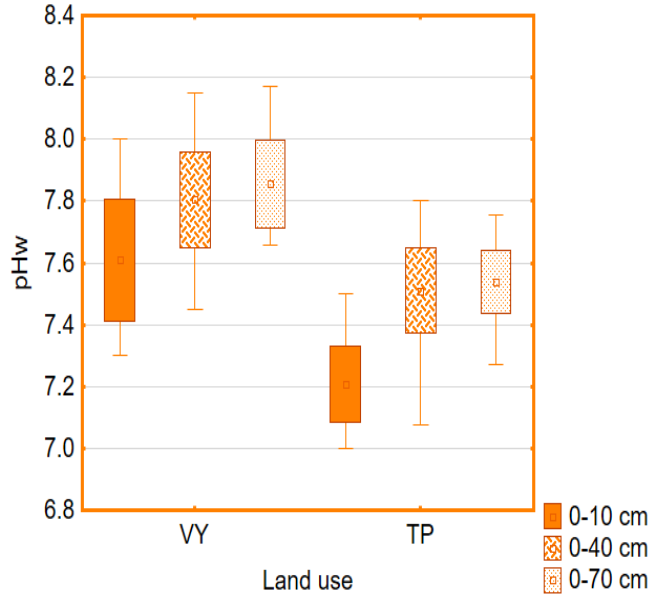
SOC



C:N



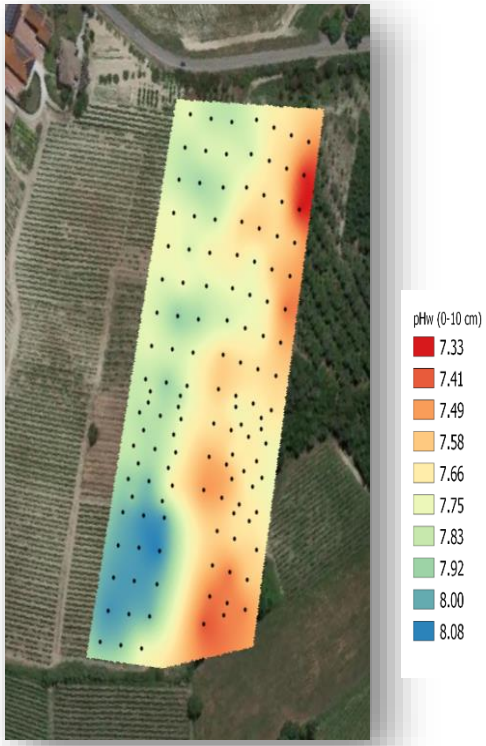
pH in water



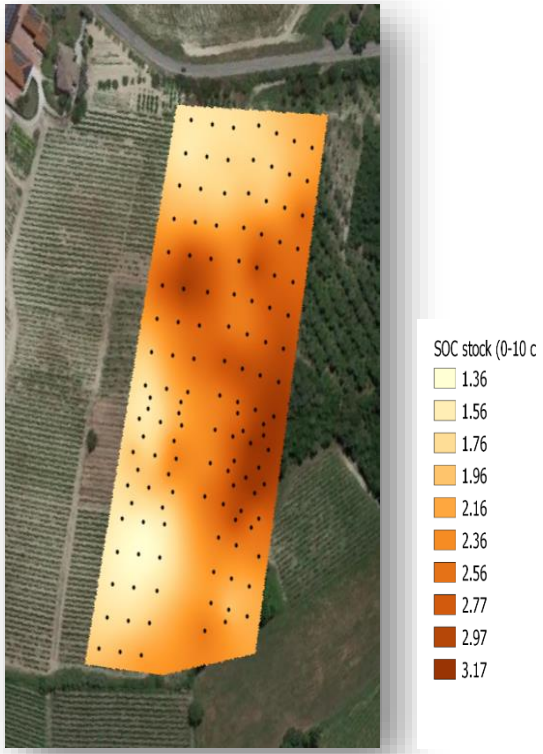
Results-Effects on spatial distribution

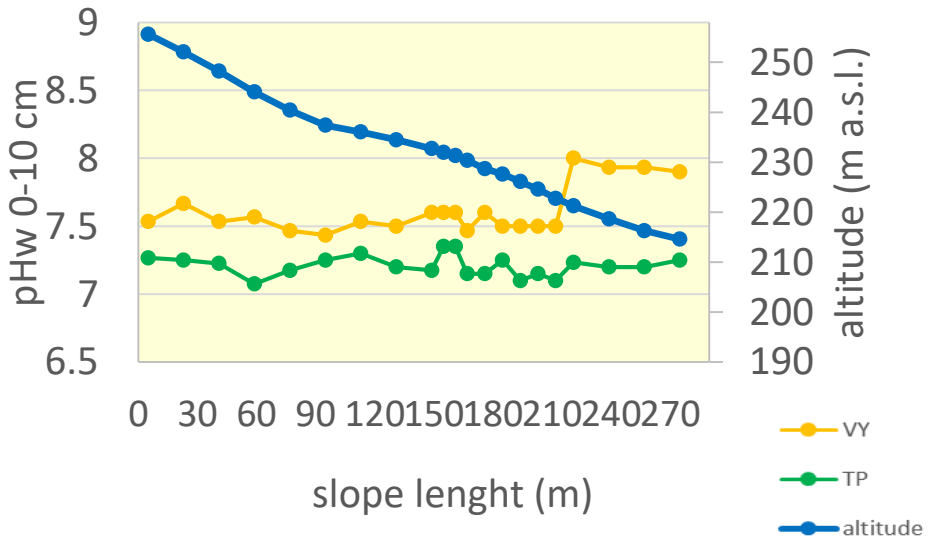
While at TP the spatial distributions of SOC and pH were quite homogeneous, at VY there were variations along the slope with accumulation of SOC at the change of slope gradient and at the foot of the slope and with increase in pH values in the lower part of the slope, likely linked to deposition of carbonate sediments.

