Vineyard Soil Management: Soil Fertility Parameters and Carbon Sequestration

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❑ Introduction

Soil tillage and management concepts are basic operations in viticulture because both interventions may shift the viticultural ecosystem to a stable, sustainable system or if the worst comes to the worst it will partly loose its productivity and will get harmful for surrounding environments through erosion events and nutrient losses into neighboring water bodies.

❑ Material and Methods

Testplots: “Geisenheimer Mäuerchen”
(49.96867 °N; 7.949713 °E; 110 m a.s.l.).
Slope: 4.5°. Soil: clayey loess derived loam.
Seven years after planting (1965) with Riesling/5C, the trial was implemented with 4 replicates for every tillage system (fig. 1) and finished after 20 years.

Tillage Systems

Control [C]: cultivation as required, rototiller/rotary cultivator (≤15cm); ≈ 5x/season

Permanent grass cover [PG]: depending on growth mulching 5-6 x/season

Natural grass sod [NG]: no tillage since 1965; natural vegetation; mulching 5-6 x/y

Extensive cultivation [EC]: : reduced tilling ≈ 3x/season and ridge up in autumn

Intensive shallow cultivation [IC]: shallow, mechanical till ≈ 6x/season and ridge up in autumn

Soil Analysis

Sampling: in every plot in the inter row 0-40 cm with 10 cm increments

Testing: pH, P and K
Fe, Zn, Mn and Cu

Carbon: dry combustion (with correction for inorganic C

Soil Enzymes: neutral and alkaline P-ase
a- and ß.glucosidase, and urease

fig. 1: Material and Methods

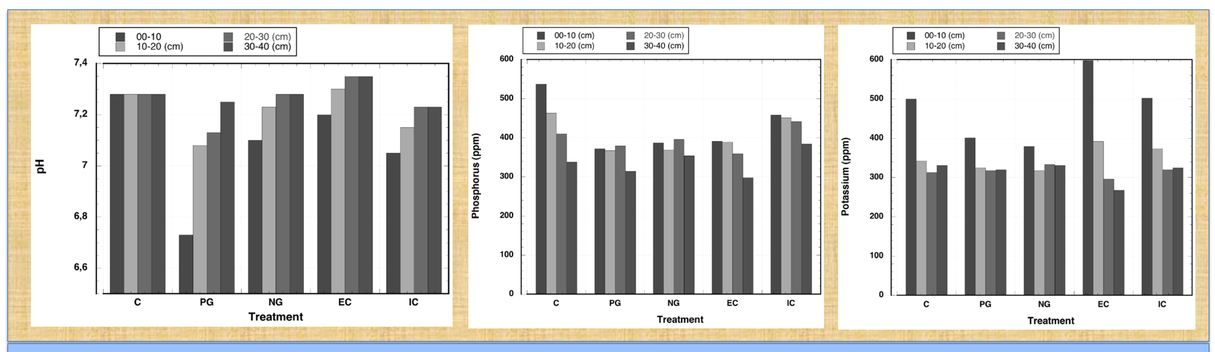

fig. 2 : soil pH | fig. 3: soluble P | fig. 3a: exchangeable K

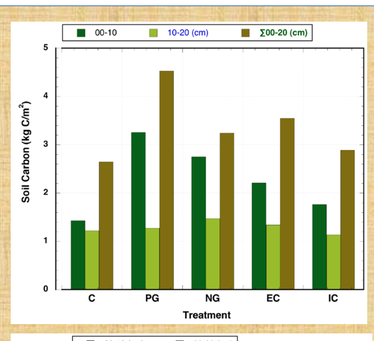

fig. 4: soil carbon stock

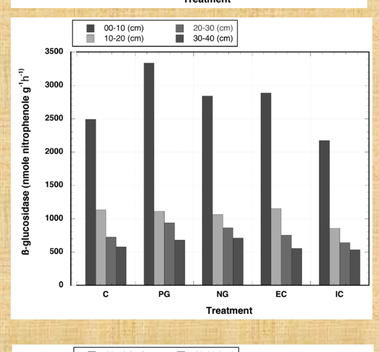

fig. 5: α-Glucosi-dase

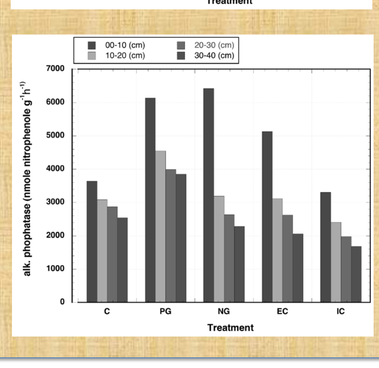

fig. 6: Phospha-tase

❑ Results

Permanent grass cover reduces significantly soil pH (fig. 2) in the layer 0-30 cm. Other treatments are non-significant.
In addition, PG reduces inorganic P (fig. 3) and soluble/exchangeable potassium (fig. 3a).
New nutrient equilibria will be installed. They will improve growth of grapevines and reduce physiological disorders like “bunch stem necrosis”.
Permanent grass and natural grass sod increase soil carbon content significantly against all other treatments (fig. 4).
Highest capacity is found in PG.
Soil fertility measured with glucosidase and phosphatase activity is also significantly increased (fig. 5 and 6).

Outcomes

Installation of PG and NG in vineyards offer an opportunity to improve soil nutrient balances and higher micronutrient availability (not shown), thus improving the overall nutritional status of grapevines. Soil fertility indicators are always on top in PG and NG.
During the test period of 20 years, PG stored in an average of ≈3.3 t CO_2 x ha^{-1} x a^{-1}.
Neither the control plot nor the tilled ones could significantly increase the soil’s C-stock.
PG and also variations of it are promising tools to store atmospheric CO_2 to help in order to overcome partly problems of upcoming climate change.

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