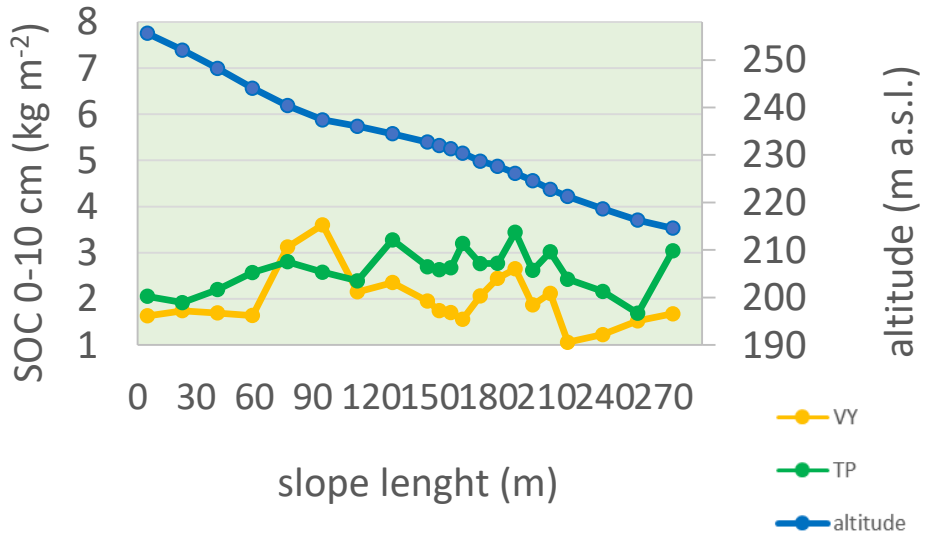
pHw (0-10 cm)



SOC (0-10 cm)







Conclusions

- the 30 years of afforestation of the VY strongly modified SOC stock, resulting in an average increase of 26% which became 42% if the organic layers were included;
- soil acidification (pH average difference of 0.4) and change in SOC type (C:N average increase of 1) were observed at TR compared to VY;
- the spatial distribution of soil properties inVY were affected by erosion and deposition dynamics unlike in TR where vegetation contrasted erosion.